PhD Dissertation

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"...And suddenly the memory revealed itself"
The role of IT in supporting social reminiscence

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Abstract

*Every human being is familiar to the experience of reminiscence: recalling and revisiting our past memories. We reminisce to create our identities. We reminisce to maintain our relationships. We reminisce to review our lives. And we also reminisce **together**. This dissertation develops around the topic of how IT stimulates reminiscence, motivated by its proven benefits in people's well-being and its prevalence across all stages of life. The focus is set on older adults, with the overall goal of fostering intergenerational social interactions (that is, interactions between older adults and younger generations). This thesis is motivated by the current interest on active ageing as an emergent way of life, with better and more opportunities for health, participation and security. As the world ageing population continues to increase and the average life expectancy of people increasing every year, there is a growing need for understanding the ageing phenomena, and particularly, for designing human centered information technologies (IT) that enhance opportunities of social participation as people age. Within this scenario, this dissertation addresses the following research questions using a participatory approach to research and design: (i) what is the role of IT in enabling a more happy and active ageing?; (ii) in doing so, how can IT stimulate intergenerational social interactions?, and (iii) can IT-supported social reminiscence facilitate these interactions and make of them an enjoyable experience?. To answer these questions, we leverage upon a participatory action research approach to gain an understanding of the topic, moving later to the participatory design of IT for social reminiscence and finally, evaluating how IT supports the practice of social reminiscence in a face-to-face intergenerational context. The contributions of this dissertation can be summarized as follows:*

- ***Knowledge:*** *an understanding of what role IT can play in supporting, stimulating and accompanying active ageing and social interactions through the practice of reminiscence.*

- ***Model:*** *a conceptual model of the different stages of IT-supported social reminiscence sessions, and an extended model of the design spaces for intergenerational engagement.*

- ***System:*** *an exemplary socio-technical system that fits the aforementioned roles, including a knowledge base and algorithms to support contextual stimulation of reminiscence, using multimedia resources that are publicly available on the web.*

- ***Evaluation:*** *quantitative and qualitative results obtained from observing the use of our system in a real intergenerational context.*

Keywords: Active Ageing, Reminiscence, Social Interaction, Interactive systems, Participatory Design, Participatory Action Research

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To Marijo.
To my parents, Ygnacio and Aurora.
To Oscar, Lourdes, Cynthia, Rafael.
To Sofia, Gabriela, José and Gonzalo.
To the Big Family.
To the Old Friends.
To La Fiebre Trentina.

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A Ph.D. is a journey about life as much as it is about science. You learn the beauty of the scientific method and do your best to extend human knowledge in that one exciting area of your dissertation topic. But there is also another side to all of it. The part that nobody tells you about because it is just different for everyone. In those baffling moments when you are lost, when you do not know what you are doing or where you are going or why, there you get to face *yourself*. And then you discover your true strengths and your *most dreadful inner foes*. You fight yourself, and so many times lose the battle. But, in the long run, you survive to discover that the journey was truly worthy. You look back and see the paths you have walked, and realize that everything gave something back to you, even those things you worked hard to do but ultimately failed. A Ph.D. is a journey of self-discovery and, paraphrasing Carl Sagan, a *humbling and character-building experience*. And my journey would not have been possible without the help of so many great people.

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Introduction

It happens to all of us. We are walking down the street while a sudden smell, or a simple sound, or a person passing by spontaneously triggers our memory and make us remember something in our past. Sometimes is a positive and lovely memory, that we treasure and that draws a smile in our face. Sometimes is a tough memory that we might not enjoy to remember, but that helps us to reflect and learn about ourselves. This act of recalling and revisiting our past experiences is what is called *reminiscence*. It is an experience that we are all familiar with, and one that is common to all ages and cultures. Reminiscing helps us to create our identities and maintain our relationships [171], to increase our life satisfaction and to lower or prevent depression [368], among many other benefits. Its practice is also used frequently with therapeutic purposes [363] and, as a human experience, it is typically spontaneous and unstructured in nature [105], sometimes private and some others very much social [368]. Reminiscence's cross-generational prevalence, as a human experience, and the fact that some of its forms gain importance as we grow old (i.e., life review [96]), led us to explore how information and communication technologies (IT) can support reminiscence as the mean to an end, with the end being that of enabling a more happy and *active ageing (AA)*.

During the last two decades that brought us the Internet and the boom of IT, our world has undergone a major cultural shift around one of the most important topics of our times: *the challenges of ageing.* All around the world, and especially in developed countries, the old "needs-approach" to ageing, thinking of elderly as the people who just need care due to their limitations, has been left behind and replaced by a more positive "rights-approach" [373] that emphasizes the fact that life does not end at that imaginary and fuzzy line between young and older adults, and there can still be lot to it beyond the natural limitations that are imposed by age.

This is a global, cultural change that comes along in a world whose population is rapidly ageing and living everyday longer lives. The World Health Organization (WHO) estimates that by 2025 there will be approximately 1.2 billion people worldwide over the age of 60, reaching 2.0 billion people by 2050, with 80% of them living in developing countries [373] [65]. Such increase surely brings economical and societal challenges to many social systems [148], but it also opens a whole new array of opportunities

to seize. In this context, IT has a role to play and it can be not only to improve care, prevention and compensation of age related limitations, but also to create new opportunities for health, security and participation as we naturally grow older [356]. In other words, the premise upon which this dissertation is built states that IT can, and will, play an enabling role in allowing people to achieve a more AA.

Of course, AA is a challenge with many sides. When older adults lose their ability to move within their environments without needing assistance they are less likely to remain active in the community. Health is also naturally challenged by ageing with older adults facing higher rates of morbidity, mortality, health care utilization and costs, which can all result in a poorer quality of life [167, 168, 176]. Research in this domain has led to a call for a greater focus on prevention of age-associated, physical function decline and disabilities [169, 140], which along with the improvement of healthcare services and solutions that compensate for physical and cognitive decline, are the most common ways in which technology addresses age-related challenges.

While the focus on prevention and health care is indeed key for enabling participation, another fundamental aspect, however, has to do with the social context: how to increase, sustain or enable social interactions as we age, beyond the natural limitations that come with age. Social relationships are a key element of healthy and happy lives [222] and they are challenged as we grow older due to several factors like the reduction of our social networks or the physical limitations that prevent people from engaging with others as often as they would prefer. This is where this dissertation steps in: *what can technology bring to the social dimension of active ageing?. How can IT help older adults to achieve the goals of an active ageing, maintaining, and enriching, their social interactions with family, friends and peers?.*

These are, of course, overly broad questions to address, which require an interdisciplinary approach where IT and engineering traditional methods are not enough. Hence, in the search for an answer to these questions, this dissertation has leveraged upon a participatory action research approach [285] in order to provide first an understanding of what roles IT already plays and what the needs of older adults are with respect to technology and social interactions, while at the same time enabling them to achieve the goals of AA through active participation in their communities. This participatory exploration, combined with a deep literature research, eventually resulted in a broad range of experiences of social interactions where technology can play a positive role: from substantially improving remote communication with the family for increasing social connectedness, briefly passing by enabling real time remote participation in social events, and finally getting to facilitating face-to-face intergenerational conversation through storytelling. Each of these experiences have been explored pragmatically in this research project, by designing, implementing and evaluating prototypes to support them. But, each is also an entire research and design space on its own. With the goal of deepening our learning and providing a more substantive contribution to the state of the art, the focus was finally set in one of such experiences: face-to-face, intergenerational, social interactions through the practice of **social reminiscence** (i.e., when memories are shared for conversation or teaching lessons learned from past experiences [368]).

The double individual, social nature of the reminiscence experience together with its benefits and its cross-generational, cross-cultural prevalence, form the basic motivation that drives the core part of this dissertation, focused on the design, implementation and evaluation of a socio-technical application aimed at stimulating and facilitating the practice of social reminiscence in a conversational context, as a mean for intergenerational social interaction. *Reminiscens*, as the system is called, is fundamentally a technology probe for observing how IT can foster socializing between older adults and their younger counterparts. This dissertation describes the whole design and research process around and before *Reminiscens*, including exploratory experiences that led to it, ultimately contributing to the state of the art with: a

model of the different stages of IT-supported social reminiscence that represent the design spaces for (or roles played by) IT in supporting social reminiscence; an exemplary socio-technical system that fits these roles, including an algorithm for suggesting contextual triggers of reminiscence; and, an analysis of the use of this system in a real intergenerational, conversational context, including a discussion of the future avenues for research and design of IT-supported intergenerational social interactions.

In the very end, the final goal of this dissertation is to trigger the involuntary but exquisite human emotion described by Proust's famous *Madeleine* [290], for the benefit of a better, happier and more active ageing.

> *...No sooner had the warm liquid mixed with the crumbs touched my palate than a shudder ran through me and I stopped, intent upon the extraordinary thing that was happening to me. An exquisite pleasure had invaded my senses, something isolated, detached, with no suggestion of its origin. And at once the vicissitudes of life had become indifferent to me, its disasters innocuous, its brevity illusory this new sensation having had on me the effect which love has of filling me with a precious essence; Whence did it come? What did it mean? How could I seize and apprehend it?.* **And suddenly the memory revealed itself**. *The taste was that of the little piece of madeleine which on Sunday mornings at Combray, when I went to say good morning to her in her bedroom, my aunt Lonie used to give me, dipping it first in her own cup of tea or tisane. (M. Proust)*

1.1 Research Questions and Problems

This research project starts from the premise that social interactions are a fundamental aspect of well-being, and this relevance holds (perhaps even stronger) as we age. Given this premise, which is later grounded in literature, the dissertation revolves around the role of IT in enabling social interactions and well-being as we age. The research is then driven by the following general research questions (GRQs):

- **GRQ1.1.** *IT and Active Ageing:* can IT play a role in enabling a more *active ageing*, i.e., the improvement of opportunities for health, security and participation as we age?

- **GRQ1.2.** *IT and Active Ageing:* how does IT play this role?.

- **GRQ2.1.** *IT and Socializing:* can IT enhance (i.e., increase, sustain, improve) social interactions for older adults?

- **GRQ2.2.** *IT and Socializing:* how does IT enhance (i.e., increase, sustain, improve) social interactions as we age?.

These general questions are answered by two means: through scientific literature review and exploratory works that included both research and design of IT aimed at enabling AA and social interactions (see chapters 2 and 3). The work undertaken for answering this first group of questions led the project to a shift of focus towards a more specific human experience: the practice of reminiscence (i.e., revisiting our past memories) as a way for enabling intergenerational social interactions in a face-to-face conversational context. Given the potential of reminiscence as a practice to improve subjective well-being and its cross-generational prevalence, the goal became to stimulate and facilitate this practice and, by using reminiscence as a vehicle, to also stimulate social interactions. This focus is expressed in the following refined research questions (RQs):

- **RQ1.1** *IT to stimulate reminiscence:* can IT stimulate the practice of reminiscence in a social and intergenerational context?

- **RQ1.2** *IT to stimulate reminiscence:* how can IT (which technology, which designs, which interactions, what content) stimulate the practice of reminiscence in a social and intergenerational context?

- **RQ2.1.** *IT to stimulate social interactions:* can IT-supported reminiscence systems facilitate increased and sustained intergenerational social interactions?

- **RQ2.2.** *IT to stimulate social interactions:* how can IT-supported reminiscence systems facilitate increased and sustained intergenerational social interactions?

- **RQ2.3.** *IT to stimulate social interactions:* is IT-supported social reminiscence enjoyable?

These questions are answered through both (i) a literature review on the topic of reminiscence, covering its conceptual background and its research from the IT perspective (see chapter 4); and (ii) a participatory action research approach intertwined with an interaction, engineering (participatory-driven) design process that led to a socio-technical system we call *Reminiscens*, which was used as a technology probe for a more concrete study and evaluation of IT-supported social reminiscence for enabling social intergenerational interactions. We set (ii) as the core of this research project.

1.2 Dissertation organization

The present dissertation starts by introducing the motivations, research questions and problems it is aimed to resolve. To this introductory part follows a review of the core concepts and the state of the art (with a focus on information technologies) that are used to frame the research project within a conceptual framework and present the exploratory works that led to and motivated the work.

This conceptual framework has three layers, that goes from the very general domain of *active ageing*, passes by the intermediate level of *socializing* (as one fundamental aspect of AA) and finally delves into the practice of *reminiscence* (as one specific way of enabling socializing). Each domain is explored in detail in a different chapter that offers both the theoretical overview and a detailed review of IT for that domain.

Also in this first part, we describe exploratory works (sections 2.5, 3.3 and 3.4), which are not central and can, thereby, be skipped while reading this dissertation. They are included in the dissertation because they contributed to the process that led to our final (and core) research questions. In summary, the first part of the dissertation includes the following chapters:

- **Chapter 1 (Introduction)** introduces the motivation of this dissertation, the research questions it aims to answer and the problems it seeks to solve.

- **Chapter 2 (Review on IT for Active Ageing)** presents a thorough review of the ageing problem domain and its solution domain from an IT perspective, using the concept of active ageing as the integrating framework. It also presents a small exploratory design work (AllenaVita) undertaken as a part of a local research project in the area of healthcare informatics from the Province of Trento, Italy.

- **Chapter 3 (Review on IT for Socializing)** extends the previous chapter by providing a brief introduction on happiness, well-being and the importance of social relationships for them. It briefly summarizes how IT can enable active ageing by improving opportunities for socializing and presents two exploratory works undertaken for the purpose of enabling social interactions for active ageing. The first one (What's Up), focused on remote asynchronous interactions; the second

(EngAge) focused on remote synchronous real-time social interaction.

- **Chapter 4 (Review on IT for Reminiscence)** presents a review on the theory behind the practice of reminiscence and an overview of IT for supporting, stimulating or facilitating this practice, which this dissertation empathizes as a way for bridging and stimulating intergenerational social interactions in a conversational, face-to-face context.

The second part of the dissertation describes the methods and tools we used for answering our research questions, the way in which these methods have been applied in the research project, the description and insights of the design process that has driven the research from its early stages and a technical overview of the proof-of-concept that resulted from this process: *Reminiscens*. In summary, the second part includes the following chapters:

- **Chapter 5 (Methodology and research plan)** describes the methodological approaches used for this project and the resulting research plan that applies them. Each approach is introduced by a small overview of literature that defines it.

- **Chapter 6 (Designing IT for Social Reminiscence)** describes the design process that has driven the research project from its beginning, describing in detail each of research and design activity undertaken during this process, along with the insights results and insights obtained from them.

- **Chapter 7 (The Reminiscens System)** focuses on the technical contributions of this dissertation, as they are expressed in the resulting *Reminiscens* platform and application, explaining how the different insights obtained during the previous exploratory and design experiences are connected to the technical decisions we made during implementation.

The most important part of the dissertation follows in the third part, with the description of the final field studies we have conducted, their results and the discussion around these results together with the conclusions and future research and design spaces that can be addressed. The third part includes the following chapters:

- **Chapter 8 (Field Studies)** describes in detail the two main field studies of this research project, designed to answer the last two research questions presented in section 1.1, including the results, analysis, and discussion of results.

- **Chapter 9 (Conclusion and Future work)** extends the discussion of results and their implications for the future, presenting a the lessons we have learned with this research, the limitations of our work and the future research directions opened by this dissertation.

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This dissertation would not have been possible without the extended and participatory action collaboration with the **Elderly Services Center "Contrada Larga"**, managed by the social Cooperative Kaleidoscopio of Trento in Italy [1], with both its staff and its wonderful community of active seniors.

In the same way, the project has been entirely developed within and supported by (in so many different ways) the *Lifeparticipation* research team[2], which is a foundational part of the *Social Informatics* research group at the University of Trento, Italy.

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[1]Centro Servizi Anziani "Contrada Larga" gestito dalla Cooperativa Sociale Kaleidoscopio: `http://kaleidoscopio.coop/index.php/ita/I-nostri-servizi/Centro-Servizi-Anziani`

[2]`http://www.lifeparticipation.org/`

Finally, parts of this project had been conducted under the scope of the following research projects, funded by the Province of Trento:

- Project **"ANCHISE portale RSA"** (2012-2013), developed by the *University of Trento* in collaboration with *HIT s.r.l.* and *RSA Brentonico*.

- Project **"ERMES (Empowered REmote Medical Service)"** (2012-2014), developed by the *University of Trento* in collaboration with *Centro Ricerche GPI*, *Telecom Italia* and the cooperative of medical services *SERMEDA* .

2

Review on IT for Active Ageing

"Running is my life. I will keep running to inspire the masses" says Fauja Singh in a recent interview after announcing his retirement from running marathons [1]. The surprising aspect of his statement is not so much the intention to quit running competitions but rather his age: Fauja is 102 years old and known as the oldest marathon runner of the world[2].

What Fauja is teaching us is that life does not end after retirement and that the right exercise, diet, determination and opportunities have the power to keep or even improve quality of life also when facing the burdens of age. Fauja is not only an extraordinary sportsman, he is also representative of a more general phenomenon of today's ageing society (admittedly, an exceptional one): increasingly, people do not just live longer and generally healthier, but they also keep practicing physical activities (e.g., dancing, hiking or swimming), reading to stay informed or writing themselves to inform others, engage in social relationships (also over long distances), or travelling, even in advanced age. That is, older adults are increasingly active and want to take part of society and to contribute to it. *Active Ageing* (AA) is a concept that encompasses this phenomenon, fostering a physically, mentally and socially active lifestyle as a person ages. It is a complex, multi-faceted problem that involves a variety of different actors, such as policy makers, doctors, care givers, family members, friends and, of course, older adults.

Information and communication technologies (IT) increasingly play the role of **enablers and facilitators of AA** as we grow older. In this chapter, a theoretical overview of the ageing phenomena and its active version is presented, followed by a review on how IT enables AA, serving both as answers to our first set of general research questions (see section 1.1). This review has also been submitted for publication as a survey on IT for AA [277]. The chapter is finalized by presenting one of the exploratory works developed within this research project, and that can be categorized as yet another example of IT for AA.

Active Ageing forms the *big picture* that motivates this dissertation. This big picture is zoomed in the following chapter to one specific aspect of AA: its *Social Dimension*. Finally, a last zoom in is done to get to the actual core of the dissertation, centered around one of many experiences that can enable intergen-

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[1]http://news.discovery.com/human/life/101-year-old-marathoner-retire-130124.htm
[2]http://en.wikipedia.org/wiki/Fauja_Singh

erational social interactions (as the means for enabling AA): **Social Reminiscence**, understood as the act of revisiting the past memories and sharing them for the purpose of conversation in an intergenerational context.

2.1 Theoretical Background

2.1.1 What's Ageing?

Ageing is a process we all undergo from the moment of our birth. At the beginning, ageing means growing, getting stronger, and differentiating ourselves while we build our identities, gain experience and knowledge. Around the age of 20, our physical, sensory, and cognitive capabilities peak and stabilize until we reach our 50s/60s. While our life experiences and our knowledge (and perhaps our wisdom) will continue to grow, our capabilities start to decline depending on factors like our genetics, lifestyle, and social environment. The exact reason of this decline is not yet entirely understood. Some theories speak of a natural and programmed process that takes place in our bodies, while others explain decline as the result of damage accumulated over time [160]. Independently of the reasons that determine decline, ageing unavoidably affects functioning as a complex interaction of genetics, chemistry, physiology, and behavior/lifestyle [238].

Ageing often comes with augmented risk of adverse health conditions that may affect physical functioning. Some of the most common age-related health problems are mobility related. Sometimes the changes in physical capabilities come as a result of diseases. Non-communicable chronic diseases increase in most societies [203] and negatively effect on physical functioning. Examples of non-communicable diseases are diabetes, cancer, and hypertension. Most of the health problems in old age are chronic non-communicable diseases [373], which require constant monitoring and care. Although research has shown that many of these conditions have their origins in early childhood, it is well known that behavioral factors; e.g., tobacco or alcohol consumption, a sedentary lifestyle, etc. considerably increase the risk of developing or aggravating non-communicable diseases.

Independently of health, there are three macro-areas of manifestations of age that group different phenomena that affect quality of life and that allow us to structure our analysis: *physical capacity*, i.e., the capacity to perform physical activities; *sensory capacity*, i.e., the capacity to capture and interpret information; and *cognitive capacity*, i.e., the capacity to process, reason on, and produce information. Common cardiovascular, neuromuscular, physiological, sensorimotor, and cognitive changes associated with ageing are summarized in the literature [99, 219, 249].

Research has also shown yet another key aspect of ageing, one that it is sometimes disregarded or not mentioned when discussing the phenomena: our ability to still grow in happiness. In fact, there seems to be an increase on self-reported subjective wellbeing once we pass our 50s [340]. This duality of ageing, where we can grow in some aspects (i.e., experience, wisdom, happiness) and yet face also decline in others (i.e., physical, sensory and cognitive abilities) is what takes us to the concept of **Active Ageing**, which we discuss and define in the following section.

2.1.2 What's Active Ageing?

Ideas around AA have taken many different names and forms within the field of Gerontology. In the mid 1990s, one of the first attempts to sum up these ideas into a term was the definition of *successful ageing* as having a "low probability of disease and disease related disability, high cognitive and physical functional capacity, and active engagement with life" [303]. Terms such as healthy or productive ageing and ageing well followed later in the same line of describing desirable ideals about the ageing process [234]. According to Tesch-Roemer [347], these definitions represented an idealization of ageing and were not inclusive enough. The Organization for Economic Co-operation and Development (OECD) defined AA as "the capacity of people to lead productive lives in society and economy" [263], focusing the concept on the occupational dimension. The WHO popularized AA by publishing a policy framework for enabling AA. WHOs definition emphasized opportunities within the process of ageing with AA being the "process of optimizing opportunities for **health**, **participation** and **security** in order to enhance quality of life as people age" [373].

This focus on opportunities represented a shift in how the concept was understood and the definitions that followed took the same approach, differing only on which aspects or dimensions of quality of life were emphasized other than health, security and participation. Along with the emphasis on opportunities, the point of view of these definitions was almost always that of policy makers trying to enable AA through society's institutions.

The United Nations through its Economic Commissions for Europe (UNECE), for example, emphasize that the promotion of *social integration* and *active involvement* in community are the key elements of AA [353] while *autonomy*, *self-determination* and *choices* are the core dimensions according to [234]. The Institute for Prospective Technological Studies of the European Union (IPTS) emphasize the need for policies around *independence* and *autonomy* [233] defining *AA policies* as those that "enable people, as they grow older, to lead independent lives (socially and economically), making their own choices about how to shape their lives in all its spheres".

In 2012 the European Union (EU) promoted the **European Year for Active Ageing** [3] updating the definition of AA to "growing old in good **health** and as a **full member of society**, feeling more fulfilled in our jobs, more **independent** in our daily lives and more **involved** as citizens". The EU takes then a more lifestyle oriented definition, which is summarized in a particularly inspiring phrase from their website: "No matter how old we are, we can still play our part in society and enjoy a better quality of life". *Employment*, *Participation* and *Independence* are the key dimensions in this definition.

Other definitions of AA use phrases such as "engaged in life", "live life as fully as possible" [4] or "having as much as possible of *independence*, *autonomy* and *social inclusion*" [108]. One of the latest term definitions says that AA is a "*process* that leads to both objective and subjective quality of life in old age in the domains of *health*, *social integration*, and *participation*" [347].

In summary, the general idea is that it does not matter how old you are, there will still be a role to play in society to enjoy a better quality of life. Whether we define it from a policy-making perspective or from a lifestyle point of view, AA improves wellbeing in the dimensions of health, participation, security, employment, independence, autonomy and integration. All these dimensions can be argued to be included within those proposed by the WHO, leading to the definition we used in this dissertation, where we put together both policy makers and the lifestyle perspectives.

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[3] http://europa.eu/ey2012/
[4] http://www.icaa.cc/about_us/philosophy.htm

Definition 1 Active ageing (AA) *is having a physically, mentally and socially active lifestyle as we age, with optimized opportunities of quality of life in the domains of health, participation, and security.*

"***Health*** is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" [374]. ***Participation*** is the ability of a person to engage in socio-economic and cultural activities, making a productive contribution to society as they age (e.g. attending cultural activities, volunteering, being part of local communities, interacting with family and friends). ***Security*** is having adequate protection and care when assistance is required while maintaining as much as possible of autonomy and independence (e.g. receiving quick response to emergencies such as falling, or having the possibility to make our own choices). Altogether, these are the three ***main aspects of AA*** and they influence each other in multiple ways [250, 359]. Health is often seen as a precondition for participation and security, however, it is also well know that more social participation can improve health, while at the same time security can enhance people's opportunities for participation [347].

2.1.3   Determinants of Active Ageing

How well both individuals and populations age is determined by a set of enabling factors (and the interplay between them) called the **determinants of AA**, each affecting one or more of the three main aspects of AA presented before.

Definition 2 Determinants of AA *are influences that surround individuals and which the process of AA depends on.*

Based on the report by the WHO [373] and other inputs from the literature cited in the previous section, there are 17 determinants that are key for enabling AA, organized in six main categories. Building upon WHO's definitions, each of these categories is explained in the following paragraphs, along with a description of each specific determinant included in them.

Health services (Table 2.1) are public or private health services to which a person has access, including health promotion, disease prevention, curative and mental health services. Part of this is the equitable access to primary healthcare and long-term care by informal caregivers and/or healthcare professionals.

Behavioural determinants (Table 2.2) are the behaviours a person regularly follows. Behaviours like healthy nutrition, active participation in ones own care, not smoking nor using alcohol and engaging in regular physical activity can all have a positive impact on AA.

Personal determinants (Table 2.3) are the set of characteristics of a person's biology, genetic and physical limitations, including psychological factors like ones own intelligence, cognitive capacity, self-efficacy and self-esteem.

Environmental determinants (Table 2.4) are the conditions of a person's physical surroundings which can help people age better. Transportation means, safe housing, clean water, air and safe food are all environmental determinants of AA.

Social determinants (Table 2.5) are the conditions that define a person's social environment, including how much support a person receives from its social networks, how many opportunities for education and lifelong learning the person has access to and how much risk of violence and abuse the person is subjected to.

Finally, ***economical determinants*** (Table 2.6) are the set of different aspects of an individual's economic environment like level of income, access to work and to social pension (also referred to as social protec-

Table 2.1: Active Ageing Health Services determinants

Determinant	Description
Cure services	Health services that provide attention and recovery treatment when an emergency is triggered (either because of a disease or an accident) or when the person endures a chronic health condition or disease that demands constant treatment. For example, a cure service can help to avoid long term loss of capabilities, helping people to stay active faster and for longer.
Care services	Availability and quality of healthcare and long-term care for elderly in the place they live. For example, a constant and good care can ease the burden of age related limitations, helping people to feel good and facilitating their participation in social or personal activities.
Prevention services	Health services to prevent potential physical or cognitive losses. For example, vaccinating older adults against influenza prevents them from being affected by this disease and related complications, potentially alleviating also the economic cost of treatments.

Table 2.2: Active Ageing Behavioral determinants

Determinant	Description
Adherence to a treatment	Level of compliance of a person in following medication and treatment. For example, if a person adheres correctly to a prescribed treatment, his or her health conditions will improve faster or the burden of diseases gets reduced.
Lifestyle	The individuals' way of living manifested in activities, attitudes and interests. For example, participation in regular, moderate physical activity can delay functional decline.

Table 2.3: Active Ageing Personal determinants

Determinant	Description
Psychological factors	Everything that makes to a person's psychology like its cognitive capacity, motivation, self-efficacy and self-esteem. For example, a good self-esteem will make it easier for people to adopt healthy lifestyles.
Biological and Genetic factors	A person's intrinsic biological characteristics and inherited health conditions and limitations, including also its inherited or acquired physical limitations. For example, physical conditions like constant tremors of the hands can reduce the type of activities a person can engage in.

tion) services.

Altogether, determinants influence the process of AA by improving or deteriorating the opportunities for Health, Participation and Security. They can be seen as the general categories of problems that must be solved in order to enable AA. The role that IT can play is that of attacking the problems that are hidden under each of these categories, so that in the end, opportunities for *health*, *participation*, and *security* are

Table 2.4: Active Ageing Environmental determinants

Determinant	Description
Mobility and Transportation	Opportunities for, and quality of, mobility and transportation systems existing in the environment. For example, a good public transportation system can facilitate people to stay in touch visiting friends and family.
Age-friendly infrastructure	Availability of infrastructure that it is accommodating to disabilities that may appear as we grow old. For example, ramps for accessing building.
Communication access	Infrastructure for communication and availability of communication means. This determinant has a role in supporting elders' social relationships, for example, keeping them in touch with relatives and friends living abroad.
Housing and daily living	How supportive is a person's housing environment to facilitate performance of daily chores and activities. For example, the availability of ramps or wheelchair stairs lifts can be key in facilitating the life of people with physical impairments, allowing them to maintain independence.
Quality of water, air and food	The quality and availability of air, food and water in the environment. For example, clean water is fundamental for those who have a fragile health (i.e. people with chronic illnesses and compromised immune systems) can reduce the type of activities a person can engage in.

Table 2.5: Active Ageing Social determinants

Determinant	Description
Risk of violence and abuse	Level of insecurity in the social environment. For example, older people who are frail live alone may feel particularly vulnerable to crimes and such as theft, and hence limit their participation in social activities.
Education	Quality and availability of education opportunities in the social environment. For example, low levels of education can result in difficulties for finding jobs as we become older workers.
Social support	Quality and availability of support and social interactions in a person's social network. For example, supportive social connections and intimate relations are vital sources of emotional strength.

Table 2.6: Active Ageing Economical determinants

Determinant	Description
Income	Level of income perceived by individuals. For example, better income can guarantee access to better, healthier diet.
Employment	Opportunities and quality for employment, volunteerism or leisure time activities. For example, access to employment through volunteerism in old age can help people to feel useful for contributing meaningful in society.

improved.
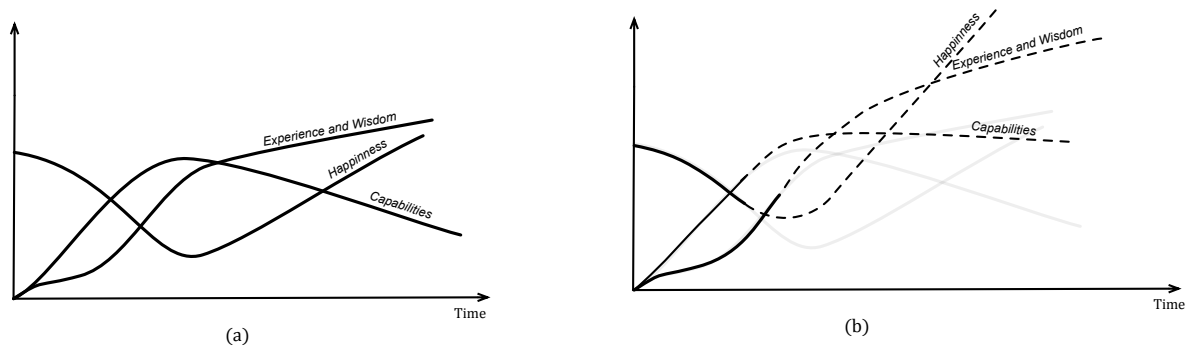
Figure 2.1: Ageing and Active Ageing phenomena simple representation

Summarizing this section, literature on ageing is often focused on the declining aspects of the ageing phenomena. AA pushes this perspective towards a more positive view that takes into account all aspects of growing older (not only those that decline) and emphasize improvement of opportunities as we age. As a general model, albeit only for representation purposes, we prefer to think of ageing as a process during which we gain in some aspects while losing in some others. Active ageing is about optimizing gains and minimizing loses. Figure 2.1a is an abstraction of this idea, where life is represented by several curves that change over time. Things like experience and wisdom can be represented as S-Shaped learning curves [118], slow at the beginning and getting to plateau towards the end. Happiness seems to follow a U-Shaped evolution [340], increasing in elderly years. And finally, our capabilities (physical, sensory and cognitive) get to a peak and then start to decline. Enabling AA is about getting from Figure 2.1a to Figure 2.1b, slowing decline as much as possible and increasing life experiences, wisdom and, ultimately, happiness.

2.2 IT and Active Ageing

IT can help to maintain health and independence increase participation and enhance security as we grow old. This section explains the four approaches by which IT enable AA and provides a systematic review of existing systems for this purpose.

2.2.1 Objectives of IT for elderly

The four approaches in which IT can enable AA come from the literature of Gerontechnology, an interdisciplinary field devoted to "the study and design of technology and environments for independent living and quality of life of older adults"[5]. These four approaches are summarized as *Gerontechnology goals* [177]. Figure 2.2 shows our representation of each of these approaches in terms of how they positively impact some aspects of our life. In each figure, the dashed curve represents how would our life course be by following these approaches. A definition of each goal follows the figure.

- ***Prevention.*** Is the first and foremost goal of Gerontechnology. Successful prevention can make the other three goals redundant. In addition to enabling AA, prevention implementation success

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[5]http://gerontechnology.info/index.php/journal/pages/view/isghome

(a) Prevention and care of injuries or illnesses

(b) Compensation

(d) Care of chronic conditions

(d) Enhancemenent
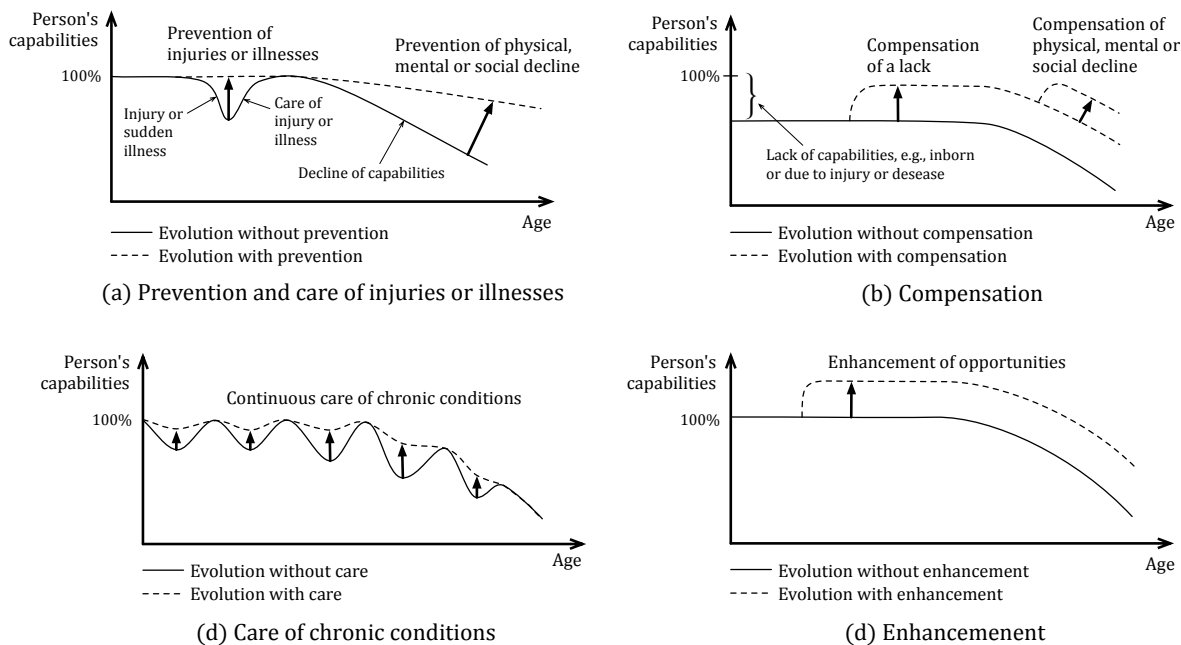
Figure 2.2: Gerontechnology Goals

may also lead to economics savings that can be redirected to other societal needs [177]. As we age, prevention helps us to avoid injuries and slow down physical, mental and social decline (Figure 2.2a). Using a machine to stay fit and keep walking, following a physical training plan using videos on YouTube, improving our nutrition with a tool that helps us log and monitor what we eat or stimulating our brain with computer games are examples of IT enabling AA through prevention.

- *Compensation.* When an impairment or disability can no longer be prevented or cured, *compensation* comes into place to either reduce the impact of the declined capability, or to partially and artificially replace a not available capability (inborn or due to injuries or illnesses; Figure 2.2b). Compensation is applied either on the environmental or on the personal level [177]. (Geron)technology can be used for these purposes, making up for impairments that people face as they age.

- *Care.* When we cannot prevent nor compensate a problem, and/or we need assistance to recover from an incident or to reduce the impact of a chronic condition, *care* is needed (Figures 2.2a and 2.2c). (Geron)technology for care acts to facilitate the work of the caregivers. The caregiver can either be a formal caregiver (e.g., nurse, physician) or an informal caregiver (e.g., family member, friend).

- *Enhancement.* (Geron)technology can help to create new opportunities and extent existing capabilities, and help people gain new capabilities (Figure 2.2d). Using IT to keep updated with our interests, to learn new things, to find interesting activities to join, to augment experiences in which we are already involved, to enable real time access to information or to discover new experiences or work opportunities that we can commit to are examples of IT for enhancement.

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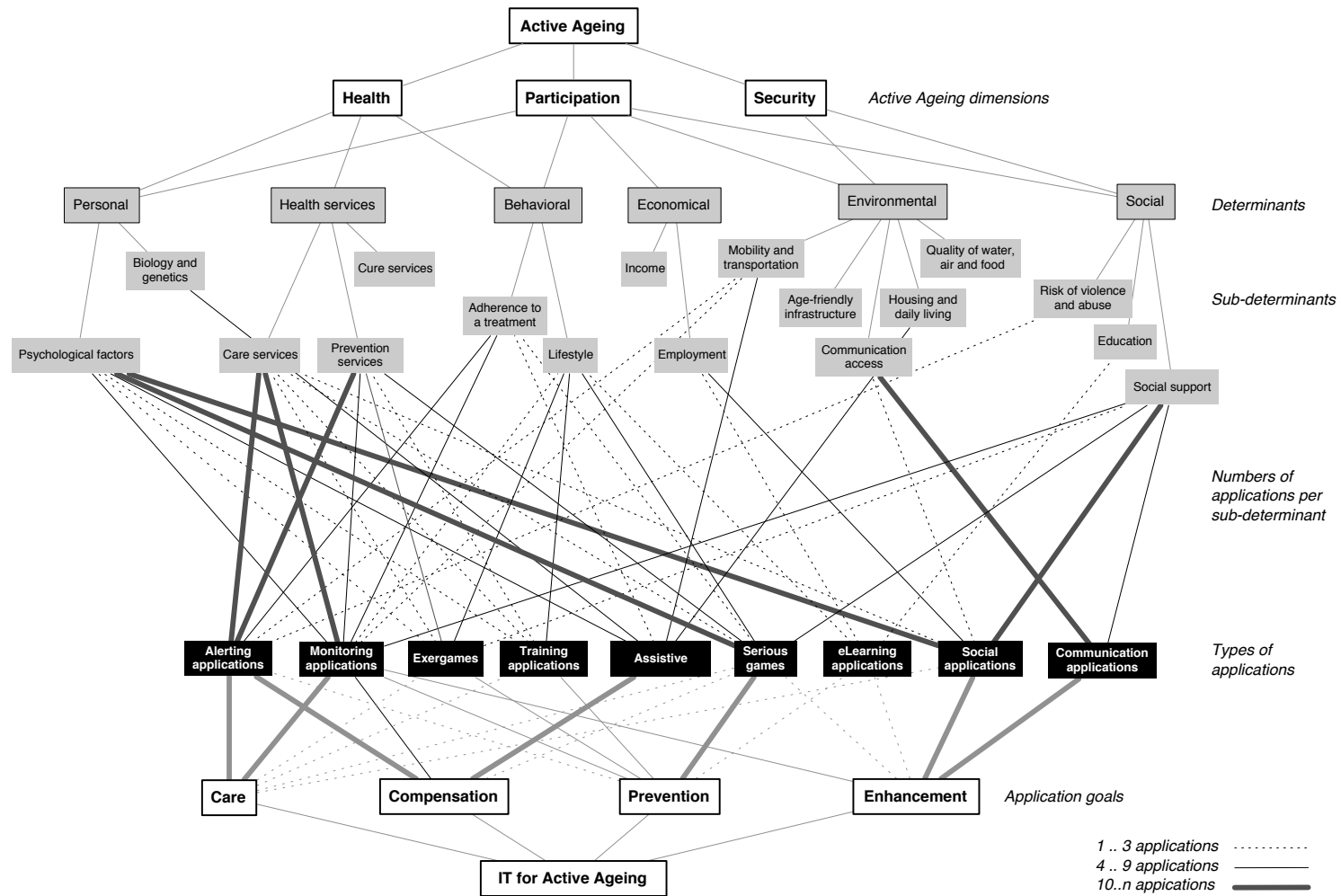
Figure 2.3: ICT for Active Ageing: evaluation framework.

2.2.2 Evaluation Framework

To understand how IT can aid AA, that is, which IT *solutions* may help address which of the *problems* of AA, part of this dissertation focused on developing a conceptual evaluation framework that brings together the two perspectives introduced above. The structure of the framework is illustrated in Figure 2.3: On the top, we find our *definition* of AA, with its three major *dimensions* (health, participation, security). In order to understand how IT may modulate these dimensions, the framework shows which *determinant categories* (and their specific determinants) can be used as levers. From the bottom, the solution space is structured first into the four *goals* (or also application domains) technology may pursue, in order to make life better; then, the framework shows what *types of applications* may serve which of these goals.

The types of applications are a bottom-up result of our analysis that stem from a careful clustering of all considered applications into groups of applications serving similar purposes; clusters were considered only for groups with at least three members. Applications of the same type share common features, such as monitoring physical activities, gaming, alerting about medication, and similar. Given the versatility of applications and the different uses one may make of them, one application may fit into one or more different types. However, in order to assign each application to exactly one type of application when multiple options were available, we opted for the type in which most the features of the application were focused. For example, *alerting applications* generally include the features of *monitoring applications* (e.g., tracking some metric of measure), in that they add additional functionality to their features (e.g., rules that fire if a measure exceeds a given threshold and notify a caregiver or family member). The ***types of applications*** we have identified in this analysis follow along with a proper definition:

- ***Monitoring applications*** are systems that keep track of the state of something or someone (e.g., activity sensors like wearable step counters or pedometers).

- ***Alerting applications*** are systems that notify about the occurrence of an event (e.g., medication reminders).

- ***Assistive applications*** are systems that help users in the realization of an activity by suggesting how to perform the activity (e.g., interactive mobility guides).

- ***Training applications*** are systems that guide someone to improve a particular skill over a period of time (e.g., nutritional virtual coaches).

- ***Exergames*** are serious games that have physical exercise as a primary purpose (e.g., Nintendo Wii fitness games).

- ***Serious games*** are games whose primary purpose is solving a problem, not pure entertainment (e.g., cognitive stimulation games).

- ***Communication applications*** are systems that enable remote peers to communicate (e.g., person-to-place texting services).

- ***Social applications*** are systems that enable social interaction and networking (e.g., social networking services).

- ***eLearning applications*** are systems for electronically supported learning and teaching (e.g., Web knowledge and wisdom sharing sites).

As illustrated in the framework picture, the role of application types is not merely that of classifying applications, but, more importantly, that of *connecting* the determinants of AA with the four gerontech-

nology goals and of *explaining* which type of application may be used to act on the determinants and to implement which goal.

In order to facilitate the comprehension of what characterizes applications for AA, we identify seven major dimensions to further analyze each application:

- *Stakeholders:* These are the people who interact with the application. We distinguish three types of stakeholders: the *beneficiary*; the *family*, including informal caregivers and friends; and the *healthcare professional*, which includes formal caregivers (e.g., doctors) and generic healthcare experts (e.g., physiotherapists).

- *Beneficiary:* This is the most important stakeholder, typically the older adult, that benefits from the application. Examples of beneficiaries are *independently living* or *community-dwelling* elderly, older adults *following a treatment*, under *informal* or *formal healthcare*, with *physical* or *cognitive impairments*, and similar.

- *Intrusiveness:* This refers to how much an application represents an uncomfortable obstacle to the normal life of the beneficiary. Examples of potentially intrusive elements are *storage of private information*, *frequent requests* to interact with the system, *reminders or alerts*, the need to *wear or carry* a device or sensor, and similar.

- *Risks:* These refer to the potential harmful consequences or damages in the case the application or device does not function properly. Examples of risks are *physical injuries*, negative *emotional impact*, or *leak of sensible information*, and similar. The higher these risks, the lower the potential adoption.

- *Collected data:* These refer to the information that is captured, processed and/or stored. Typical examples of collected data are: a person's *performance* in a physical or cognitive activity, *medication prescriptions*, *adherence* to a treatment, etc.

- *Persuasion techniques:* The are the techniques that aim to keep the motivation to use the application high. Examples are: *gamification*, *competition*, *collaboration*. The full list of persuasion techniques we consider is provided by Fogg [143].

- *Infrastructure requirements:* These include the hardware, software and infrastructure requirements of the application, such as: *PC* (e.g., desktop computer, laptop), *game consoles* (e.g., Nintendo Wii, MS Kinect), *touch/gesture devices* (e.g., tablets and tabletops), and *custom-made devices* (e.g., medication dispensers, vests), and similar.

In the following, these dimensions are used to analyze different examples of IT for AA, classified according to the objective they help to achieve.

2.2.3   IT for Prevention

We start our review of IT applications and services for AA with those that help people to prevent (or delay as much as possible) age related physical and cognitive decline.

2.2.3.1   Applications for Prevention

The first approach to prevention from the IT perspective is the use of ***exergames*** to motivate people to participate in positive and healthy activities. Most exergames are designed to prevent physical decline by

helping and motivating elderly to engage in physical activities, maintaining and even improving physical abilities such as muscle strength and balance. Gaming consoles that allow players to control games with their movement favour the development of these systems. For example, many of the games available for the Nintendo Wii console have been tested with seniors in several studies [207, 214], almost always with positive results in terms of acceptance of the technology and increase of physical activity. There are also efforts to improve the design of these games to make them even more suitable [155]. In this line, SilverPromenade [156] is an exergame specifically designed to motivate institutionalized frail elderly (e.g., living in assisted living facilities), into taking virtual walks by easily stepping in and out of the Nintendo Wii's balance board (i.e., a board similar to a weight scale that serves as a game controll for the Wii). In this way, the games can facilitate *prevention services* focused on maintaining good levels of physical activity which in turns influence positively the *lifestyle* determinants. To a lesser extent, also Microsoft's XBox 360 Kinect console which does not need a remote sensor but instead uses a 2D camera, has been tested with success to, for example, stimulate visual performance of institutionalized elderly with wheelchairs [90]. According to Jung et al. [195], exergames in groups can also enable AA by improving *psychological factors* like self-esteem and affect.

Other than game consoles, physical training often demand for custom-built devices and sensors. For example, de Morais and Wickstrom [113] have used a custom-built device with a camera and body sensor to record the movement of the elderly in order to monitor and guide the senior elderly to exercise Tai Chi. By learning Tai Chi, the beneficiary will also improve physical abilities, positively affecting the *lifestyle* determinant. Similarly, a custom-built walk-board is used by Kim et al. [205] to encourage elderly to walk more by detecting when they are walking over it and giving incentives to do it again. The incentive is implemented by using the metaphor of a "virtual sheep" that they have to take care of within an animated farm, displayed in a PC. The more they walk, the better the situation of the sheep. Also for walking, Hansen [175] developed a custom-built robot that plays a ball game with the elderly in which a ball is exchanged between both of them while the robot is moving. The elder has to hand the ball back to the robot, which push him or her to walk. Walking more, in these examples, results in a positive impact on the *lifestyle* determinant.

Mobile devices have also been leveraged for exergames. This is the case of "Walk 2 Win" [251], a mobile game that elderly can play in group or individually and in which to progress, they need to walk in a closed environment and discover hidden artifacts. The application uses a smartphone and local Wi-Fi to detect the user's geographical location and a central server to synchronize and moderate the game. By simply playing, people increase their walking and socialize at the same time, positively affecting *lifestyle* and *social support* determinants.

Similar to exergames, the second approach to prevention involves the use of ***serious games*** that require the user to do a serious task while playing a game. Most serious games follow the goal of stimulating cognitive functioning skills (i.e., vigilance, visual-spacial attention, selective attention, focused attention, divided attention, hand-eye coordination, memory, etc.), positively affecting *psychological factors* determinants. One example of such games is the simplified version of Stepmania[6] for iPads [136] designed specifically for elderly to play with and improve their divided attention abilities. Stepmania is a musical game in which a group of floating symbols falls through the screen, synchronized with a background music. The goal of the game is to catch the symbols just when they overlap with their corresponding button on the screen, by tapping on the buttons. Because the game requires concentrating on multiple moving object at the same time it can improve divided attention in the long run. Cogniplus [308] is

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[6]http://www.stepmania.com

another example with the same goals and wider range of cognitive training programs, deployed on a custom-built computer for animated cognitive games known as the Vienna Test System[7] Cogniplus is used by psychologist in formal therapeutic environments, hence potentially improving health *prevention services*.

Also in the line of improving *prevention services* and *psychological factors*, tabletop devices (situated touch displays on a table) are also a popular platform to deploy serious games for seniors. Two examples are the HERMES Maze [76], used for training memory and preventing the elderly from missing medical appointments; and an adaptation of the popular puzzle game Tangram [381], used to support psychomotor activity therapies. They both leverage on tabletop devices to offer a range of cognitive training games (e.g. puzzles, crosswords, mazes) that emulate the experience of playing a physical table board game, where seniors sit around a table and play together. The tabletop Tangram uses also a webcam to monitor game playing in order to detect mistakes and train the user in solving the puzzles, with the goal of improving short and long term memory.

More in the line of improving *lifestyle* determinants, mobile devices have also been used to deploy serious games. An example of this is OrderUp! [166], a mobile game that runs on a smartphone and puts the user in the role of a server in a restaurant whose goal is to make meal recommendation as quickly and healthy as possible, in order to keep the job. The more healthy the choices, the more health points the user gains. Ultimately, the goal is to motivate people to consume healthy food. Since a small social network is integrated in the system to discuss nutrition choices, there is also a positive impact in the *social support* determinant. Similarly, Derboven et al. [117] designed a shopping game where elderly has to remember the shopping list and buy the products in a virtual reality shop. The family can connect with the elderly and assist them with the shopping. This practice improves memory skills, adding *psychological factors* to the list of determinants that are positively affected by this system.

The third approach to prevention is the use of ***training applications*** with the purpose of preventing decline or loss by training an ability or skill. These applications benefit from incorporating persuasion techniques but without making the training into a game like serious and exergames do. An example of this type of applications is ActiveLifestyle [323], an iPad based training application that provides video-based training exercises to improve strength and balance. The application also incorporates persuasive strategies (i.e. positive and negative reinforcement, social interaction with public bulletin board and private mailing system, collaborative training, self-monitoring and reminders) in order to motivate the user into adhering to the training plan. Similarly, Flowie [39] is a training application for motivating elderly to walk. Flowie keeps track of the daily step count of the person with a pedometer and displays progress using growing flower in a situated display placed in the home. A third example of the same type is Seniorcize[8] a tablet application that presents workout sessions and tips about physical exercises. By supporting and motivating physical exercises training, all these applications positively affect the *lifestyle* determinant.

In the same line, also affecting positively the *lifestyle* determinant, and leveraging the use of sensors, Steffen et al. [334] designed an application to suggest physical exercises and monitor the user activity trough a wearable sensor, thereby coaching the user throughout the exercises. Other works have used robots as trainers, which is the case of "robot exercise instructor" [137], a mobile robot that coaches the elderly user to perform seated exercises to improve physical strength. During the training, the robot performs the exercise activity and the trainee imitates the robot. Training applications addressing the

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[7]http://www.schuhfried.com/vienna-test-system-vts
[8]http://www.walkinglibrary.com/seniorsize.html

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lifestyle determinant are not only about physical activities. DanceAlong [202], for example, is a training application for learning how to dance. Focused on nutrition, Autom [70] is a small robot that help users to improve their nutrition and prevent health problems through a conversational system that engage elderly in a daily coaching dialog about nutrition.

Finally, one last example of training application is CleverMind[9], an iPad application with a nice and intuitive interface specifically designed for elderly with decreased cognitive ability that features cognitive assessment training, tracking and reporting integrated within all the other functions of the tablet like surfing the Internet or connecting with loved ones through facebook. The goal is to entertain users while at the same time strengthening their cognitive proficiency, positively affecting *psychological factors* and *social support*.

The fourth approach to prevention is the use of ***monitoring applications*** that monitor user's behaviors, sending this information to third party who can response to it in preventive manners. Most of these applications affect the *prevention services* and *care services* determinants, because they improve the connection of elderly with their caregivers. For example, the nutritional advisor system [216] allows nutritionists to create a menu and a diet schedule for an elderly patient, who can later report about his or her compliance with the diet, which can have a positive impact on the *lifestyle* determinant. Similarly, but focused on cognitive testing, Byun and Park [78] designed a monitoring application that keep tracks of the elderly performance metrics (i.e. reaction-time, short-term memory, discernment) in three different cognitive games, informing about it to the beneficiary's doctor, who can use this information to assess the psychological wellbeing of the patient in order to plan interventions or adjust therapies. The same approach is proposed for Alzheimers interventions [232] and for other services to asses cognitive state of elders [193, 194] in order to support *prevention services*. Playing games within these applicaitons have also a the additional positive impact on the elder's *psychological factors*.

Another monitoring application to support *care and prevention services* that is mixed with a game consists of a system to monitor elderlys performance in following the instructions correctly when playing Dance-Dance-Revolution (a dancing game where a person receives dancing instructions and needs to move accordingly) [332]. The person's movements are monitored through a sensing carpet and a score is presented at the end of each music allowing caregivers to monitor dancing movements and assess patients physical conditions. This, in turn, is used to support training advices or to adjust the physical training program that serves the purpose of preventing physical decline, thereby also addressing the *lifestyle* determinant.

In some cases, a self-monitoring approach might be enough to improve *lifestyle*. For instance, Consolvo et al. [101] provides a fitness device that allows the elderly to monitor their own physical activities and sends the data to their phone to support user self-awareness about his physical conditions. Another self-monitoring application worth mentioning is the Iom feedback hardware[10] consisting of a wearable sensor that measures "skin conduction level" as a measure of stress, and later guides the person, through a PC application, in how to control and reduce stress, addressing then the *psychological factors*.

To a smaller extent, prevention is also enabled by the means ***alerting and eLearning applications***. Alerting is used to inform the elder or a caregiver in a potentially harmful situation right away, trying to prevent them from happening. An example is the Ambient Trust Cube [316] consisting of a custom-made light cube that visually alert elderly when they try to visit a risky website (using a definition of risky websites

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[9]http://www.myclevermind.com
[10]http://www.wilddivine.com

provided by the WebTrust[11]), thus preventing potential *risks of violence and abuse* that might result from these websites. On eLearning, Ali et al. [42] designed an application that organizes nutritional knowledge in modules that are easy to use by elderly, helping them to gain awareness of their nutrition to prevent health problems, thereby addressing the *lifestyle* determinant and positively affecting also *education*.

2.2.3.2 Discussion

Prevention applications aim to prevent a decline. This can be physical (e.g. strength and balance), cognitive (e.g. memory, attention and vision) or even social (e.g. social isolation). Hence, accuracy (e.g. accuracy of collected data or functioning of the application or device) so important, since the lack of accuracy does not seriously hurt the beneficiary. This, along with the facts that games are motivating and simply fun, are strong reasons of why most of the applications in this section are ***exergames*** and ***serious games***. In this regard, Nintendo Wii and MS Kinect are frequently used as an instrument to deliver exergames for the elderly. However, most cognitive training games and applications use a cheaper device such as a personal computer or a tablet. Given that physical training games require the beneficiary to perform physical activities, exergames using Wii and Kinect can fulfil this requirement. Cognitive training games usually require an interface with controls (e.g. keyboard, mouse, touch interface) to supply the training program. Bearing in mind the lower demand for accuracy and the beneficiary of prevention application (which is considered as a healthy elder with limitation) games are a very good choice. Another reason for serious and exergames to be so popular in prevention is that they were very successful to increase the adherence of a preventive activity.

Monitoring applications are also widely used for the purpose of prevention because they are useful to keep the healthcare experts updated about the beneficiary's situation and eventually allow the experts to control the beneficiary's behavior. Monitoring applications often-times enable healthcare experts to take decisions about the beneficiarys healthcare and to prescribe a more accurate intervention based on the beneficiary health. Hence, most of these applications target more that one user category. It is usually the beneficiary itself and the healthcare experts or family that controls the monitoring part. Among these, fewer monitoring applications do not involve a third party and instead provide self-monitoring to the beneficiary.

Training applications incorporated with persuasion techniques are also very common, particularly in serious training scenarios, where professionals are behind the training programs that are facilitated by the systems. Gamification is also widely used in most of the training applications in addition with other persuasion strategies (e.g. positive and negative reinforcement, self-monitoring, and awards) to motivate the elderly to adhere to the training plan.

The rest of the applications (i.e., alerting applications and eLearning) are rarely used for the purpose of prevention. In prevention, alerting applications are acting similar to self-monitoring applications by reminding the beneficiary about potential risk or threat that might happen. It is notable that very few applications used eLearning in order to prevent a physical or cognitive decline by teaching the beneficiary exercises that changes their lifestyle to a more active one. Unlike the aforementioned applications, eLearning is using an indirect way to prevent the beneficiary from a wrong lifestyle or activity.

Based on our analysis, prevention applications are usually not too intrusive and tend to be cheap since they often-times do not require high accuracy and a complex custom-built system. Lack of accuracy in these systems however might hinder the user experience and lead to frustration with the technology.

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[11] http://www.webtrust.org
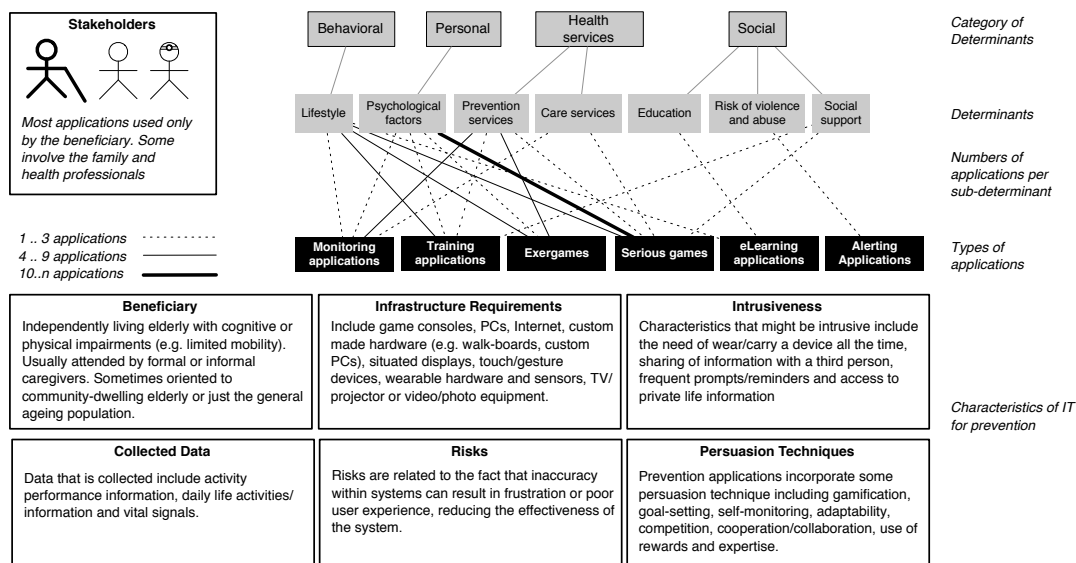
Figure 2.4: Typical characteristics of IT solutions for Prevention

Intrusive characteristics might include in some cases the need of carrying or wearing a sensor (i.e., a pedometer to count steps). In general, natural user interfaces such as tablets and tabletops are very common, providing direct interaction with the objects on the interface.

Furthermore, prevention seems to be the most important area where game mechanics and persuasion technologies can find a successful application domain. In fact, they are already in use within many of the contributions for prevention we have included in this review, showing effectiveness in improving, for instance, adherence to training plans [323, 39].

Figure 2.4 presents this summary visually, highlighting the connections between AA determinants and the types of applications that affect them along with their aggregated characteristics. The thickness of the lines represents how many applications of a type have an influence on the determinant to which they are connected. The boxes around the figure explain the general characteristics of applications for this particular goal of IT according to the dimensions of analysis we have introduced in our evaluation framework.

2.2.4 IT for Compensation

When an impairment or limitation can no longer be prevented, IT enables AA by compensating the reduced ability. In this section, we describe IT contributions that fall under this category, including assistive, alerting, monitoring, serious games and social applications.

2.2.4.1 Applications for Compensation

The first way in which IT contributes to compensating the impact of a reduced or lost ability is by assisting people in activities where the affected ability is involved. We refer to this type of contributions as *assistive applications*. A system that is exemplary of this approach is MAPS (Memory Aiding Prompting

System) [85], which helps to compensate memory limitations while performing daily life activities like taking a bus to reach home or shopping groceries for a meal, addressing thus determinants of *psychological factors*, *housing and daily living* and *mobility and transportation*. MAPS uses a PDA (i.e., personal digital assistant) to prompt a person what to do in order to complete an activity, one step at a time. The list of steps to follow (i.e., the assistance script) is previously prepared by caregivers, loaded in the PDA via wireless networks and triggered manually by the person who selects what activity to perform or automatically by the PDA which suggests what to do. MAPS can also integrate information from a public transportation system and GPS in order to provide a real time personal travel assistant. The guidance provided by MAPS has been found to be effective on increasing independence of its users, who were also able to follow instructions, although not always in a precise way [84]. Addressing also *housing and daily living* and *mobility and transportation* but without focusing on *psychological factors*, the Information Bubbles system [187] also provides assistance information in a PDA, only in this case the prompts are automatically displayed when the elder is inside a "bubble" (i.e., usually visited buildings like the town hall or the supermarket) and contain guiding information about that place (e.g., where specific products of the supermarket are). iGrocer [317] is a smartphone assistive application that advises users what to buy, what to avoid and where to find products in the supermarket, based on a nutritional criteria that is previously established to respond to the user's particular health conditions or needs, addressing the determinant of *housing and daily living*.

More focused on *mobility and transportation* and *psychological factors*, Fujitsu's Smart Walking Stick [149] compensates forgetfulness by embedding an assistive application in an everyday common object used by elderly: their walking canes. The cane has a GPS sensor locate the person, a LED display mounted on top to show what direction should be taken, and it vibrates to indicate when a direction must be changed. Similarly, another embedded IT application is the GUIDE-Me AIS prototype [151], which mounts small displays in medication containers to indicate which pill must be taken, in what doses, at what time, addressing in this way the determinant of *adherence to a treatment*. The Cook's Collage [254] also follows this line by embedding a situated display and a recording camera in the kitchen furniture in order to first record pictures of the steps necessary to cook a meal and subsequently display these pictures to aid the person remember the process, addressing then the determinants of *psychological factors* and *housing and daily living*. The BioAid iPhone hearing aid app [61] is another assistive example, turning an iOS device into a hearing aid by processing sound from the microphone and then delivering it over headphones in real time, thereby compensating reduced hearing abilities in older adults and addressing *biology and genetics* factors.

IT systems can also act as facilitators of daily life activities, compensating for lack of mobility and strength. This is the case of the Gesture Pendant [254], a wearable necklace that interprets elderly hand gestures in order to perform home related tasks like opening a door, dim the lights, or close the blinds, addressing in this way the determinant of *housing and daily living*. Similarly, compensation through facilitation can also be achieved by designing user interfaces with a focus on specific limitations, like visual impairments (i.e., *biology and genetics* factors), which are not limited to elderly users, but can also benefit younger users also visually impaired in some way. For example, BigLauncher [59] provides an Android launcher application (i.e., a UI theme) that uses fonts, icons and colors suitable for users with limited vision. Similarly, the No-Look-Notes is "an eyes-free system that uses multi-touch input and audio output" [68] to guide a blind or visually impaired person while writing on a smartphone. Other auditory interfaces are the WebAnywhere browser [60], which facilitates internet navigation using the voice and provides an audio output of the content in websites; and the PENPAL [355], which is an electronic pen that scans and reads out loud any text document. In general, most of the IT applications

for accessibility (e.g., screen readers like JAWS [12] are suitable to compensate visual impairments that come with age.

In the same way that BigLauncher compensates visual impairments with a carefully designed user interface, the IDBlue special pen [188] compensates the lack of skills in using technology by offering a more natural interface to interact with a digital agenda system. Lack of skills with technology often leads to frustration and a decrease in self-esteem, which is part of the *psychological factors* determinant. The digital agenda organizes elderly daily activities and medical visits. The pen can read RFID tags that are attached to images on a special board. Like a remote control, each image represents a functionality of the agenda that runs on a PC. When the user taps an image with the pen, the associated tag is read and transmitted via Bluetooth to the computer, which interprets and executes the actions on the system. The digital agenda in itself is also an example of an assistive application for compensating declining memory.

A second way in which IT compensates age-related cognitive decline is via ***alerting applications***, the most typical example being medication intake reminder systems that alert the person when it is time to take a medicine, addressing the determinant of *adherence to a treatment*. The e-Pill medication dispenser family [127], EMMA [190] and RMAIS (RFID-based Medication Adherence Intelligence System) [241] are some examples of embedded reminders in medication dispensers (i.e., custom- made devices that organize and facilitate the retrieval of pills). Alerts can be auditive, visual or even phone calls that will only stop once the patient takes the pills from the dispenser. If missed, e-Pill dispensers will also send SMS or email alerts to caregivers. We mention only three in this paragraph, yet alternatives abound in the market and in literature [241]. Other examples of medication intake alerting applications are implemented as smartphone applications, which is the case of UbiMeds [322], Wedjat [362], AIS REMIND-Me [151] and the Medication Compliance System [292].

Another interesting usage of alerting systems is for compensating visual impairments to address the determinant of *mobility and transportation* through the use of ultrasound detectors (i.e., like the sonar of submarines) integrated with walking canes to detect objects that are further away from the original cane length. Once the sonar detects a potential obstacle, the cane would start to vibrate to alert the person about the obstacle. Examples of this are the Ultracane [333], the K-Sonar [38] and the Miniguide [152].

A third way of IT for compensation is the use of ***monitoring applications***, commonly part of alerting systems, that complement the task of compensating cognitive decline for addressing *adherence to a treatment*. As an example, radio frequency identification (RFID) technology has been used to add monitoring in medication dispensers [241][183]. RFID tags are attached to medication boxes. The medication dispenser uses an RFID reader to scan the medication box and read information about the treatment and the doses stored in the RFID tags. This information is compared with the measures of a scale that weighs the box after the pill is taken, to monitor how well the treatment is followed and inform the user. CARE-Me [151] is also a monitoring application for compensating cognitive decline and improving medication compliance. It uses a positive feedback metaphor in a digital photoframe to inform about compliance and make the patient aware of the progress. The metaphor is a tree that it is populated with parakeets. Each parakeet represents a week of the treatment and grows in size after every day in which the dose of the medicine was correctly taken. At the end of the week, the parakeet flies away and a new one appears [151]. This is one of the very few systems that integrates a persuasion technique to motivate the person in achieving a goal.

The Fujitsu smart stick [149] and the alerting mobile application proposed by Qudah et al. [292] can be also listed as monitoring applications. The first uses 3G or Wi-Fi connectivity to send positioning data

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[12]http://www.freedomscientific.com/products/fs/jaws-product-page.asp

back to a host computer, where caregivers or relatives can monitor the person's position, along with other vital signals like the hearth rate, addressing mainly that person *mobility and transportation*. The second uses data-mining algorithms and bio sensors for analyzing patterns of medication intake in relation with vital signals (e.g., hearth rate), with the hope of better understanding medication effects, addressing then *adherence to a treatment*.

One last monitoring application that belongs to the domain of compensation is the memory aid Show me the Video proposed by the HERMES project [76]. This application records a video stream of the elderly's house events, and then replays them in a tabletop device to help the beneficiary to remember the event, addressing *psychological factors* and compensating for age-related reduced memory.

The fourth way of IT for compensation is the use of **serious games** to compensate for reduced memory through the means of an entertaining game. In this line, MoviPill [114] addresses the determinant of *adherence to a treatment*, improving medication compliance by persuading patients with a mobile phone game that fosters social competition. Each time the patient takes the medication, a score is calculated based on how close to the prescription time it was taken. At the end of each week, the game highlights the week's winner to all players and resets the game for the following week. A second Serious game that also help to compensate age-related reduced memory (i.e., *psychological factors*) is the HERMES Maze [76], which is deployed in a tabletop device and challenges patients with a maze that has an appointment sheet as the reaching point. The patient has two starting points, one with "appointment clues" (e.g., medical visit) and the other with "time clues" (e.g., 11 a.m.). By playing the game, the elderly is aided to recall real life appointments with doctors or medication intake times. In terms of evaluation, only De Oliveira et al. [114] include a study where the effectiveness of social competition was compared to the use of reminders, finding that social competition augmented compliance.

Finally, the field of Robotics has also contributed with **social applications** in the form of robots that provide companionship and sense of social connectedness to compensate loneliness and thereby address *psychological factors*. Generally, they are used by seniors who are under psychological therapy for dementia or depression. Two examples of this type of robots are the Huggable [338] and Paro [358]. Both Paro and the Huggable are therapeutic robotic companions with sensitive skins that react to touch to trigger some type of response of the robot. The Huggable serves also as a communication and monitoring medium, collecting information in the form of video and audio, which is later sent to a health professional, who can in turn monitor the progress of the patient and communicate directly with him if there is a need. A field trial of Paro shows both a psychological improvement and a physiological indication of stress reduction (via urinary tests) after interacting with the robot for a while [358].

2.2.4.2 Discussion

Compensation applications are mostly used by older adults independently, mostly because they are oriented to older adults that have either cognitive or physical impairments that need to be compensated (e.g., lack of memory, visual limitations, hands tremor, etc.). Compensating a cognitive and some physical decline (e.g., loss of sight or hearing) often requires to work on building physical artifacts or infrastructure (e.g., walking canes, motorized wheelchairs, hearing aid devices, ramps etc.). This is what is usually referred to as **assistive technology** and we have decided to draw a line on what we consider IT by including only applications that process and store information that people can consume or interact with. It is common that IT applications for compensation require then some form of custom-made hardware (e.g., medication dispensers). Mobile devices and wearable sensors, combined with home automation

equipment, are other typical infrastructure requirements. Family and doctors are involved when monitoring applications are used to track medication compliance, allowing them to know when a person has not taken the medicine. In general, alerting applications for compensations are oriented to self-sufficient people, able to follow instructions. Monitoring applications for compensation aim at extending assistance in the form of additional control. Not including common assistive technology applications, IT for compensation mostly contributes to compensating cognitive decline related impairments.

Frequent reminders and access to personal health information (e.g., medication compliance, daily life activities and vital signals) are common elements of these applications that could potentially be perceived as intrusive, raising privacy concerns. Constantly wearing or carrying devices or sensors (e.g., the gesture's pendant) can be perceived as physically obtrusive [244], which is why this aspect needs to be designed carefully to render their benefits clearly in order to reduce this perception. When the benefit of technology is noticed clearly and they are seen as relevant, people are willing to make concessions about their privacy [316]. More importantly, since people will rely on these applications for guidance, there is a risk of producing more harm than good if the guidance is not correct or appears in the wrong moment. Persuasion techniques (e.g., goal-setting, rewards, social competition) are used in this domain, mainly for addressing medication compliance by keeping people motivated to follow their treatments. This seems to be a promising direction that has not been thoroughly explored yet.

As final note, there is clear tendency toward more integration between physical artifacts and information and communication technologies (like in the case of the augmented canes). More and more, assistive hardware is merging with information and communication technologies, resulting in an emerging field of opportunities for new and innovative assistive services.

Figure 2.5 visually summarizes this discussion, showing the different types of applications, AA determinants they affect and their aggregated characteristics according to our evaluation framework. The thickness of the lines represents how many applications of a type have an influence on the determinant to which they are connected. The boxes around the figure explain the general characteristics of applications for this particular goal of IT according to the dimensions of analysis we have introduced in our evaluation framework.

2.2.5   IT for Care Support

IT for Care comes into place when a problem can no longer be prevented nor compensated, and assistance is needed, either to facilitate recovery from an incident or to reduce the impact of a chronic condition.

2.2.5.1   Applications for Care

The first approach to care support is the use of ***alerting applications*** aimed at taking care of elderly by alerting someone about the occurrence of an event, with the goal of triggering response when falls, missed or due medications, lack of activity and other adverse situations put elderly at risk.

The major part of these applications are for detecting and alerting about falls. Thanks to these alerts, caregivers can immediately react and avoid or at least reduce the risk of more serious injuries. Most of these systems rely on wearable sensors that leverage on the use of tri-axial accelerometers to monitor body motion and detect falls [325, 349, 69]. In addition to accelerometers, Doukas and Maglogiannis [123] collect and monitor sound data, combining it with movement data in order to detect falls of patients. Chen and Lin [89] introduce an RFID-based gait monitoring system to assist caregivers detect stumbles

Stakeholders

Most applications used only by the beneficiary. Some involve the family and health professionals

1 .. 3 applications ·········
4 .. 9 applications ─────
10..n appications ━━━━

Health services	Personal
Behavioral	Environmental

Category of Determinants

| Prevention services | Psychological factors | Biology and genetics | Adherence to a treatment | Mobility and transportation | Housing and daily living |

Determinants

Numbers of applications per sub-determinant

| Social applications | Serious games | Assistive applications | Monitoring applications | Alerting applications |

Types of applications

Beneficiary

Independent living elderly with cognitive or physical impairments (e.g., reduced vision), that may be suffering from a disease, dementia or depression, and following a medical treatment. In some cases, used also by community-dwelling elderly.

Infrastructure Requirements

Include custom made hardware (i.e., medication dispensers), Internet, mobile phone/device, touch/gesture devices, video/ photo cameras, wearable hardware and sensors, PC, robots, environmental sensors, situated displays or smart home domotics

Intrusiveness

Characteristics that might be intrusive include frequent prompts/reminders, the need to wear/carry a device, access to private life or personal health information or sharing of information with a third person

Characterisitics of IT for compensation

Collected Data

Data that is collected include daily life activities/information, medical treatment compliance/description, personal multimedia or vital signals

Risks

Risks include that the inaccuracy or failure of the system can cause misunderstandings/ misuse, frustration or event health problems. Failing to make notice that the system is down, may prevent users from benefitting from the system (e.g., reminders not arriving if battery is over).

Persuasion Techniques

Few applications make use of these techniques, including reminders, rewards, competition, goal-setting or gamification

Figure 2.5: Typical characteristics of IT solutions for Compensation

and falls. Tests in laboratory were successfully performed to check the effectiveness of the fall detection system. Of these evaluations, only Doukas and Maglogiannis [123] performed a pilot study with real people, involving 5 older adults. The results of this study showed that the mobile device to detect the falls was effective in doing so, but the especial vest designed to carry the device was uncomfortable.

Next to wearable sensors, mobile devices and applications have been explored and tested to alert about falls [81, 135, 196]. These applications process the data collected by the phone's accelerometer, and when a fall is detected, send an alerting message first to the user himself, and, if the user does not reply, to a list of emergency contacts.

Another approach to alert about falls is supported by cameras. In that case, the images captured by a set of cameras installed in a given environment are continuously processed and monitored in real time to detect falls, and alert caregivers using a personal computer or a dial center in case of a fall emergency. For instance, Shieh and Huang [318] propose a "human-shape-based falling detection algorithm". Doukas and Maglogiannis [124] and Yu et al. [380] leverage on the combination of audio and video information, known as multimodal processing, using a speech recognition system to double check a possible fall by also analyzing the extracted voice. Fernández-Caballero et al. [139] "mix accelerometer-based fall detection and computer-vision-based (visible and infrared) fall detection".

Environmental sensors are also an option to detect and alert caregivers about detected falls. Alwan et al. [43] introduce a floor vibration based fall detector combined with "battery-powered pre-processing electronics to evaluate the floor's vibration patterns and generate a binary fall signal". Whenever a fall is detected a wireless transmitter sends the alert to a communication gateway, that in turn forwards the alert to caregivers. Alerting systems for fall detection and response can enable AA by can enable AA by supporting and improving *care and prevention services*.

As previously noted, alerting applications are also applied to warn caregivers about problems of *adherence to a treatment*. For instance, UbiMed [322] is a mobile application that offers automated scheduling,

reminders and tracking of prescription drugs intake, including proactive alerts sent to physicians and relatives when the patient fails to adhere to the prescription regime. The medication compliance system [292] is another mobile application that integrates a medication compliance system with the use of biosensors (e.g., electrocardiogram) to "monitor and provide personalized feedback to cardiac patients and health professionals". These two applications also aim at compensating memory loss and improving adherence level to a treatment as described in Section 2.2.4.

In addition to mobile applications, some contributions integrate alerts to caregivers in medication dispensers like e-Pill [127], EMMA [190] and RMAIS [241]), with the goal of assisting people in managing their complex medication regimen autonomously at home, without the active support of a caregiver but still involving the latter in monitoring compliance.

The second most common approach to care in our review uses **_monitoring applications_** to track elderly health, daily life activities, and dangerous situations (e.g., fire, unknown people breaking into the house, or elderly lack of activity), aiming at providing better and faster care when necessary, improving in this way both health *care and prevention services* determinants. Examples of these applications, use wearable sensors to monitor vital signals and body motion, share such information with caregivers who evaluate their behavior and, intervene when there is a problem (e.g., low vital signals, high blood sugar, low pressure) [243, 225, 79]. Monitoring application also leverage on the use of wearable sensors to collect data about seniors' daily life activities to detect low levels of activity, e.g., a symptom of depression or a coming disease, and inform health professionals about this [206, 100, 379]. Some of these applications are also used as alerting applications that remind the elderly about upcoming events like a visit to the doctor, the time for taking a medicine or the time to buy groceries [379] to encourage them to be more active. Some alerting applications that are used for improving *adherence to a treatment* are also bundled with monitoring applications that collect information about medication compliance and sends it back to doctors or the family for following up [241, 292].

More focused on health information, DigiSwitch [80] captures images from daily activities of older adults, allowing them to view this "information as it is collected and temporarily cease transmission of data for privacy reasons". Holzinger et al. [185] collect vital signal and body position data to detect abnormalities (e.g., faints, low or high heart rate) and call an assistance center (which makes it also an alerting application). Cameras have also been used for the monitoring purpose, Nasution and Emmanuel [256] leverage on posture-based events recorded by cameras to identify possible intruders. Appiah et al. [46] and Shankar et al. [316] adopt cameras aiming at monitoring daily life activities and alerting caregivers in case of unexpected behaviors (e.g., elderly did not wake up or spent many hours on the bed, undesired people inside the house). Monitoring applications can also be used to help health professionals in providing assistance, like the case of Lifeline [161], a monitoring system used by doctors to follow patients with cognitive disabilities while they try to accomplish a task and conveniently help them if they detect that they are lost, having a positive influence in the feeling of safety of patients, part of the *psychological factors* determinant.

Another approach to care comes in the form of **_serious games and exergames_**. Both have shown to be effective for improving elderly care by the means of, for instance, rehabilitation sessions in virtual reality environments. This approach presented good results in motivating and improving physical conditions of elderly recovering from hip fracture story [159]. Moreover, Nintendo Wii Fit has been used to improve elderly's balance during stroke rehabilitation care sessions [342]. Both applications were tested with real users. The first approach, was tested with 66 participants, 98% of which felt less fear of falling after the physical intervention period. The second test was focused on feasibility, showing positive results in a

clinical setting, where the only participant of the study improved balance and self-confidence. Sugarman et al. [342] state, however, that "further studies need to be done in order to assess the social validity and effectiveness of the use of the Wii and similar gaming systems as a treatment modality". Improvements in reducing the fear of falling have a positive impact on the *psychological factors* determinant the use of these games as part of rehabilitation therapies can improve the *care services* determinant.

Closely related to games, ***training applications*** are also used for care. Deployed on tabletop devices, some training applications have been used during upper extremity motor rehabilitation care sessions in order to improve motor control [45]. This approach was in the process of being installed in the rehabilitation hospital. The initial responses the authors received from the therapists were positive, which indicates that these application can potentially improve *care services* by facilitating the delivery of training from real therapists.

Finally, only one IT for care contribution in our review falls well under the category of ***social applications***, improving the *social support* determinant through a cognitive training platform where caregivers can assist patients with cognitive impairment in cognitive tasks that are part of training program [246]. Although this application can be also classified as a ***training application*** that addresses *psychological factors*, the focus of the contribution is set on the platform to involves the family network in assisting the cognitive training from remote, putting the social aspect upfront.

2.2.5.2 Discussion

Most of the care applications focus on assisting independently living elderly, in order to prolong their independence and consequently postpone their entrance in a nursing home. Care applications are characterized by the involvement (in the use of the system) of all three stakeholders of our evaluation framework: beneficiaries, health professional and the family. The goal is often to support remote healthcare monitoring of elderly's daily activities, health status, and adherence to treatments.

Among the applications, alerting applications (mainly for fall detection) and daily monitoring solutions are the most widely researched. In the former, the elderly needs to carry or wear a special device (e.g., mobile phone, body sensors) or be surrounded by sensors, cameras, or microphones to monitor his environment. Such approaches make the daily life of elderly safer in the sense they can receive fast assistance when risky situations are detected (e.g., falls, unconsciousness, potential symptoms of a disease). Proper monitoring and alerting systems can lead to fast diagnosis and reaction by from caregivers in case of emergencies. In addition, they increase the sense of security and diminish the fear of falling [342, 159], affecting positively not only the wellness of the person being monitored, but also their physiological and emotional conditions.

Privacy issues are critical in these applications since sensible data needs to be collected, stored and analyzed. Due to the risky nature of the situations that care applications are designed to control, accuracy is an important aspect. Lack of accuracy is hence among the most important risks aspects on care applications. Moreover, depending on the approach, the person who is being monitored can feel too much control over him/her in addition to privacy concerns, which may cause some discomfort. Wearing a body sensor or carrying a smartphone all the time increases the intrusiveness of such services.

Exergames, serious games, and training applications have also been explored and tested as means to keep older people mentally and physically active, although only with small user samples and during short periods of time [342, 45, 159]. In such preliminary studies, researchers noticed that these games decreased participants' fear of falling, and also improved their balance.

Care and prevention services, along with adherence to a treatment are the determinants most addressed by care applications. In contrast, a few of the care applications we have reviewed have an impact on other determinants including psychological factors, social support and risk of violence and abuse. When addressing psychological factors, the goal is either on facilitating family involvement on cognitive training [246] (which in turns increases social support) or on facilitating the task of remotely following and assisting daily life activities [161] of patients with cognitive disabilities. More evaluation, however, is needed to establish the effectiveness of these applications. As for the *risk of violence and abuse* determinant, the only solution in our review that can have an impact on this leverage on a mixed monitoring and alerting approach that uses a surveillance system that controls house entrances and alerts caregivers and family members in case of undesired visitors. In this context, an evaluation has found these type of systems are only accepted when their usefulness is clear. Moreover, spatial privacy (where the camera is placed) is less important than activity sensitivity (what is the activity that is being monitored). A camera in the door to provide security is then much more accepted than a one inside the house due to different nature of these different spaces [316].

An important note on applications for care is that they often fall in the borderline between care and prevention (especially, monitoring applications). When the main goal is to facilitate the provision of care in case of emergencies rather than preventing a particular situation from happening, we have categorized the system as a care application. Borderline issues also appear often with compensation, because the provision of care in itself can be seen as a way of compensating for a lack. However, we have generally applied the rule of classifying a system as compensation when the system does not involve a third person to provide some form of care.

Figure 2.6 presents this summary visually, showing the connections between AA determinants and types of applications with their aggregated characteristics according to our evaluation framework. The thickness of the lines represents how many applications of a type have an influence on the determinant to which they are connected. The boxes around the figure explain the general characteristics of applications for this particular goal of IT according to the dimensions of analysis we have introduced in our evaluation framework.

2.2.6 IT for Enhancement

Enhancement is about enriching the life of people by opening new opportunities for participation, health and security. The last group of contributions we describe in this paper fall under this category.

2.2.6.1 Applications for Enhancement

The first and foremost way in which IT enriches opportunities of life it is through ***social applications***. Some of these adopt a holistic approach, trying to enhance opportunities in many aspects of people's social life. Life2.0 [198] is an example of this, envisioning a web-based platform targeted at senior citizens and their local communities, where they can easily see who is around, what is happening and communicate with others in the community, improving their *social support*. The platform addresses also the *employment* determinant by allowing elderly to explore who can help with a task and also offer help or other services on their own. The iNeighbour TV [354] also addresses both these determinants by offering similar functionalities but with a user interface more familiar to seniors: their TV sets. NextDoor [258] and HomeElephant [186] are other similar community oriented social networking platforms (in this case
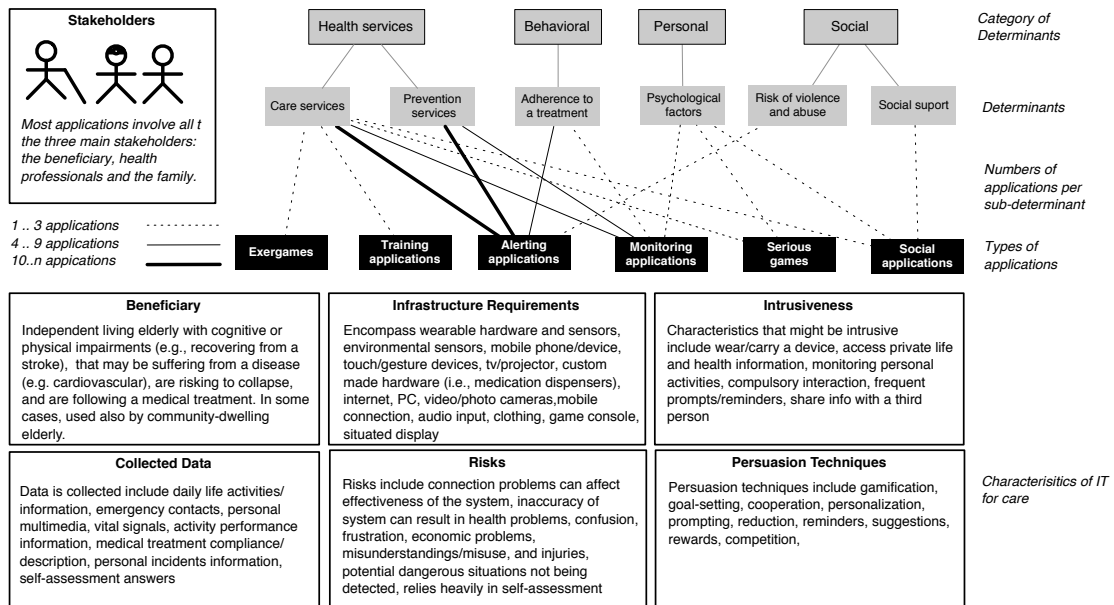
Figure 2.6: Typical characteristics of IT solutions for Care

focused on neighbourhoods), which are not specifically tailored for seniors but that can fit their needs and increase their *social support*. Not focused on local communities but also aiming at a broad range of social needs, the Silverline project [324] is developing a family of smartphone applications tailored for seniors like *Discover*, which will allow them to share their daily activities on the go; and *Inspire*, which delivers inspirational stories in text, picture and video formats on a daily basis with the goal of enhancing their subjective wellbeing.

Other social applications focused more strictly on enhancing social interactions, allowing elderly to share something of their interest (and hopefully of interest to others too), interact and communicate with others. NetCarity [217] addresses *social support* by facilitating social interactions with family and community through tabletop applications such as the *Social Window* and the *Public Square*. In the first, each member of the family is represented by a house, forming a virtual neighbourhood where, by tapping on a house, the senior can get status information and options of communication with that person. In the second, the user interface emulates the central square of a community, where people would physically meet, including news boards and containers for sharing digital media by dragging and dropping local media on the square. Other applications aim to enable novel ways of interacting for people who are away of each other. StoryVisit [293], for example, extends the experience of video-conferencing by allowing adults to read and tell a story book to younger children using a web application that synchronizes the story at both ends of the communication, displaying the text of the story on the screen of the reader, and text with pictures (like a real book) on the screen of the child listener. This allows elderly to stay connected with their family in a funny way, improving *social support* and *communication access*. Similar systems that are commercially available are *Playtell* [283], *Readeo* [296], and *A Story Before Bed* [191]. Remote social interaction for seniors has also been addressed through the means of simplifying traditional social networking services like facebook. FamilyRibbon [134], offering both tablet applications and web front ends to use a simplified user interface of facebook. Similarly, Phiriyapokanon [281] has proposed a

redesign of facebook with an emphasis on metaphors that are common knowledge to seniors, like a newspaper deployed on an iPad

Face-to-face socializing can also be improved with IT to address *social support*. SharePic [47] is a tabletop application that allows multiple users to share pictures and collaborate in their management or in the creation of other picture-based resources like postcards and collages, while they are together. Similarly, The Timecard [262] and the Shoebox [53] can enhance face-to-face interactions by triggering conversation when people are together, exploring old memories, which in turn can positively influence *psychological factors* like their self-esteem or coping styles (i.e., the conscious effort placed on solving difficult personal and interpersonal problems). These two applications allow elderly and their families to organize and explore life memories using a situated display embedded in artifacts that imitate familiar physical objects like the shoe boxes people used to put pictures in. The Timecard was particularly seen by users as a way to cope with loss of family members [262]. In the same line, Reminiscens [273][274] is a tablet application that stimulates storytelling of personal memories by displaying contextual multimedia around life stories. The goal is to motivate intergenerational face-to-face interaction to address *social support* and stimulate reminiscence to address *psychological factors*. The same goal is pursued by CIRCA [162], but with the focus placed on supporting reminiscence therapies for dementia patients. Although not for face-to-face interactions, other applications that also support reminiscence to address *psychological factors* and allow elderly to share their stories to address *social support* are the Project Greenwich [348] and the Book of Life by the european project SOCIABLE [329] The first offer a website for elderly to share their life stories while the second one is a tabletop application that emulates a book where each chapter corresponds to a different stage of life (e.g. infancy, adolescence, and adulthood). A final example worth of mention is MEMENTO [370], a system based on a physical interface, the ANOTO pen and paper, to allow seniors to write their stories in a physical paper while their writings are automatically digitalized. The final story is both digital and physical, enabling sharing via email or in face-to-face interactions.

The knowledge of elderly can be important also for collecting and preserving the collective memory of a community. For example, Memoro [146] is a mobile application to collect videos of elderly telling their stories and advises, automatically sharing the video on a public web site with the purpose of preserving their knowledge and wisdom, positively affecting their *psychological factors*. Also the PACE telementoring platform [57] leverages on the knowledge of seniors to help young people in learning languages or any other skill during a video conference call, which increases elderly *social support*. Similarly, wisdom/knowledge sharing websites like the Elders Wisdom Circle [377] and The Amazings [321] open new opportunities of *employment* to seniors that want to offer their counselling to others that might need it. In The Amazing, the sharing takes the form of online courses that cover a wide range of topics including, among many others, knitting, water color painting and gardening. The TimeCapsule [226] is a final example for this paragraph, addressing *social support* by offering a social networking service that allows seniors to digitalize old pictures, add location information and write stories about them so other people can later see and comment on these pictures when they pass by the place where the pictures were taken using a mobile application.

Also for enhancing the *social support* determinant, some social applications seek to improve participation of elderly in local community events. The Mirror Motive [316] aims to achieve this by detecting when the old person is near the mirror and then displaying general information about the local community, including invitations to social events that will take place nearby. A more subtle way of participation is by consuming information shared by friends and family, increasing their awareness of their lives. ePortrait [103] connects social networking services to a photoframe situated in the house of the old

32

person. Pictures posted by the family in a closed group of facebook are automatically downloaded to the photoframe. A similar system is proposed by Biemans and Dijk [58], which uses SIM-based photoframes where family and friends can send MMSs with pictures and text. Using a tablet instead of a photoframe, Rodríguez et al. [301] propose an "electronic newspaper through which elderly and their families share information, personal reminiscences and stories", interacting also in real time through a turn-by-turn memory cards game.

A second general way of enhancing life is by improving and increasing the means of communication, addressing the determinant of *communication access*. **Communication applications** fulfill this role, with some focused solely on improving, facilitating or increasing access to communication mediums. This dissertation exploratory work, What's Up, is also an example of this, facilitating intergenerational communication by providing a communication platform and a tablet application specifically designed for elderly to receive messages from their younger relatives and friends, who in turn use their smartphones [119]. The main goal of What's Up is simplicity, giving elderly a tool in which they do not need to do anything while messages will just arrive and appear on their tablets. An evaluation of What's Up based on *think aloud* protocols and questionnaires revealed that the older the user, the simpler the UI that is preferred, putting simplicity as one of the most important features. Other systems similar to What's Up with extended capabilities and commercially available are VideoCare [350] and ConnectMyFolks [189] In the same line, senior oriented smartphones and tablets are commercially available, most offering a simplified UI of smart mobile systems, oriented to users that engage with a touchscreen or a smartphone for the first time in their lives. Examples include the Fujitsu Stylistic S01 [150], Emporia [132] and Doro phones and tablets [122].

Other applications address the determinant *communication access* with tools to support person-to-place communication, which provides a communication link between the family that is constantly on the move and the older adult who is staying at home. The Epigraph [223] and the HomeNote [311] are two noticeable examples, by which people can send messages directly to a place (e.g. home) rather than a person. The first uses an special touchscreen display where elderly can select from a list of channels, each corresponding to one member of the family who can update the channel via email or SMS. The HomeNote is very similar, with the addition that it supports also local scribbling by using a stylus to write over the device, to leave notes that are meant to be read by anyone at home. Similarly, the Message Center [376] relies on a piece of paper for seniors to write messages which are automatically scanned by a special device and sent either via email, SMS or fax to a mobile phone, a PDA or a fax machine. The same device can also receive messages and print them. Other systems in this category are Wayve [221], Collage [357] and On Message @ Home [280]

Enhancement also addresses the determinant of *social support* with **monitoring applications** oriented to increase participation in the lives of family and friends by increasing awareness of their whereabouts. The Ambient Plant [316] is exemplary of this, with a system composed by two flower pots at different houses that detect when a person is nearby and and notifies about this to the remote side, where lights on the pot will be turn on to inform the person on that side about the presence in the other end. The goal of this system is to increase feelings of social connectedness by letting the elderly know when the family is at home. This simple awareness about family whereabouts has been pointed out as a way of supporting the peace of mind for extended family members (i.e., those living away) [302]. The Home Awareness prototype [228] has the same goal, only in this case the focus is set on a remote place, collecting information of that place's environment and reproducing it at local side. A special home device is installed at the receiving home to reproduce the remote environment's light, temperature (using a controlled fan) and sound (using skype), which, according to a field trial, can be translated in people

having a picture of the remote place constantly in their heads, triggering practical concerns (e.g., it is time to mow the lawn again) and giving them a feeling of satisfaction and connection. Another example in this line is the Digital Family Portrait [255] that uses a situated display to show daily life events of an elder in the form of icons around a portrait located at the house of the family. The Whereabouts Clock [310] does something similar, but displaying information about the family at the elder house. Using information of the GSM cell ids in family members cellphones, the system displays location information of each of them in a situated display that has the form of a clock with pictures of the family members moving around. Sellen et al. [310] evaluated the Whereabouts Clock and found that visual representations of family whereabouts increased the sense of community. A more recent commercial product in this line is Lively [252], which enables automatic activity-sharing between family members using special low cost sensors that are attached to everyday home objects like the fridge or medication containers. These sensors automatically sense when these objects are moved, and depending on those movements, infer what the activity is for later sharing with the family a summary of daily life patterns.

Exergames and serious games that are played with others to enhance social interactions can also serve to improve *social support*. There are basically two types of serious games in this domain: those that aim to enhance social interactions and exergames which serious purpose is to enrich physical activities of elderly. In the space of social interactions, Mahmud et al. [231] propose an inter-generational game, deployed in a tabletop device, where elderly and their grandchildren compete to find a princess in a maze. In the same line, Age Invaders [204] is an augmented reality game deployed on a special display integrated with the floor of the house. On top of it, elderly and their grandchildren play in teams following footprints and other that appear on the floor. Age Invaders is also an example of an exergame that helps to improve physical fitness by enriching physical activities of elderly.

Finally, one last way for enabling AA through enhancement is using ***eLearning applications*** to address *education* and *employment* determinants by allowing elderly to gain knowledge and skills that can help them to improve their *participation* in society. RefocusLab [297] and SeniorLearning [314] are two platforms of eLearning oriented to elderly. Both are based on the open source eLearning platform Moodle and are proposed by European Projects with the goal of training older adults in information communication technology (ICT).

2.2.6.2 Discussion

Enhancement applications improve or open new opportunities for *socializing*, *communication* and both *contribution* to and *participation* in society. In particular, IT has greatly contributed to enrich opportunities of the ageing population in terms of social support and communication access, connecting them better to family, community and professional caregivers and benefiting almost in equal measure independent living, community-dwelling and elderly living under formal care in assisted living facilities. Our review presents a prevalence of social and communication applications above the other types of applications. Interestingly, also monitoring applications have an impact on *social support* by facilitating constant awareness about family and friends' whereabouts. While privacy is not at concern if the applications are perceived as useful, there is a need to support ON, OFF and PAUSE for monitoring [316].

Most of the contributions we have reviewed involve the end beneficiary and the family. To a lesser extend, health professionals are sometimes involved as well. Usually, they demand constant or too frequent interaction through prompts or reminders, which is an aspect that needs to be designed with

care not to become intrusive. In the same measure, data collected by enhancement applications very often include personal information and social contacts, which is also an aspect to design carefully not to become a barrier for adoption.

Because of the prevalence of social and communication applications, the most common determinants that are addressed by enhancement applications are *communication access* and *social support*. Since many of these applications have an strong emotional impact, *psychological factors* can also be influenced by enhancement. The risk, however, is that these system could also have unexpected negative effects on people's emotions. For example, when elderly is put in contact with their personal life and memories, we have observed in our practice that some perceive this as a reminder of their age, while at the same time others find it rewarding and joyful. The emotional impact of the application is thereby and important variable to control when building enhancement systems.

On the other hand, few contributions we have analyzed explored the dimension of keeping elderly in their work to address the *employment* determinant. These contributions are mainly focused in allowing older adults to share their knowledge, experience or wisdom for the benefit of younger people or peers. Building systems that can help seniors to keep contributing to society, is an area that still holds many opportunities for innovation. Crowdsourcing could be an area to explore for this. Mutual help systems also hold some potential while raising some concerns about who administer the offering of help to assure that the seniors are not abused [198]. There is also much to do yet in the space of *education*, to keep seniors active in learning new skills that can open opportunities for employment or simply interaction for them.

Another interesting thing to notice is that very few of the enhancement applications exploited persuasion techniques in order to increase social interactions and communication. This means that there is an open space for exploration of persuasive technologies that are specifically designed to motivate social interactions.

One aspect that is emphasized by most enhancement applications is simplicity. This emphasis might explain why most applications for enhancement rely on touch or gesture devices, like tablets and smartphones, as means of interaction with the older adult, showing a clear trend towards natural or direct manipulation interfaces, which are usually considered as easier for users that do not have much experience with technology. Also because of this emphasis on simplicity, many social applications operate with the intuition that current popular social networking services are too complex for older adults, considering that the features of social services should be described in no more than 6 sentences [281]. In contrast to this, statistics show that senior users of social media continue to increase year after year [384], with one third of the Internet users aged 65 or more using social networking sites. After age 75, however, the Internet use drops significantly.

In summary, enhancement applications, along with care, are the most rich in terms of diversity of features that are used by individual applications, informing about general aspects of life and mediating communication and interaction being the most common features. Much of the work on enhancement address the emotional dimension of increasing the feeling of connectedness by providing awareness about our family or friends whereabouts or enhancing the person's self-esteem by giving some purpose to his or her life. This makes it extremely difficult to evaluate what is the actual impact of these technologies on people's wellbeing, resulting on a lack of strong evaluations in the form of randomized controlled experiments.

Figure 2.7 represents this summary visually, illustrating the relationship between AA determinants and types of applications. The thickness of the lines represents how many applications of a type have an influence on the determinant to which they are connected. The boxes around the figure explain the general
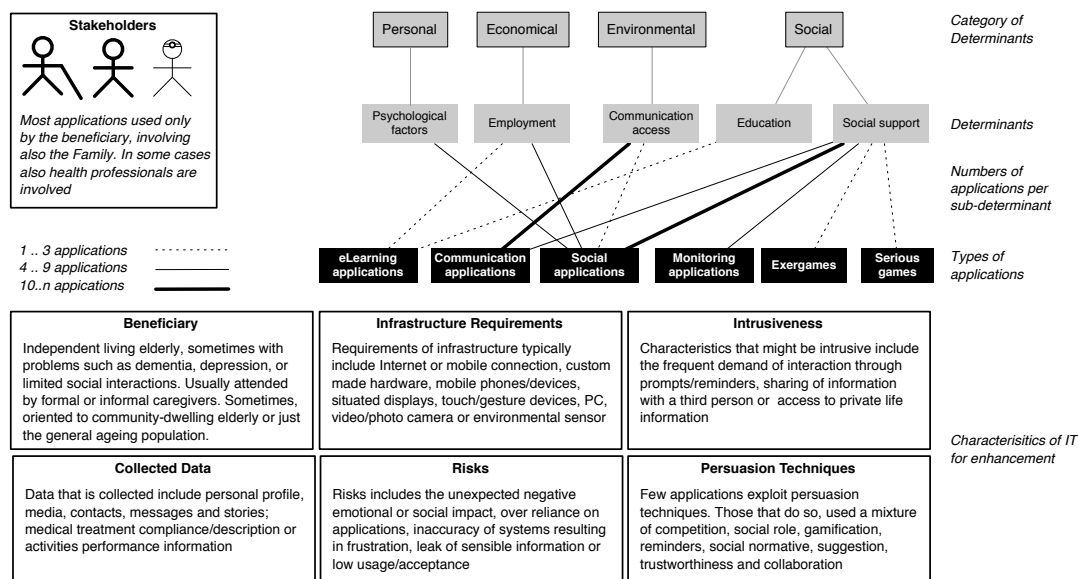
Figure 2.7: Typical characteristics of IT solutions for Enhancement

characteristics of applications for this particular goal of IT according to the dimensions of analysis we have introduced in our evaluation framework.

2.3 Challenges of Software Design for Elderly

In this chapter, we have described and discussed about examples of information technologies that can enable AA by influencing its determinants. Sometimes, these technologies are aimed not to the final beneficiary, but his or her caregivers. Other times the main beneficiary is the one who interacts directly with the system. An important aspect for the later scenario has to do with how technology and interactions with technology are designed to ensure its effective use and application. Although there is a large variability of design considerations to take into account, we summarize the most common ones in this section.

First, to cope with age related **physical impairments**, a solution may come from the interface device used to interact with technology. For example, impairments that are associated with manual dexterity make it harder for elderly to perform tiny movements with the mouse or a touch pad [305]. For this reason, touch screens have been shown to be better suited in reducing usage barriers and avoid frustration [208]. Touch screens, and in general direct manipulation interfaces, might increase user satisfaction, reduce anxiety of using computers, are easier to use and increase speed of tasks completion [281]. Multi touch gestures, however, might increase difficulty and must be carefully designed [341]. Moreover, most touch screens are capacitive, i.e. they react to electrical charges in our fingers, which is in turn affected by blood circulation. Because of age-related decrease in blood circulation, it might also be the case that some touch devices require better sensitivity [247].

Second, to cope with **sensory impairments**, the considerations are often related to the visual user interfaces. Sensory impairments interfere in the way elderly people hear, see, and touch things. To cope

with vision problems dark backgrounds should be avoided as well as small fonts, similar text and background colors, complex font styles, and distracting colors or pattern backgrounds. Because of lesser contrast sensitivity, the use of complementary colors (i.e. colors in opposite sites of a color wheel) is recommended. Large, easy to read text, with high contrast is another common recommendation, which goes along with limiting the amount of information on screen, both of which can improve visual search efficiency and attention. Regarding hearing impairments, high frequency sounds should be avoided for alarms and alerts, since elderly cannot properly hear them. Because of the reduction of spatial acuity of light touch, small buttons, links, and keyboards, as well as a short distance between navigation buttons, are discouraged.

Third, to cope with **cognitive decline** usually implies careful design of user interfaces in ways that reduce complexity. Keeping simple grammar structure, avoiding implicit text and messages, and technical expressions are ways to achieve this. In addition, the information should be presented slowly, so that the old person has enough time to read and process. Older people with and without previous computer experience placed much more importance to words than icons in their everyday interactions with the web [305].

Clear structure of tasks and consistency of information are additional important requirements to reduce complexity and cognitive load. Key function unity (i.e. one key one function), page function unity (i.e. one page one function), the use of wizards for complex tasks, coloring and labeling information, navigation bars or menus and consistency of user interfaces across software versions are some guidelines to achieve this [281]. The need for quick answers and reactions from the user should be avoided; on the other hand the feedback from the system must be rapid, continuous and distinct to help the users in understanding where they are.

The learning process is also part of interacting with technology. This process has to be adapted to elderly individuals, allowing enough time to memorize and process all new information. It is important to offer context information about the learning subject in order to cope with memory loss. Constantly available instructions written in a non-technical language are highly recommended.

The many challenges we are faced with while ageing can negatively affect our motivation to engage in positive lifestyle behaviors and that will result in a more active life. Motivation has, therefore, become an important design aspect to take into account when designing IT for AA. An novel concept in this line is that of persuasive technology [143], which refers to the design of technology which goal is to drive people into adopting positive behaviours by the means of IT-mediated persuasion strategies or techniques that are bundled inside IT applications and services.

2.4 Summary and Outlook

In this chapter, we reviewed the different interpretations of Active Ageing (AA) according to the existing literature and showed its evolution over time. We discussed how Information Technology (IT) can serve not only to mitigate some of the negative side effects of ageing (e.g., physical and cognitive decline) but also how it can serve to give raise to new opportunities (e.g., by enhancing capabilities). We proposed a conceptual framework that brings together the two different perspectives and correlates the determinants that affect quality of life during the ageing process with the type of support IT can provide to modulate these determinants. We used the framework to systematically review exemplary IT services and applications that explicitly provide support for AA, an exercise that allowed us both to appreciate

the extraordinary value IT may bring to older adults and, at the same time, to identify a set of challenges and opportunities.

We summarize these latter as follows, grouped by the four gerontechnology goals that accompanied us throughout this chapter:

- *Prevention*. Modern, IT-assisted prevention aims to promote lifestyle changes early in the life of a person. This is particularly visible in *training applications* and in many of the *serious games* and *exergames* reviewed in the paper. The increasing inclusion of specifically targeted *persuasion strategies*, aiming to increase effectiveness, into games and applications is particularly noteworthy in this context. Although the application of games to enable active ageing – but also to brake social isolation – is just in its beginnings, the number of IT applications in the serious games and exergames categories is already considerable. We read as an indication that the transformation of older adults into active, playful older adults is already ongoing. The question is whether this trend can be sustained with the availability of novel technologies only or whether there is something else that needs to happen for seniors to become more playful. A better evaluation of this aspect is needed to understand both the dynamics and, possibly, how to improve technologies. Partly, this is part of our own future work, e.g., in the context of the *ActiveLifestyle* [323] and *The Virtual SocialGym* research project (http://socialgym.org/)which both aim to enable and motivate older adults to stay physically fit and heavily leverage on suitable persuasion strategies.

- *Compensation*. Most of the identified IT solutions for compensation are oriented toward compensating the symptoms of *cognitive decline*, such as the loss of memory. This result is somewhat physiologic, in that we focused on software solutions and commodity devices for personal use. Especially for compensation, we however note an increasing integration of *custom hardware* with *dedicated software* and services. On the one hand, hardware is more and more carefully crafted in the form of wearable devices and sensors that are more powerful, more precise and less invasive and that keep the level of additional stress low. On the other hand, we have seen that compensation applications are most effective if they are integrated into the living environment of older adults and which is designed for and aware of their limits and capabilities. In this respect, we expect to see a better integration of applications, devices and domotics in the near future. If we widen our focus a bit, we can see a trend toward bionics and robotics for compensation, which will enhance the human body with artificial extensions and improvements. The challenge here is understanding how to bring together the IT and these novel technologies.

- *Care*. From an economical perspective, economical restraints will force us to translational and clinical research towards *personalized medicine* (diagnostics and treatment), thereby steering efficient therapy for AA, e.g., with companion diagnostics and increasing cost effectiveness. This demands academy and industry to provide completely novel tools and possibilities for innovation and potential commercialization within life science in close collaboration between health care, academy, and industry, focusing on individual needs. IT has allowed tremendous improvements and spreading of promising telemedicine applications, but, despite the technical maturity, telemedicine services for AA are still limited and the market remains highly fragmented. Telemedicine is a tool that should be integrated as much as possible into the usual practice of future public healthcare, however, the integration of telemedicine service in healthcare systems is still an open challenge. Home (re)habilitation is becoming one of the most appealing applications of telemedicine. The increasing share of the elderly population and the related expected increase in health care costs, are a strong incentive to search for new ways to assist AA for individuals at home,

e.g., via dedicated technologies. For instance, we have reviewed several care applications, where monitoring and alerting capabilities are increasingly used in a home or informal environment to enrich the quality of health services.

- *Enhancement*. An interesting aspect we have noticed throughout our review is that the merger of physical assistive technology with information and communication technologies does not only bring an increasingly wide range of innovative services to prevention, compensation and care, but it also connects people with older adults and keeps them engaged in community activities. Social applications are spreading among older adults and increasingly connect them with friends and their family/community circles. There is also an emerging thread of emotions-oriented social applications, whose main purpose is to enhance peoples subjective wellbeing. An aspect we have seen is not yet well developed, is education or work for older adults. We expect the advent of MOOCs (Massive Open Online Courses) [227] as well as the crowdsourcing of work (e.g., via crowdsourcing platforms specifically tailored to elderly) to play a major role in this respect in the near future. Our future work in this space is represented by the *Reminiscens* project [273, 274, 275] , which brings together older adults as narrators and young volunteers as listeners in storytelling sessions where a tablet application is used to facilitate the preservation of their memories while stimulating interaction with contextual multimedia and questions.

While in the beginning of IT for AA the focus was mostly concentrated on usability and user experience (in Section 2.3 we summarize the most important lessons learned), today the landscape if IT for AA is much more varied, open and rich of opportunities. Much has been achieved in terms of interface design and ease of use of technologies for older adults, but today the focus has noticeably shifted toward new services, applications and devices that can be offered to prevent, compensate, care and enhance and to make one's life better - independently of age. Beyond any doubt, the role that IT played so far in enabling this transition was crucial, and its potential and contributions are far from over.

2.5 Exploratory work: AllenaVita

An important part of the research approach for this dissertation relies on learning by doing. That is, to step into an exploration mode and build something that would push us to improve our understanding of the topic even further than what we would have by simply relying on literature. Each of the introductory state of the art chapters include thereby a section about one or more exploratory works that were undertaken with the goal of learning more about the topic in that section (or part of it).

One of such exploratory works is the result of a collaboration with a research center devoted to the design, implementation and support of technologies for healthcare[13] based on the Trentino Region. The research collaboration is part of the ***ERMES (Empowered Remote Medical Service)*** research project, which aims at developing a territorial telemedicine model focused principally on reducing the risks of cardiovascular incidents on the region population, both old and young, but specially older adults. Such territorial model should also empower people to take control of their own health and lifestyle, increasing self-awareness about the status of their health while maintaining high levels of independence in their lives. For achieving these goals, we proposed to co-design, along with doctors, nurses and some representative patients, a life coach platform named *AllenaVita*.

AllenaVita is currently ongoing and entering an implementation phase. In this section, we present the

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[13]http://www.cr-gpi.it/

design of AllenaVita and some of the main lessons we got from its evolution so far. Prototypes discussed in this section are fully in italian because they were designed for italian-only speakers. The content presented here is a summary of extended technical reports from the **ERMES** project [109] and has already been presented in medical domain conferences with a high acceptance from the medical community [93][92] . The backend infrastructure and the framework for implementing the mobile application are also subjects of a more technical publication [279], while the front-end mobile application and persuasive strategies of the life coach are the subject of a demo publication [276].

2.5.1 Scenario and goals of the project

The motivation for AllenaVita comes from an ongoing trend towards the empowerment of individuals for gaining more awareness and control in the improvement of their own health and lifestyles. This trend encompasses the goals of progressing towards and active ageing with those of having a greater role in the decisions about our personal healthcare, understanding clearly what our responsibilities are [213].

This trend is promoted by the Health Ministry in Italy [14], with an emphasis on new socio-technical models for sustaining innovative forms of home based healthcare.

Telemedicine, especially the remote monitoring of vital signs, can help improve the quality of care health and reduce the occurrence of complications in people at risk for or with chronic conditions. Several studies have already demonstrated the clinical validity of the remote monitoring of blood pressure, mainly because it brings greater therapy compliance of patients [265] and helps to reduce healthcare costs. The most recent applications of telemedicine are now accessible, yet many monitoring services are often temporary, with no prospect of use structured and integrated healthcare network . In this scenario, the ERMES project is born with following goals:

- To propose and build an innovative model of healthcare for hypertensive patients that can effectively reduce their cardiovascular risk through lifestyle improvement;

- Design and implement information technologies to support the aforementioned model;

- Evaluate the efficacy and sustainability of both the designed technologies and the the economic sustainability of the proposed model.

2.5.2 Proposed Solution: the lifecoach

With ERMES' goals in mind, our proposal was to opt for a model where both healthcare monitoring could be clearly linked to lifestyle improvement activities (i.e., improving nutrition, increasing physical activities, etc.), so as to motivate both patient therapy compliance and lifestyle improvement. AllenaVita is the resulting design for part of the project's technological support

As evidenced in this chapter, enabling both care and prevention for an active ageing relies highly upon monitoring alerting applications, with an emergence of applications that include persuasive strategies by design, with the goal of motivating positive behaviours. The concept of *persuasive technology* [143] uses persuasion and social influence to drive change of behaviour in people. Behaviour, as defined by Fogg, is the product of motivation, ability and triggers [142]. People will engage in a positive lifestyle behaviour if they are motivated, have the ability and are triggered to do so. In AllenaVita, persuasion is achieved

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[14] `http://www.salute.gov.it/eHealth/paginaInternaEHealth.jsp?id=2515&lingua=italiano&menu=telemedicina`, last retrieved in April 2013
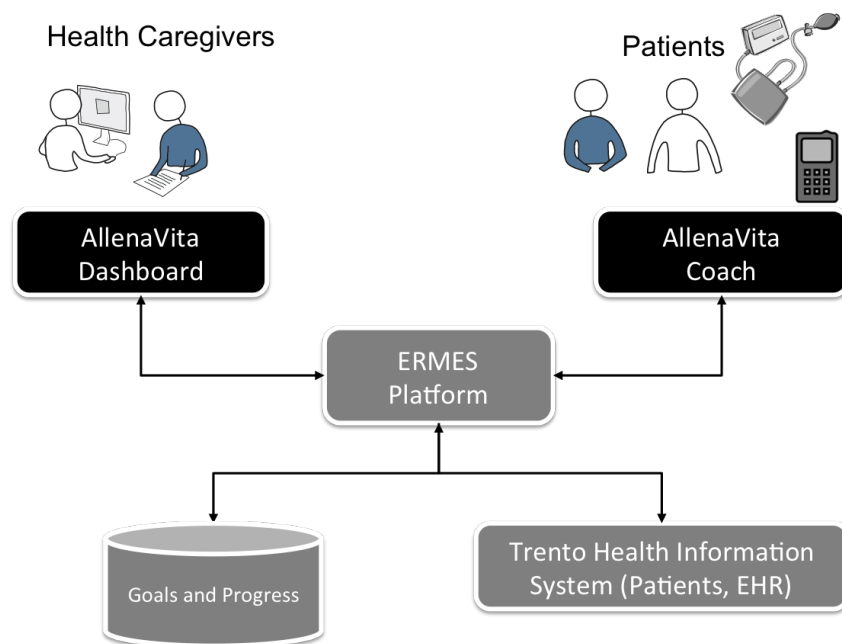
Figure 2.8: The ERMES Project Platform, with AllenaVita as Front-end

through the means of a smartphone that the patient uses for both keeping track of his vital measures (e.g., blood pressure, level of sugar in bloodstream, weights, etc.) and for learning what to do in order to improve his/her lifestyle (e.g., walking 30 minutes daily, avoiding some particular foods, etc.). The persuasive strategy of AllenaVita is that of constantly raising awareness by facilitating self-monitoring and by using reminders about ones own health status and what to do to improve.

Figure 2.8 shows the main components of the ERMES platform, with the AllenaVita as the front-end. On one side **AllenaVita Dashboard** is a web application built for health professional caregivers (doctors and nurses), who will use it to register patients from the **Provincial Health Information System** into the program, gathering information about their overall risk of developing a cardiovascular risk, which decrease is the main objective of the program. The stratification of patients will serve to build profiles of care, through the health parameters monitor (blood pressure, BMI, blood glucose, lipid profile). AllenaVita will allow the nurse to observe the evolution of the different health measures while the physician, according to the risk of the patient, will be able to schedule a therapy (i.e., health parameter measurements calendar, medicine to take, etc.), set some lifestyle goals to achieve and select some activities to suggest to the patient so as to achieve the goals. The nurse periodically monitor parameters to assess the compliance of the patient with respect to the therapies and suggested activities. Figures 2.9 to Figures 2.13 show the prototype of the AllenaVita Dashboard. On the other side of the system, patients will use **AllenaVita Coach**, a smartphone (in the future also tablet) application for registering health parameters, reminding about lifestyle improvement activities and dates related to specific therapies and receive direct feedback from doctors about the progress. AllenaVita will favour a direct feedback from healthcare professionals to maintain high motivation and will have a system of positive reinforcement in the visualization of the results. Figures 2.14a to Figure 2.15b show and explain the different screens of the initial AllenaVita Coach prototype.

In the first version of the prototype, two different strategies were in place to support patient's self-
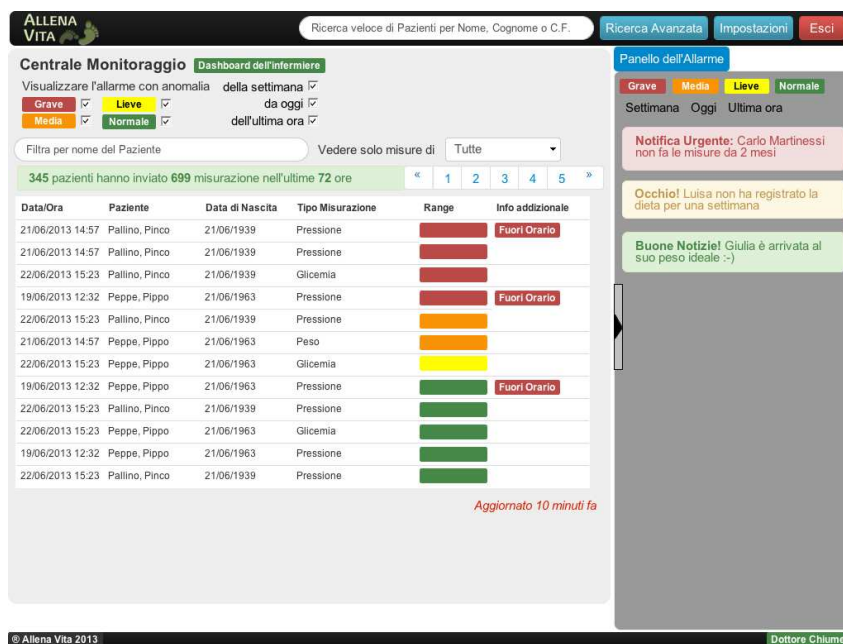
Figure 2.9: **AllenaVita Dashboard.** The home screen, with the upcoming list of health parameters values from patients, ordered by their level of alert

monitoring. The first strategy consisted in providing a daily list of activities to follow rendered as a list of reminders in the application's main screen (the *allenatore approach*, Figure 2.14a). The user would then click on some of them to act in consequence. For example, if a suggested activity was to register blood pressure, the user would then access a step-by-step wizard that would guide him through the process or registering this health measure, either manually or using an enabled device which can transmit the measurement automatically via bluetooth (Figures 2.14b, 2.14c, 2.15a and 2.15b).

The second strategy relied on the patient's self discipline by simply providing a diary view with buttons to access the different categories of health/lifestyle activities registration (the *diario approach*, Figure 2.16a). In this way, users would have their agenda completely under control, registering their information when they best preferred. For example if the user decide to register information about a physical activity, it would then access the appropriate category to see the list of goals and suggested activities (Figure 2.16b), and from there on access the specific activity to register (Figure 2.16c).

AllenaVita coach would also provide feedback on the progress towards the achievement of the goals, as an additional layer of persuasion (Figures 2.17a, 2.17b, 2.17c and 2.17d). The initial version of the progress feedback screens relies mainly on a simple quantitative approach of informing users about how many days they have succeeded in following the list of suggested activities (green is fully compliant, yellow is almost, red is not compliant, gray is no registration available) with additional information when available (i.e., number of steps walked by day). Part of the progress is also to access the history of health measurements including with feedback about the different alert ranges in which the measurements fall in (Figures 2.17e and 2.17f).

Finally, the lifecoach is also designed for users' to receive messages from doctors containing feedback on their progress or call to actions when high risk alarms are raised (Figures 2.18a and 2.18b).
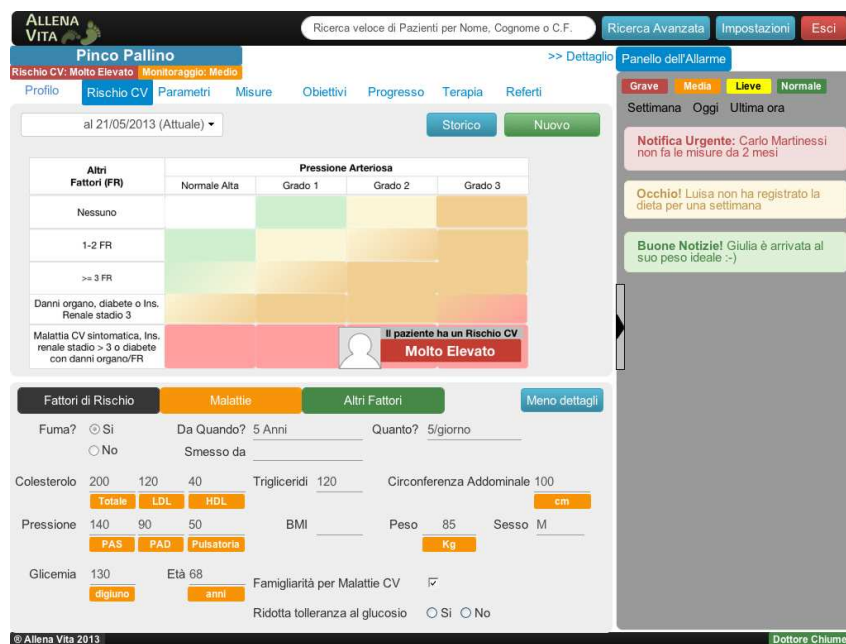
Figure 2.10: **AllenaVita Dashboard.** Risk Assessment screen, where doctors and nurse classify patients according to their risk for developing a cardiovascular disease, and monitor their evolution

2.5.3 Participatory Design with SERMEDA

During the whole length of this dissertation, we have followed a participatory approach to both research and design, which for AllenaVita was translated into a weekly involvement of all or part of the interested stakeholders in co-design meetings where we have iteratively validated AllenaVita's design proposals for the front-ends and ERMES' model of territorial telemedicine. Semi-functional prototypes where introduced in each meeting to have live test demonstration of the desired features and guide the discussions.

A limitation of our co-design meetings, however, has been the little participation of potential patients due their non availability for the project. We could only organized one co-design meeting with patients. The rest of the process was developed with the participation of health caregivers representatives of the SERMEDA cooperative[15]. To address this limitation, a focus group with potential patients was organized in which they tested the semi-functional prototypes and discussed its potential applicability in their lives.

2.5.4 Lessons Learned

For a first feedback from future older adults users, a focus group was organized with 4 potential users of the life coach application (66 years old average, 3 men, 1 woman). In pairs, we asked them to test a wireframe prototype of the future life coach so as to them having an idea of what the user experience would be like. After a brief testing, a discussion followed around the following the questions detailed below. In this section we summarized the most important observations resulting from this focus group.

- Is it hard to use the life coach approach for monitoring one owns health and lifestyle? How do you feel about this experience? How much time would you dedicate to using the coach every day?

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[15]SERMEDA (Servizi Medici Assistenziali) cooperative: http://www.sermeda.it/it/
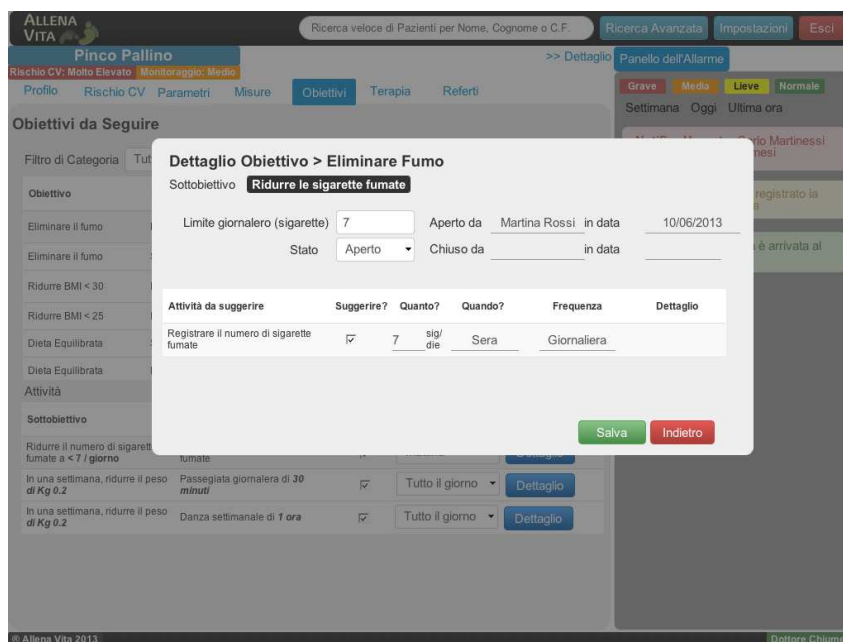
Figure 2.11: **AllenaVita Dashboard.** Goals and Activities screen, where doctors can set lifestyle goals and activities to suggest to patients based so as to achieve the goals

- How do you feel knowing that a doctor or a nurse will be constantly informed and visualize your inputs in the coach? How do you feel about getting messages from them regarding your health and lifestyle?
- What approach to self-monitoring do you consider easier, the daily reminders approach or the registration diary?

In general, the lifecoach was seen as *easy and intuitive* to use. The two most important problems were the difficulties steaming from the little size of the device and the use of medical nomenclature that is not recognizable by patients.

For the size, the decision to develop a smartphone-only prototype as a first approach were linked to the project non-functional limitations. A tablet would probably be preferred, but more expensive and less mobile (i.e., automatically counting steps would be more difficult). A solution for the size problem might also come from the use of a electronic pen, which participants mentioned "they know well how to use". The fact that this was suggested by them it is also an indication of the high level of knowledge with respect to technologies our participants had.

As for nomenclature, this is a direct result of the little involvement of potential patients during the co-design process and it is easily solvable by investigating and understanding well what is the language used in this domain from a patient perspective. There is clearly a mismatch between patient's understanding of lifestyle and health concepts with respect to doctors way of categorizing these ideas. For example, during our co-design meetings, doctors were happy in having the weight reduction goals directly linked to physical activities, while nutrition goals were completely separated. Participants of the focus groups pointed out that from their perspective, nutrition can actually be more important for weigh reduction than physical exercise.
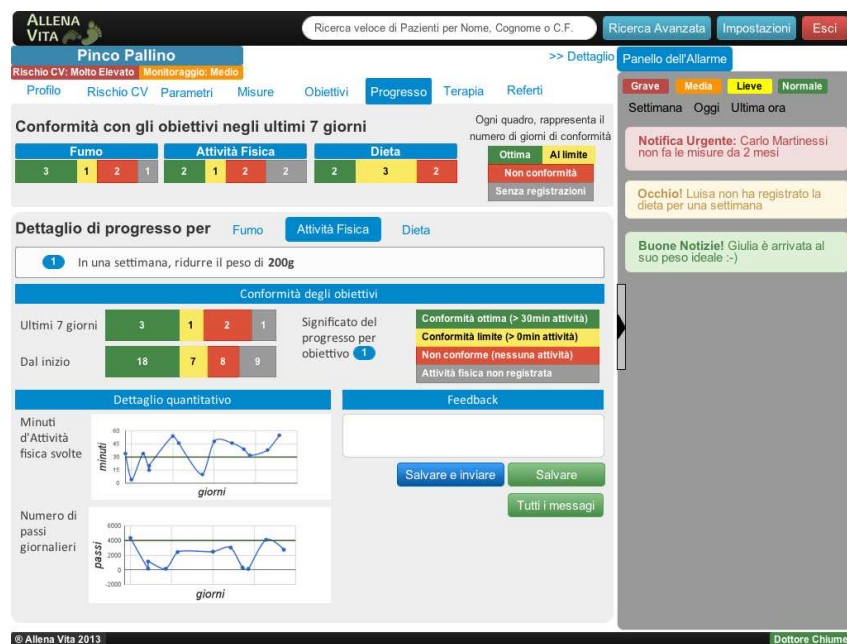
Figure 2.12: **AllenaVita Dashboard.** Progress monitoring screen, where doctors can track the progress of patients in achieving their lifestyle goals

As for the experience itself, all participants mentioned a high interest in participating of a self-monitoring program, supported by AllenaVita, stating that they would not mind devoting 30 minutes to 60 minutes every day to using the application. They are aware of how important it is to improve their lifestyles and difficult it is to be constant on this. "We know what to do, but even so, we do no do it. Maybe this tool would push us to do it". This expression summarizes both their need for having more support in their lifestyle changing endeavours and their hope that tools like these might come handy. All participants of the focus group mentioned to be highly interesting and expecting the program to be officially opened to be part of the experimentation.

Other minor usability problems were related to the lack of a better representation of the measured values meaning before they are sent (i.e., show ranges directly after measurements), some confusions between the terms "Allenatore" and the name "AllenaVita" ("aren't they the same thing?") and from the prototype daily activities example having more than one task of the same type but slightly different ("why are they two of the same things to do?")

When asked about how they feel of doctors and nurses being aware of their progress, there were some mixed feelings. While they all mentioned that this would be a reassuring experience, a general anxiety was noted about the possibility of underachieving their goals and making somewhat public. This can potentially become a non-positive pressure on them, which must be alleviated in future versions of the system. On the other hand, they said that "doctors know anyway" about their lack of compliance. A need for having an "emergency" button was also discussed as a potential way of improving their security. Getting some form of feedback from the doctors as soon as possible seems to be the key for them to comply.

As for the approaches to self-monitoring, while we thought that both *allenatore* and *diary* approaches would enable distinctive experiences of life coaching, they were complementary from their point of
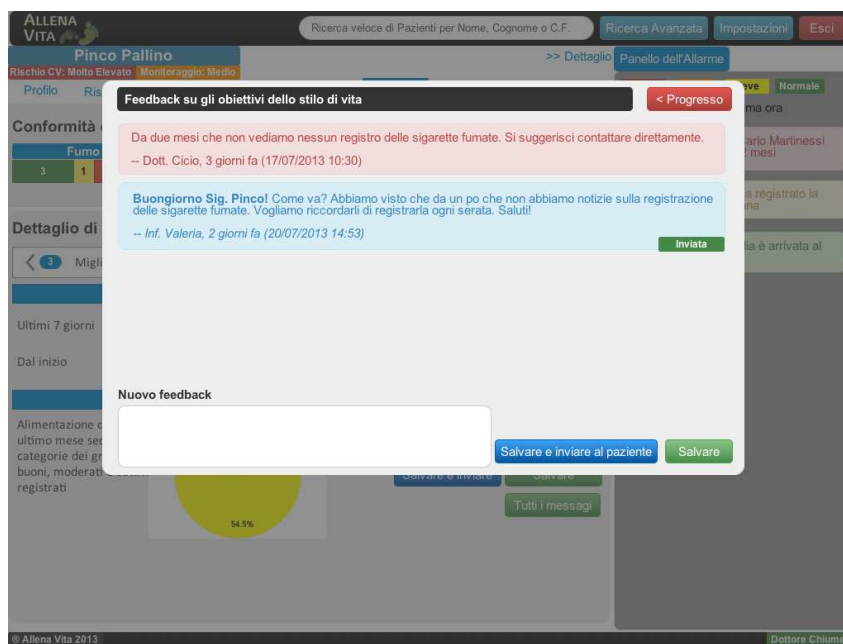
Figure 2.13: **AllenaVita Dashboard.** Feedback screen, where doctors can send direct feedback to patients

view. They could see themselves using some times one and some times the other. This, however, must be validated in a real longitudinal experimentation of the system.

As key take away for this dissertation purposes, the focus group and the discussions in the co-design meetings made very clear that when health is involved, more interaction and feedback from doctors, including real-time interaction, are considered to be key in improving patients compliance in following treatments. We believe the same could hold for improving lifestyles.

Figure 2.14: **AllenaVita Coach.** (a) the *allenatore (trainer) approach* with the list of daily activities to follow, rendered as reminders in the main screen of the application; (b) blood pressure registration first step, the user can choose to do it manually or to obtain the measurement from an enabled measurement device; (c) blood pressure registration while the measurement is being taken

Figure 2.15: **AllenaVita Coach.** (a) blood pressure registration finalized; (b) blood pressure registration final additional details before sending the information
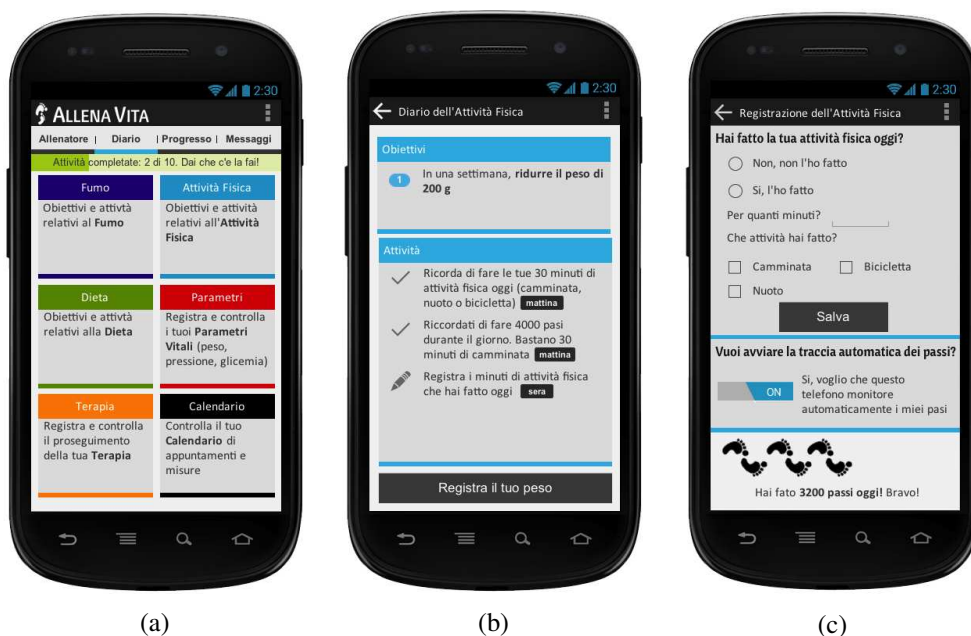
Figure 2.16: **AllenaVita Coach.** (a) the *diario (diary) approach* with all the self-monitoring categories for registering both health measures and lifestyle activities; (b) physical activities category, describing goals and activities the patient can follow to achieve the goals; (c) registering a lifestyle activity (daily walk)

Figure 2.17: **AllenaVita Coach.** Progress screens. (a) progress on the physical activities category; (b) progress on the nutrition category, progress is shown for one goal at a time; (c) progress on the nutrition category, in this case for the second goal on nutrition; (d) progress on the category of reducing smoke; (e) the history of blood pressure measurements; (f) details of single blood pressure measurements.

Figure 2.18: **AllenaVita Coach.** Feedback Screens. (a) list of the most recent messages received from caregivers, including the list of caregivers following the user; (b) list of all the messages received from caregivers.

3

Review on IT for Socializing

Within the problem space of Active Ageing (AA), the focus of this dissertation is primarily set on its **social dimension** and how IT can improve opportunities for older adults within that space. The goal of this chapter is, therefore, to present a theoretical background surrounding socializing in general, and the challenges of social inclusion for older adults, followed by a brief review on how information technology currently addresses this aspect. Together, the theoretical and technology-driven overviews presented in this chapter serve as an answer to the second part of this dissertation *general research questions* (see GRQ2.1 and GRQ2.2 in section 1.1). We close the chapter by presenting *What's Up* [119] and *Global EngAge*, two exploratory works of our own that fall within the goals of enabling social interaction for older adults. Both these explorations contributed with important insights and learnings to the ideation and development of the core work of the project.

This review on socializing and IT is a middle-ground connector between the big picture of this dissertation *(Active Ageing)* and the more specific domain that form its core (*Social Reminiscence*). The former can be enabled through more and better opportunities of socializing, and the latter can serve as the bridge for intergenerational social interactions.

3.1 Theoretical Background

The focus of this dissertation on the social dimension stems not so much from an interest on studying socializing *per se*, but rather from the realization of *its importance for human happiness and well-being*, which are, ultimately, the aspects of ageing we seek improve. Given this motivation, the theoretical overview that follows starts first by offering a brief overview about happiness and well-being, followed by a review on theory that explains how social relationships are connected to these concepts. After establishing the importance of the social dimension from the perspective of our happiness and well-being, we further our scope to the realities of the ageing population by presenting a review about on the problem of social inclusion of older adults.

3.1.1 What makes us happy?

Despite the lack of consensus about the definition of happiness, it is usually described as a measure of *Subjective Well-being* (SWB)[121, 120]; subjective because people evaluate themselves the degree to which they experience a sense of wellness [115]. The overlap between the concept of happiness and well-being is noticeable in the large corpus of research of the Journal of Happiness Studies[1]. Following this trend and taking well-being and happiness as equivalent, we found that well-being is further classified in two general types: **Global WB**, which assesses an overall judgement of one's life, including one's aspirations, achievements, and current circumstances; and **Hedonic WB**, which captures affective components of well-being, such as the experience of of feeling happy or stressed [197].

Recently, however, some authors have started to argue that happiness can no longer be used as a equivalent or substitute for well-being because it applies to too many different things and should be considered as a connected experience that is beneficial for human well-being [294]. These more recent insights ascribe to another approach for happiness research that focuses on defining happiness as the experience of "living life in a full and deeply satisfying way". This is also known as the *eudaimonic tradition*, which diverges from the *hedonic tradition* that is more focused on the fulfillment of pleasure [115]. From the eudaimonic point of view, people reporting being happy do not necessarily mean that they are psychologically well.

Beyond the definition, understanding what makes us happy is equally complex. Attempts to answer this question usually take a long time[2] and extensive research. Still, there are some generally accepted results on what are the key aspect of our happiness. *Money*, for example, has been found to be related to happiness but only until basic needs are met [121, 382], and *close relationships* (support of family, friends and community), a meaningful *role in life*, and basic *freedoms* are considered to be much more important [211]. Too much "consumption" following high income can actually be harmful [200] and some longitudinal surveys place the economical bar of money affecting happiness in a level of income of 60.000$/year. After this level, there seems to be a remarkable flat line showing that money no longer is a factor [3]. This amount is for the USA and should be normalized to the specific economical context of each country if we want to know the equivalent amounts.

Other factors that have been investigated looking for a link to happiness are status or career (well-paid professionals tend to have higher levels of stress) [128], work (higher levels of "flow", otherwise known as a positive and pleasant state of mind while at work) [107] and even sex (having a bath was better to improve mood in one study) [360]. However, none of these studies can be considered as absolute, showing how answering this question does not lead to a single answer.

Other authors in this area provide a different perspective of the topic and instead of trying to find what produces happiness, focus on analyzing the effects of happiness in the life of people who consider themselves happy. Some recent studies have shown how increased well-being can lead to longer and healthier lives [335, 91] and even to societal progress [339]. Happiness has been found to be positively associated with lower cortisol output, inflammatory responses and heart rate variability [286] [336].

When investigating how happiness changes as we grow old, a notable finding is that, as opposed to what we could intuitively expect, older people report higher levels of happiness [340]. This so called *U-Bend*

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[1] http://link.springer.com/journal/10902

[2] See Dr. George Vaillant's 68 years longitudinal study about happiness at Harvard http://www.theatlantic.com/magazine/archive/2009/06/what-makes-us-happy/7439/

[3] http://www.ted.com/talks/daniel_kahneman_the_riddle_of_experience_vs_memory.html
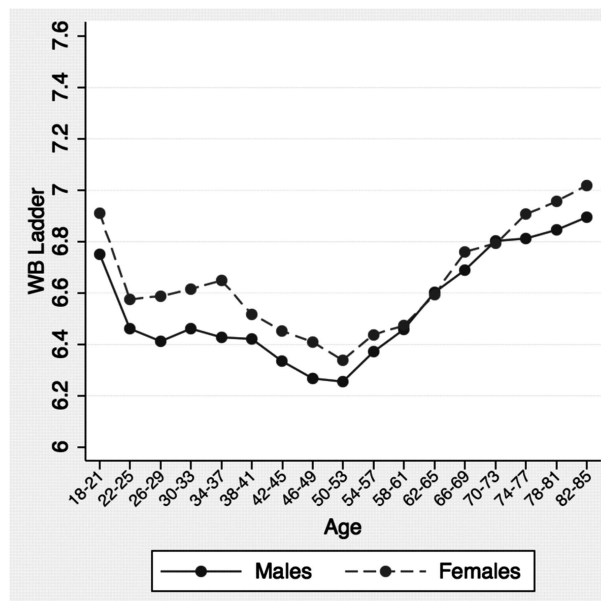
Figure 3.1: The U-Bend of Life: happiness as we grow old (as found by Stone et al. [340]). The "WBL Ladder" in the vertical scale of the chart represents average levels of self-reported subjective well-being by people in different age groups represented in the horizontal scale

of life (Figure 3.1) has been noted to be common in several country wise surveys on subjective well-being. The reasons for this are not yet clear and so far, there are only some potential theories[4]. One might be that thanks to our awareness about our own mortality, we know when we are getting closer to our death and hence, start worrying less and living more as that moment approaches, focusing on the things that matter the most. Another reason might be that the realization of everything we have achieved in life might inspire some sense of pride and less ambition or struggle to thrive or achieve more things, leaving space for actually enjoying what we already have. Independently of the answer, this U-Bend of life paints a more positive perspective of the ageing phenomena.

3.1.2 Social relationships and happiness

Of the different aspects that are related to happiness in one way or another, a dominant aspect seems to be how satisfied we feel with people that we like, spending time with them. Happier people have more social support and social connectedness [337] and there are also hints pointing to social connections and engagement as one of the key factors for longevity in some of the so called "blue zones" (places where people live to 100 years) [75]. Subjective well-being is strongly linked (both directly and through its impact on health) to social capital (i.e., strength of social ties) [181] and both to our family and social networks structure [351]. Supportive interactions have also good effects on health measures, like the functioning of cardiovascular system [352].

Happiness also spreads contagiously through large social networks, where happiest people can be found in the center of the social network of other happy people and the probability of a person reporting higher levels of happiness increase when a person in its network reports to be happy too (Figure 3.2), up to three

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[4]http://www.economist.com/node/17722567
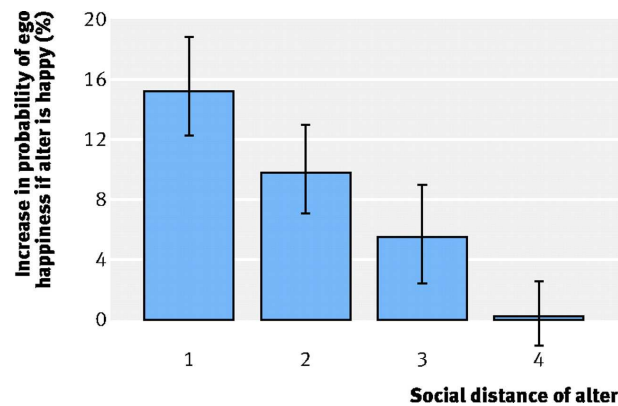
Figure 3.2: Social distance and happiness in a social network

degrees of separation in social networks that include close friends, neighbours, co-workers and relatives [145] (the study is based on a particular social network known as the Framingham social network [111]). The reason behind these clusters of happiness can be one of three: 1. there is an induction that cause changes on people who are closely connected (i.e., I am happy because my close friends are happy), 2. we form homophilic relationships (i.e., I am happy and therefore I form a tie with people who is also happy), or 3. there is a confounding effect (i.e., I am happy because I am exposed to the same external factors that make my friends happy). [94].

Not only happiness spreads through networks, but also other phenomena like obesity [95] (either by induction or by contextual factors [98]), cooperation [295] or even acne and headaches [97].

Community participation (engagement in activities within the community) has also been indicated as essential in promoting quality of life and personal happiness within a community [313]. And finally, in the same way social relationships affect our happiness, the latter also influence the former. Happier people are more likely to have fulfilling marriages, community involvement and a more satisfying social life [229].

3.1.3 Social inclusion of Older Adults

Following the well documented importance of social relationships for happiness, well-being and health, it seems only logical that these importance will hold also for the ageing population. The next step is then to explore the literature in search for an understanding about what is the reality of social relationships in old age. In this respect, there is a wide body of research on the topic of social inclusion of elderly, which we summarized in this section

Social inclusion is often defined as an imperative to reduce exclusion, which is itself defined as the inability to participate effectively in economic, social, political and cultural life [306]. This exclusion is exactly the opposite to what active ageing aims for our elder years. For a long time, policies to reduce exclusion have been focused in groups such as children, young families and unemployed people, but little has been done to address this issue in the elderly population, whose exclusion is a multidimensional process affected by participation and integration, spatial segregation (both physical and mental) and institutional disengagement [307].

Inclusion is also referred to as the sense of community characterized by the level of involvement of groups

in a community space [116], also understood as the feeling of obligation and commitment towards other members of the community. Sense of community is one of the essential inputs of the quality of life of older adults [73] [116]. Three dimensions are significant in predicting sense of community: (i) the community capacity (i.e., extent to which community members share responsibility), (ii) the ease of connecting with others in the community, and (iii) having an informal support network.

The existence of informal support networks (i.e., those that extend beyond family) is highly correlated with having a high morale in old age [224]. There are five levels of support networks usually found around older adults ranging from *restricted* (little connection with relatives and none with friends) to *diverse* (frequent contact with friends and neighbours) [369]. Seniors with *diverse networks* report the highest morale. Although the existence of these informal networks are positive, the most important social network for elderly it is still that of family. Kin relationships have a mixed nature: while they might increase "connectedness", they also introduce some level of "obligation" [222]. When asking elders, the general vision regarding their relatives is that they want to "participate" without "invading". With peers, however, they are more likely to be based on mutual interests and social needs, rather than various degrees of obligation and formality. Another type of network important in this domain are organization-sponsored virtual communities (or Managed and Asymmetric Community Networks), where members have different cognitive, physical, and emotional abilities or needs and interaction is mediated [284]. These are the types of networks we can find in nursery homes or a managed retirement communities.

Another line of research related to the social inclusion of elderly is focused on the particular phenomena of *loneliness* in old age. Around 44% of people aged 65 or more live alone in the US, and beyond the cultural praise to the ability for leading an independent life, there are challenges posed by the precariousness of elderly living in this situation which increase the risk for them to experience loneliness and many other related problems [130]. The good news are that opposed to the common view that loneliness is a very typical problem of older people, this turns out to be only partially true: loneliness is common only in the very old age. Moreover, loneliness levels have decreased, albeit slightly [126]. The bad news are older adults still have higher risks of suffering loneliness because they have higher risk of losing their social support. The key factors for developing loneliness in old age have been found to be losing a partner, reduced social activities and increased physical disabilities [37].

Despite the risks for loneliness, older adults are usually very active when they have the opportunity. Aarhus and Ballegaard [36] analyzed an ageing in place community of elders in Florida and found that they actively engage in their communities. Based on the fact that the place of higher social interaction of the community was a central news panel, he recommends that social media design for elders should mimic the physical network. Moreover, Carroll et al. [86] found that elderly people play key roles in the staff of some organizations like banks, environmental groups, sustainable development groups, etc. One particular role that they engage often is that of keepers of the community story.

Of course, the different challenges posed by age naturally can lead to a reduction of social activities and interactions of elderly with relatives and friends, even contrary to their own desire. Interactions are often restricted to sporadic phone calls and face to face meeting that are usually initiated by the elders. Most grandparents talk to their grandchildren less than once a fortnight, phone-calls seldom last more than five minutes and grandparents (or parents) initiate the great majority of the calls [133].

Addressing social exclusion usually involves the development of public policies that enhance participation and integration through good public services [307] but information technologies have also been found to play an important role. We review literature about this role in the next section.

3.2 IT and Socializing

A wide body of research has explored how technology impacts on the social dimension of active ageing. In section 2.2.6 we have already presented a broad overview of IT applications and services that positively affect the social support determinant of active ageing. Social and communication applications for enhancement can all play a key role in increasing the level of social participation and inclusion of the ageing population. In this section, we start by exploring some studies about the connections between ageing, IT and social support, and later revisit and expand the description of some of the already covered exemplary applications for enhancement, namely those that put enabling some forms of socializing at its center.

A first hint about the potential of IT for improving the social dimension of ageing comes from a longitudinal study that followed 15 elderly participants, half of whom received computers for a 3 years period, during which researchers interviewed them in three occasions to measure their levels of loneliness and social engagement. After comparing the group that received computers with those who did not, IT has been found to significantly reduce loneliness and depression, albeit mainly on well educated elders [144]. Among the different applications they reported to use, email was the most popular. A similar previous study had already found positive psychosocial outcomes from the introduction of email in the lives of older adults [372]. In another study, computer use and access to the Internet increased self-efficacy, decreased computer anxiety and help elderly to remain engaged with topics that interested them [199]. Most of the participants of the study used computers to maintain social contacts, again, through e-mails. All these examples confirm how important it is for older adult to maintain their social connection and how technology can play an enabling role in this aspect [299].

Social and *communication* applications for enhancement are commonly oriented to improve opportunities of social interactions of elderly and their families, friends and caregivers. Consider again communication systems like Videocare [350] and ConnectMyFolks [189], both designed with the goal of making it easy for older adults to communicate through a carefully designed user experience. Or more holistic social platforms like Life2.0 [198], iNeighbour TV [354] or neighbourhood oriented social networking services like NextDoor [258] and HomeElephant [186], which try to provide a broad range of services for staying informed about and interact with the local community. All these applications improve the level of social support of the ageing population by both facilitating socializing and increasing opportunities for interaction. Moreover, special purpose social networks like those oriented to the neighbourhood fit in the concept of managed and asymmetric community networks discussed in the previous section.

Some systems are designed not so much for socializing, but simply to increase the feelings of social connectedness. Such is case of *monitoring* applications like the Whereabouts Clock (a situated display similar to a clock that shows information about the whereabouts of the family) [310], the home awareness system (an ambient system designed to monitor a remote home and reproduce the conditions in the other side) [228] or the Ambient Plant (a pair of connected plant pots that indicate the presence of a person in the other side) [316]. Similarly, another monitoring system that addresses the problem of social inclusion of elderly is the recent MyLively [252], which consists of a set of small tiles that are located through all the house of a person and senses different activities to raise awareness about the conditions of the elderly in their social support networks. As we noted before, the simple awareness about family whereabouts produces a peace of mind for extended family members (i.e., those living away) [302].

Intergenerational Socializing. A type of social interaction that has not been explored enough from the IT domain is the one that occurs between older adults and young people, namely intergenerational interactions. This type interactions has been noted to help in improving the attitudes toward ageing and increasing well-being [182]. Of course, most of the systems that are used by older adults will be used in intergenerational interactions (e.g., video care to call and talk with the niece, etc.), but few focused on that type of interactions from the go. The PACE Project is one of these few [57], specifically tailored to motivate the experience of tele-mentoring via videoconferences between older adults and youngers. StoryVisit.org [293] is another example, providing a web interface for video conferencing and synchronizing a book to the video conference to guide and support remote story telling.

Our interest in socializing focuses particularly in the type of intergenerational social interaction that happens in a face-to-face context, where people meet to share a moment and engage in conversation. A relevant work in this domain the one by Svensson and Sokoler [344], who leverages upon the concept of **"tickets to talk"** (stimuli that can be used as an excuse for conversations [304] [5]) in their design of a Social TV (namely, the Ticket-To-Talk Television) which basically aims at stimulating conversations. Our work with *Reminiscens* follows exactly in this line, by which the goal is to stimulate interaction. Our work also very much coincide with [344] in the spirit of treating design for seniors as not equivalent with "design for patients". Furthermore in this space, Blythe et al. [66] explored different technologies that can provide "tickets to talk" within an intergenerational social interactions context. They explored reminiscence through the means of visualizing biographies in a map (places where people had lived) and through the exploration of archive photography to motivate conversation, finding generally that it was engaging to create biographies, but otherwise exhausting. This work holds a high similitude with the one described in this dissertation, and, in a way, connects the dots between socializing and the use of reminiscence as a means to stimulating it. For a more thorough review and extended discussion about the evaluation of these technologies, refer to the previous chapter in its section about IT for enhancement 2.2.6.

3.3 Exploratory work: What's Up

As part of our exploration of IT for socializing, we have built a mobile communication platform specifically designed to foster social interactions between elderly users and their friends and family. To validate our solution and gain further understanding of the needs of elderly from a design perspective, a "think aloud" study was conducted, investigating the usability and applicability of our solution. In this section, we describe this platform and application, named *What's Up*, and present the results from an initial evaluation[6], summarized in how a simple, almost featureless, interface is suitable for the old-est group of users and informing our design about different interaction issues to take into account for the future development of our platform.

Moreover, while working in this project we came to the realization that company and face-to-face interactions, in particular with youngsters, were particularly loved by many of our elderly users. This realization would later lead to our final focus on intergenerational social interactions in face-to-face contexts. The content of this section is also published in [119].

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[5]Dogs as "tickets to talk" for the people who are walking them in the park

[6]The evaluation was carried out by an intern student under my supervision, with my participation mainly in the final analysis of the results

3.3.1 The prototype: What's Up Intergenerational Communication

What's Up[7] is a mobile communication platform developed within the Lifeparticipation project [8] of the University of Trento, with the goal of supporting intergenerational social interactions. It is composed of two main mobile applications that provide simple communication through a common infrastructure. At one side, the younger use What's Up LifeShare, a full featured messaging application developed for the most common communication device of youngsters: smartphones (both iPhone and Android). On the other side, elders use the What's Up Display, and iPad oriented application that works as a display of all received messages and pictures. Figure 3.3 shows the communication model we propose.
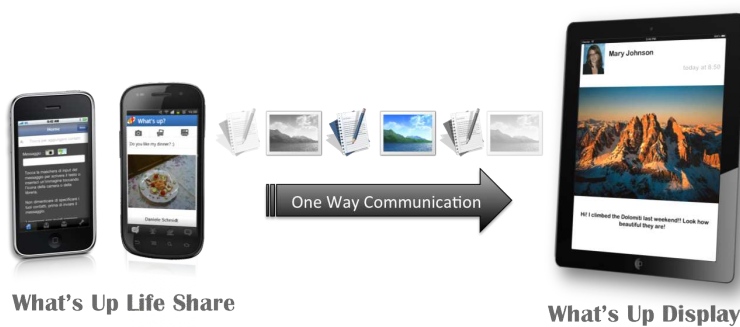
Figure 3.3: What's Up's one way communication

In the first iteration, What's Up Display worked only in a photo-frame mode, receiving text and pictures. Later on, three more levels of complexity were added, as shown in Figure 3.4, to enable simple two-way communication allowing the elder to ask for news (level 1, "What's UP"), reply with like/unlike messages (level 2, "Feedback") and reply with a text message (level 3, "Complete").

Figure 3.4: What's Up Interfaces for the Think Aloud Study

A prototype with all these levels of complexity was implemented for the study we describe in the following section, with the goal of understanding how much of the usability of the application is affected by the increasing complexity.

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[7]Demonstration/promotion video available: `http://www.youtube.com/watch?v=U-B-gfgjuz0`
[8]`http://www.lifeparticipation.org/`

3.3.2 Prototype Evaluation: Think Aloud Study

In order to assess the usability and applicability of our solution, we have introduced the iPad to 28 elder users and then installed our application with a complexity level different from the last testing (to ensure heterogeneous opinions on different levels). Basic functionalities were explained to users, asking them to navigate between resources and explain what they felt, their thoughts and concerns. Usability and applicability were then evaluated using the following means:

- Each participant answered a questionnaire about the ease of use and comfort after using the first complexity level.

- Continuing the test, each participant tested the remaining levels of complexity.

- Each participant was then asked to produce a ranking of UIs by the level of enjoyment in using each of them (using a card sorting method).

Using the age segmentation by Drolet et al. [125], Table 3.1 shows the different groups of participants of our small study.

Table 3.1: Participants of the Think Aloud small study using What's Up

Group	Age	Number of participants
Young-old	65 - 74	16
Middle-old	75 - 84	6
Old-old	85+	6

Due to the small amount of participants in each of the groups, we decided to use a within-groups approach by which all participants tested the four interfaces. During the session, each participant was video recorded while interacting with the application ("think aloud" method), with the goals of eliciting the way each UI was perceived and later extracting mental models of the users while solving problems [218]. At the end of the session, participants were asked to rank the interfaces they tested by using a printed version of each interface in cards and asking them to place them in order of preference. Moreover, each participant answered an usability and satisfaction questionnaire (See appendix C). Our exploratory analysis limited to the usability aspect, leaving the more formal mental model extraction for the future.

3.3.3 Lessons Learned

Most users responded positively when asked about the ease of use and comfort of the application, as seen in Figure 3.5.

Moreover, following other answers to the questionnaires, overall evaluation of the design is positive. Buttons meaning was clear and readability was 100% positive. Almost all feedback about aesthetics was positive. When asked 'would you use the application?' most elders that would not use the application are those that do not use computers either, while others are more in touch with technology. Furthermore, most elders answered that they would use the application alone (provided that they have been taught how to turned on/off the iPad). On the frequency of communication between elders and youngsters, our results show that people that are not willing to use the application are in general less willing to communicate also with other technologies.
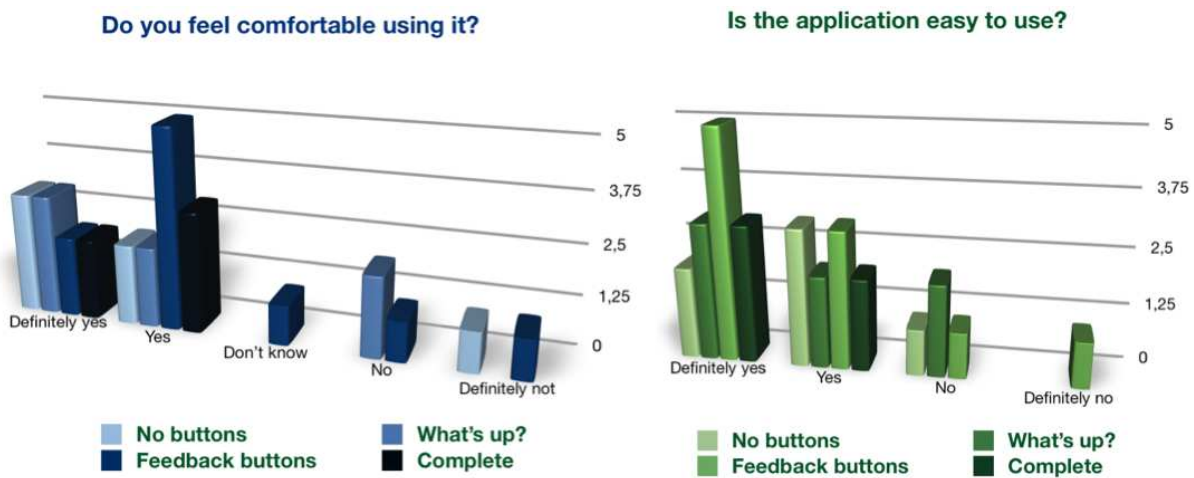
Figure 3.5: Ease of use and comfort of the application

Figure 3.6: Users ranking What's Up interfaces according to their preferences

Finally, regarding the preferred interface, Figure 3.7 shows that young-old elders prefer the most complex application, while the old-old users are more willing to use a simple interface, with no buttons and where they just have to use the finger to navigate the resources. When not considering age groups, however, no interface was particularly preferred, which means that applications should be customizable in this aspect.

Finally, from the empirical evaluation of the think aloud videos, the most important results are as follow:

- For the simple, no buttons interface, most users did not have problems, even with shaking hands.
- The "unlike" button might not have a clear meaning in occasions.
- Shaking hands is a problem when using a keyboard or buttons making them involuntary press the
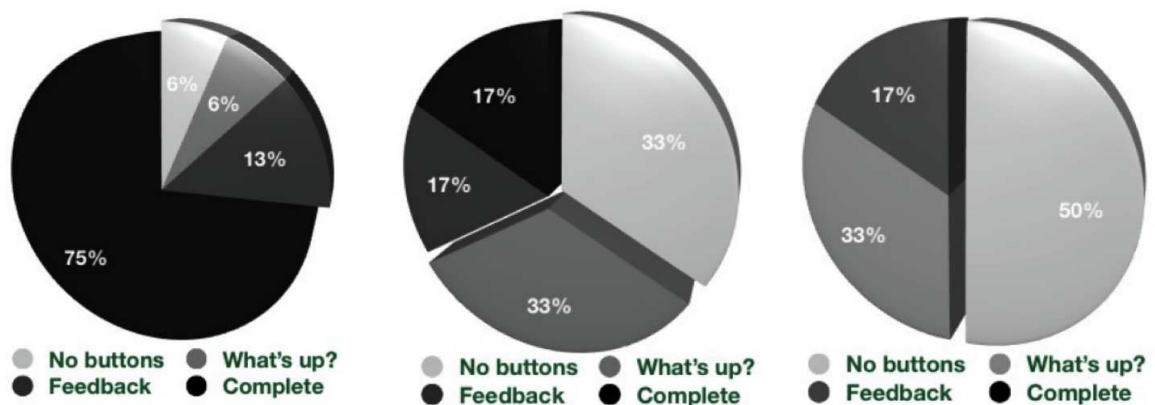
Figure 3.7: Preference of interface levels by age group in ascending order

device, which later disorientates the elders for the unexpected application behaviour.

- Sometimes, users were touching button images in the wrong place, indicating some difficulties for understanding icons.

- Some users tried to scroll buttons, indicating that multiple interaction patterns can be confusing for some elders.

- Faster users pressed buttons over and over again during delays.

A summarized video of the think aloud protocols is available online with further conclusions of our analysis [9].

After this initial evaluation of What's Up, a longitudinal intervention to study patterns of intergenerational remote interaction was designed as a follow up. Our focus and effort, however, shifted to the study of intergenerational interactions in face-to-face contexts, which forced us to leave this study as a future work of this dissertation.

3.4 Exploratory work: Global EngAge

A second exploratory work on the topic of socializing and ageing is the result of a one-time collaboration in the context of a Hackfest[10] organized by the LeadingAge Association[11].

The *LeadingAge Hackfest*[12], as it came to be known thereafter, lasted two days and brought together engineers and researchers from the IT domain, management students from the healthcare sector, gerontology experts and older adults (as mentors and coaches). Teams were formed randomly two weeks before the event and motivation scenarios [13] were presented to bootstrap the ideation process.

As a result of this collaboration we designed and implemented a prototype for a real-time remote partic-

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[9]Think aloud videos summary: `http://www.youtube.com/watch?v=pouFfeR0n0A`

[10]Also known as "hackathon", is an event in which people meet to collaborate in the quick design and implementation of information technology applications, lasting one or several days

[11]LeadingAge is an US-based association of not-for-profit organizations of the ageing services industry

[12]`http://leadingagehackfest.org/`

[13]`http://www.slideshare.net/slideshow/embed_code/24548180`

ipation system called *EngAge*. The prototype and its potential as a tool for allowing homebound elderly to participate in activities of their interest, organized by senior centers or retirement communities, was demonstrated and evaluated by a panel of both ageing services industry and academic representatives on the basis of originality, applicability and commercial potential. At the end of the even, our *EngAge* prototype and idea was appointed the winning project out of 8 competing proposals [14].

3.4.1 Motivating Scenario

The motivation for this prototype starts from the story of Shirley, who has become physically limited after suffering a hip fracture. Living independently at home, she is one of the more than 3 million older adults living in the US who are considered to be housebound and in the need of some level of home-based care [291]. Even though this term does not have a standard definition, suffices to say that Shirley can no longer participate of the activities she used to as it stays longer at home for her limited mobility. Shirley is aware of her physical conditions, but wishes to stay active and engage in social activities even beyond these limitations. "While I'm physically unable to participate in many activities, my mind is sharp and I feel I have so much to contribute", she declares.

On the other end, more than 10.000 retirement communities (CCRCs) [298] and similar number of senior centers [257] are devoted to the daily endeavour of organizing all sort activities and services for keeping older adults engaged on a daily basis. And the current trend is for these communities and centers to extend their outreach out of their locations an into older adults living independently at home [212] with the goal of building what is called a "community without walls".

The question arises then: **how can we use technology in a simple way to connect housebound older adults with communities and senior centers that might keep them engaged?.** Global EngAge aims at answering this question.

3.4.2 EngAge prototype

Global EngAge is the prototype of a real time video-conferencing application that will allow housebound older adults to remotely participate on nation-wide (or even world-wide) ongoing activities, organized by CCRCs and senior centers. The system is composed of two main applications: *EngAge Community* (Figure 3.8), which is essentially a dashboard where CCRCs and senior centers register some of their activities (making them available for online remote participation) and later start a video-conference to which housebound elderly can freely join; and *EngAge Connect* (Figure 3.9), which is a web application where older older adults can select one of the ongoing activities and enter the video-conference to "EngAge". The video-conference application was implemented using Google Hangouts API[15] (Figure 3.10).

3.4.3 EngAge Service Model and Platform

To support the whole system, the EngAge service model and platform are organized as indicated in Figure 3.11. The upper part of the figure summarizes the service model we propose as the simplest work flow for a pilot of this system to work. Housebound seniors who want to participate in EngAge events

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[14]`https://www.leadingage.org/Team_Global_Engage_Wins_2013_LeadingAge_HackFest.aspx`
[15]`https://developers.google.com/+/hangouts/`

Figure 3.8: **EngAge Community Dashboard.** The basic prototype allow senior centers to register future activities and later start the video-conference when the activity is ongoing
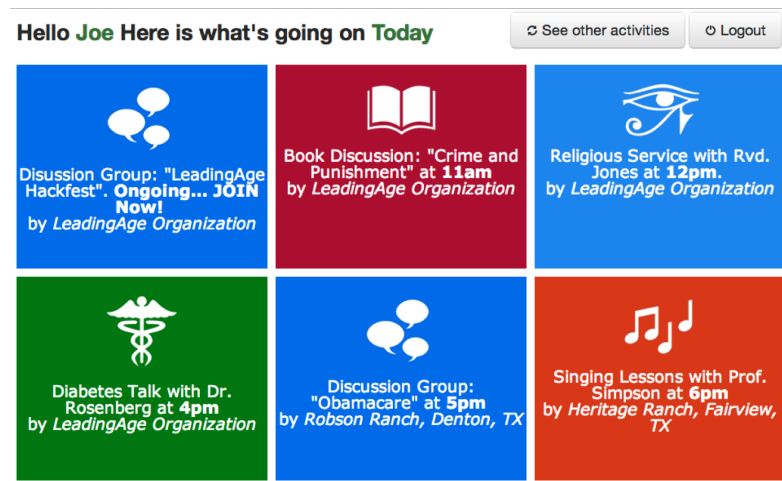
Figure 3.9: **EngAge Connect.** The basic prototype allow users to see a list of up to 6 ongoing activities to which they can enter by one click. The user can also request for new list suggested activities if the previous list was not of interest.

must request an special *user key*, or password. To do so, they have to contact local CCRCs, senior center or the EngAge service provider (via phone or through family members). The latter then registers the user and delivers the user key, along with a support team to help set-up the system, train the user and confirm its authenticity, right to the seniors' home. In this way, potential misuse by fake users is avoided at least in a minimum way.

EngAge's minimal platform is organized in five modules that enable the simplest work flow for a prototype of this idea to work. First, the **EngAge Community App** is used by CCRCs and Senior centers to register *users* and upcoming *events*. This information is sent to a **Key/Value store** exposed through restful **Data store API** that first generates *user/event keys* and then stores these keys associated with event/users metadata in the Key/Value store, which in our implementation is powered by Redis[16]).

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[16]http://redis.io/
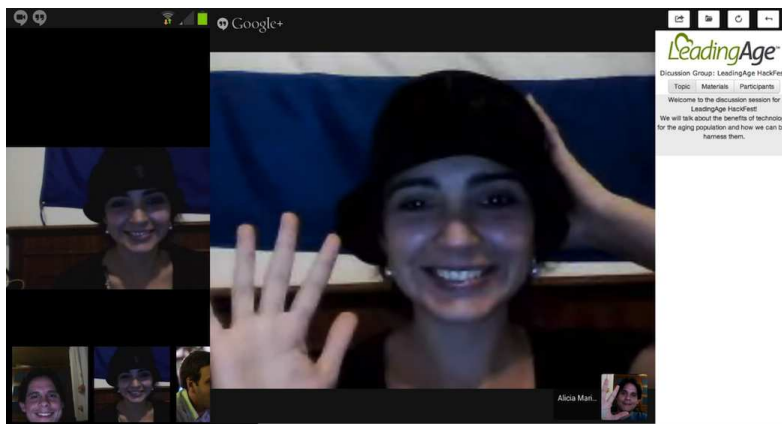
Figure 3.10: **EngAge Video-Conference.** A google hangout with and embedded hangout application that has the EngAge controls

From the Community App, an event is started when the date/time arrives. This trigger the app to sent the event key and request a hangout URL to the **EngAge Hangout App**, a hosted google hangout application. The hangout is then created and becomes available at a google-generated unique *hangout url*. The event key is then paired with the hangout url and sent to the Data store API, where it is saved.

From the **EngAge Connect App**, a user logs in using his/her user key and then gets a list of ongoing events. The Data store API respond with a filtered list of ongoing event keys and hangout URLs (i.e., ongoing events are those with an active hangout url). The user can refresh the list of events asking for other suggestions, or choose one to participate in at which point the hangout URL is open using the regular google hangout client application.
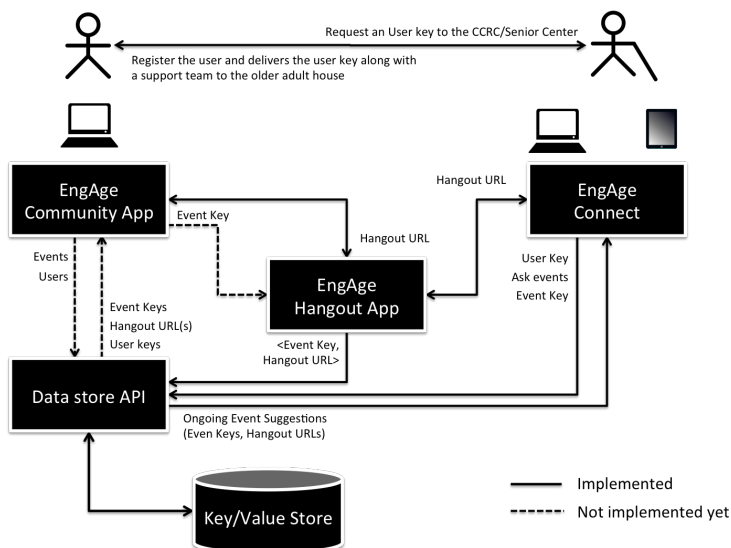
Figure 3.11: The EngAge prototype architecture

3.4.4 Lessons Learned

EngAge's prototype was focused on the simplest behaviour that mattered, which in this case was to support two-way real-time interaction between housebound elderly and people participating in CCRCs or Senior Centers' hosted activities. Future work in this line should address issues such as personalization and recommendation (e.g., how to know what activities to suggest, how to organize activities), privacy concerns of participants (e.g., when, where and how can this type of interaction be suitable for a housebound senior), security requirements (e.g., how to ensure that only housebound elderly will register the service) and other aspects encompassing research, design and engineering.

Although no systematic evaluation nor scientifically designed experiment was carried on to follow up this demo, the feedback obtained from the panel of experts and the LeadingAge community added to the the selection of EngAge as the **winning idea and prototype** served to confirm our intuition that enabling synchronous social participation for active ageing is the next big frontier where research, design and information technologies are heading to. Certainly, "communities without walls" is a concept that has been around for some time, and there have already been attempts to build similar real-time remote participation systems[17], but both these attempts and EngAge have yet to mature enough as to become mainstream. As technologies like tablets and touch screens become easier to attain, feasibility of systems like this will tend to increase, widening the design and research space for real-time participation systems.

Moreover, it its condition of being a proof of concept for a system that enables real-time synchronous social interaction for older adults, EngAge can be considered as a half way step between the genesis of this research project (*What's Up*, focused on asynchronous social interaction) and its final focus (*Reminiscens*, focused on face-to-face social interaction).

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[17]See the Virtual Senior Center pilot program: `http://www.microsoft.com/en-us/news/features/2010/mar10/03-10virtualseniorcenter.aspx`

4

Review on IT for Reminiscence

Up to this point, the focus of this dissertation has been set on reviewing the ageing phenomena, its active version and the role of social interactions for enabling the latter. This is what we can define as the **problem domain** of this dissertation, and along with the conceptual review, we have presented how information technologies play an enabling role in the **solution domain**. Our approach to this research included also the realization of exploratory works to both gain understanding and progressively test potential solutions that can improve or increase social interactions for the ageing population.

These exploratory works (i.e., AllenaVita, What's Up and EngAge) concentrated in using information technology for enabling/facilitating remote social interactions, and experimenting with them allowed us to observe the importance of social interactions in action. But more importantly, these initial experiences led us also to the realization that one of the things older adults value the most is *company and conversation*. And, from participatory experiences that will be described in chapter 6, we also realized how enjoyable and engaging can it be to enable these kind of interactions in intergenerational settings. With these insights in mind, the next step was to find an experience that could be shared across generations, in a face-to-face conversational setting. We have found this experience in the practice of **social reminiscence**, which we understand as the act of revisiting past memories and sharing them for driving conversation or teaching lessons of life (see definition 3).

This chapter finalizes the state of the art and exploratory chapters of this dissertation by presenting a theoretical overview of the experience of reminiscence, its benefits and an overview of the design space of information technologies aimed to support it.

4.1 Theoretical Background

What counts as reminiscence? How does it occur? What's the impact of reminiscing in people's lives?. This section presents an overview of the reminiscence phenomena, based on literature coming from psychology research and reminiscence/life review practice.

4.1.1 What is Reminiscence?

The experience of reminiscence has been a theme of interest from ancient times. Already in the ancient Greece, Aristotle discussed memory as a faculty of the human mind that is function of our ability to perceive time, allowing us to remember the past [48], regarding reminiscence as an experience of every living being that is able to perceive time. In modern literature, french novelist Marcel Proust's most prominent, *"In search of Lost Time"* [290], puts memory and the experience of remembering as a core theme of his novel, describing it as an involuntary act that is triggered by sensory experiences. The famous episode of the *Madeleine* cookie that triggers him to remember about a pleasant past experience is exemplary of this perspective, which forms the starting point of the whole project and which is noticeable in the use of Proust quote as a part of this dissertation title.

As seen in these early, non strictly scientific, attempts of definition, reminiscence is referred to as a process of recalling memories of one's past experiences. In its seminal work about life review, Butler considers reminiscence as an "inner experience or mental process of reviewing one's life" [77], opening with this a whole research field on the practice of reminiscence, with an initial focus on the elderly. The definition of Butler would later come to be known as one particular type of reminiscence, called *life review*. The conceptualization of reminiscence as a process can be summarized in Parker's definition of the phenomena as "a selective process in which memories are evoked and reconstructed" [266]. Another way of conceptualizing reminiscence focuses in its content, defining it as "personal memories of a distant past: long term memories of events in which the reminiscer is either a participant or a observer" [378].

As proposed by Cohen, the first definition might be too broad (i.e., encompasses every kind of remembering) whereas the second is too narrow (i.e., is only about long past events) [96], which is why in the practice of reminiscence and life review, it is more common to find definitions that distinguish different *types of reminiscence*. Table 4.1 presents a summary of the different types of reminiscence found in literature, along with an explanation of their definition. Many more categorizations have actually been proposed, but they are often not mutually exclusive [96].

In particular, our interest is set on the practice of reminiscence within a social and intergenerational context, preferably face-to-face. Although there is no formal definition for the term "social reminiscence", it has been noted that its practice can serve social purposes (i.e., conversation, teach/inform) in social contexts (with family, friends or the community) [368]. Based on this functions and contexts of reminiscence, which we will explore further in the next section, we offer a definition of social reminiscence in the following terms:

Definition 3 Social Reminiscence *is the act of recalling and revisiting past memories and sharing them with others for the purposes of driving conversation or teaching the lessons that were learned from those past experiences.*

4.1.2 Reminiscence research and practice

With Butler's seminal work on life review, a whole field of research and practice came to be known under the umbrella terms of *reminiscence and life review*[1]. It has been noted however that the research in the field is data rich but theory poor [368]. The field is highly concentrated in the practice of reminiscence (i.e., its applications in both clinical, personal and community contexts) and as such, produces a great

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[1]See the International Institute for Reminiscence and Life Review: `http://www.reminiscenceandlifereview.org/`

Table 4.1: Types of reminiscence in literature

Type	Description
Simple reminiscence [364]	non-directed, relatively automatic and unstructured autobiographic storytelling or spontaneous recollection of past experiences
Informative reminiscence [96]	narrative storytelling performed with the goal of teaching or entertaining others
Life review [171]	a more analytic, structured and evaluative exploration of past experiences, integrating both positive and negative life events
Obsessive reminiscence [154]	recollection of past memories dwelling on negative memories of guilt and failure
Integrative reminiscence [378]	same as life review, but originally termed to separate life review in two with *life review* as including only the positive and *integrative reminiscence* including also the negative aspects
Instrumental reminiscence [378]	recollection of past memories with the goal of planning and solving problems
Transmissive reminiscence [378]	recollection of past memories for passing on cultural and personal knowledge
Escapist reminiscence [378]	defensive remembering that allows the reminiscer to escape from present difficulties into a happier past
Narrative reminiscence [378]	simple storytelling, equivalent to informative or simple reminiscence

deal of publications that describe the phenomena and its effects in diverse contexts. A theoretical formalization of the reminiscence practice has been proposed by Webster [368] with the goal of orienting both research and practice in the field. This theoretical model is summarized in the *reminiscence heuristic model*, shown in Figure 4.1.

According to Webster and his heuristic model, retrieving, articulating, and disseminating self-narratives reminiscence might not only be a capacity of human beings, but also a need in the sense that it fulfills also a function that might be fundamental (e.g., the formation of human identity). These narratives are built upon people's memories after being initiated by some factor (***triggers***). Once the reminiscence is triggered, people revisit their memories either in private or public (***modes***), which gives reminiscence either an interpersonal or intrapersonal quality. Memories are not isolated, but are rather surrounded by institutional, family or relationships influences (***contexts***) and they are filtered or moderated by several individual differences like age, gender and personality (**moderators**). The process of reminiscence also serves for a purpose, allowing the person to not only recall the past, but also achieve some psychosocial goals like facilitating conversation, building self-identity or teaching and informing others about past experiences (***functions***). While serving a purpose, in the end, remembering our past for a specific reason (i.e., function) has an impact on people (***outcomes***), by bolstering a person's sense of mastery or self-esteem, among other outcomes that can be either positive or negative.

We will not cover all the components of the model in detail. From this dissertation perspective, our focus
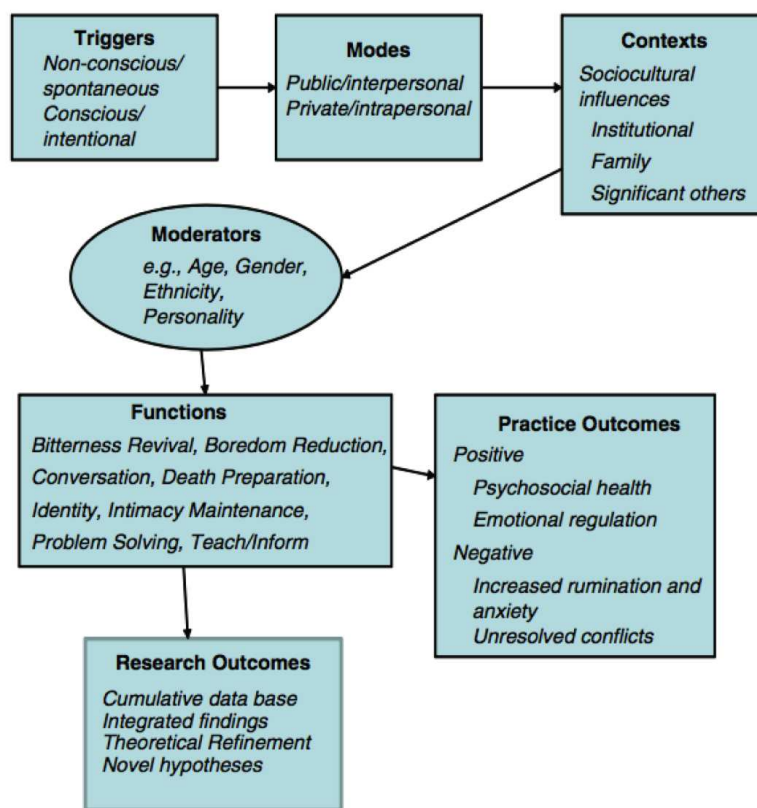
Figure 4.1: Heuristic model of reminiscence (as proposed by Webster in the field of social gerontology [368])

is set mainly on *triggers*, *functions* and *outcomes* of the reminiscence practice. This follows the goals of stimulating conversation across generations by motivating people to remember and share their life stories, studying whether these will ultimately improve people's psychosocial health (especially of older adults).

When it comes to supporting reminiscence with IT, one of the most common roles for IT is to timely trigger memories through means of specific cues that remind people of past experiences. This type of triggers fall under the *conscious and informative* category of triggers that stimulate reminiscence by directly prompting people to share earlier adventure or anecdotes. When triggers are conscious, it is usually because reminiscence is deliberatively a means to an end, which is the case for this dissertation project. Most triggers, however, are mostly *non-conscious or spontaneous* like a simple smell or any sense modality (e.g., the touch of a hand, sight of sailboat, etc.) that suddenly remind people of a past experience or sensation. The range of such triggers is very broad (potentially, anything can be inside) and research about its qualities is limited, but they might share certain general features like being more passive, less goal-focused and less effortful [368].

By remembering the past, people can connect with others, overcome negative emotions or consolidate a sense of identity. In other words, reminiscence is not really and end, but is rather always a means to an end. That end is what literature defines as *reminiscence functions*. Table 4.2 summarizes the list of different functions that reminiscence can fulfil. From that list, this dissertation is specifically focused on

using reminiscence for conversation purposes.

Table 4.2: Reminiscence Functions as presented in the *Reminiscence Functions Scale* (RFS) [365][366]

Function	Description
Bitterness Revival	ruminating on memories of difficult life circumstances, lost opportunities, and misfortunes
Boredom Reduction	filling a void of stimulation or interest
Conversation	communicating personal memories as a form of social engagement
Death Preparation	dealing with the thoughts of one's life coming to an end
Identity	searching for coherence, worth, and meaning in one's life and to consolidate a sense of self
Intimacy Maintenance	holding onto memories of intimate social relations who are no longer part of our lives
Problem Solving	identifying former strengths and coping techniques to apply to current challenges
Teach/Inform	sharing memories to transmit a lesson of life and share personal ideologies

Finally, reminiscence is applied in practice by practitioners of psychology, nursing, social work, gerontology and a myriad of other fields, who usually implement programs that aim at enhancing mental and emotional health of people, with a particular focus on elderly [368]. Webster's theoretical framework reduce the types of reminiscence interventions into three main categories for guiding the work of practitioners:

- **Simple Reminiscence** is mainly unstructured autobiographic storytelling and spontaneous reminiscence that often takes place within a relational context like anniversaries and friends or family reunions. It can be facilitated in interventions in the form of "reminiscence groups" in which prompts for positive memories are given and discussed, with the goal of enhancing social contacts and short-term well-being. Examples of this type of interventions are [50] (exploration of personal and impersonal photographs for stimulating reminiscence), [179] (group interventions in residential settings) and [371] (reminiscence to foster intergenerational interactions).

- **Life Review** is much more structured and integrates both positive and negative life events in an evaluative experience that helps people gain insight into how they have developed throughout their lives and how they have become the people they are now. In this type of intervention, there is a need for more advanced skills like structuring interventions and knowing how to ask questions that promote problem-solving and help participants reframe the meaning of their past memories. Examples of this type of intervention include individual life review interviews [170] (therapeutic effects of reminiscence in homebound elderly), guided autobiography [62], and preventive life review [67] (life review to prevent depression in elderly with mild to moderate symptoms).

- **Life-Review Therapy** is basically *Life Review*, but applied in a psychotherapeutic setting. It is the most structured of all, aimed at people with severe levels of depression or anxiety. This type of interventions will most probably elicit negative memories and negative interpretations of life events, which only counsellors with specialist skills will know how to reduce. While life review leaves identity intact, life-review therapy may involve the creation of a new life story and changes

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in self-identity. One example is the life-review protocol used by [315], in which the focus is set on eliciting specific positive memories.

Both *Life Review* and *Life-Review Therapy* can commonly be referred to as the ***Reminiscence Therapy***, which is simply defined by the American Psychological Association as "the use of of life histories - written, oral, or both - to improve psychological well-being" [49].

4.1.3 Reminiscence and Ageing

Ever since the seminal paper of Butler on life review, there has been a traditional tendency of considering the reminiscence phenomena as particularly common in old age, stating that people tend to reminisce more as they grow old, and that this, somehow, is good for them. These ideas, however, do not find evidence in formal studies and instead, reminiscence is present across all ages and cultures [96], being moderated more by gender and personality rather than by age [367].

Age might play a role moderating reminiscence when we consider its different types. For example, *simple reminiscence* is more frequent in both older and younger adults with respect to middle-aged [245]. *Life review*, on the other hand, seems to increase with age as reported by Butler [77], but results are not consistent. For example, the survey by Merriam [245] noted that 46% of respondents said that they had not reviewed their lives and seldom thought about death. There are more studies, however, that did find support for Butler's original results. For example, Lieberman and Falk [220] report that middle-aged used reminiscence primarily for problem solving whereas older adults spent more time in "cognitive restructuring" through life review and self-assessment. Similarly, Webster [367] found that older adults scored higher for death preparation (which can be considered as a form of life review) on his "Reminiscence Function Scale" [365][366] than young or middle-aged respondents. In general, there seems to be a consensus that middle-aged people are the ones who reminisce the less, probably because their lives are busier [367].

Age might also play a role on the period of life in which people focus when they reminisce. The so called ***Reminiscence Bump*** is a known phenomena by which there is a tendency for both older and younger adults to have an increased recollection for events that occurred during their adolescence and early adulthood [77][192] (roughly, memories clustered in the period between ages of 10 and 30). It was identified through the study of autobiographical memory and the subsequent plotting of the age of encoding of memories to form the lifespan retrieval curve [102] (Figure 4.2).

The reminiscence bump has some times been misused to argue in favour of the idea that older adults tend to reminisce more or to "dwell in the past", focused on reviewing their lives. There are, however, reasons to dismiss this argument. First, the bump has been observed in younger people as well [192]. Second, recent memories are far more numerous that those drawn from the bump period. The bump, however, has been observed and it has been argued that the reason of it is the fact that the majority of highly significant self-defining events tend to occur between the ages of 10 and 30 years [141].

The bottom line with the role of age in reminiscence is that is only one of several factors that include gender, personality and even health status.
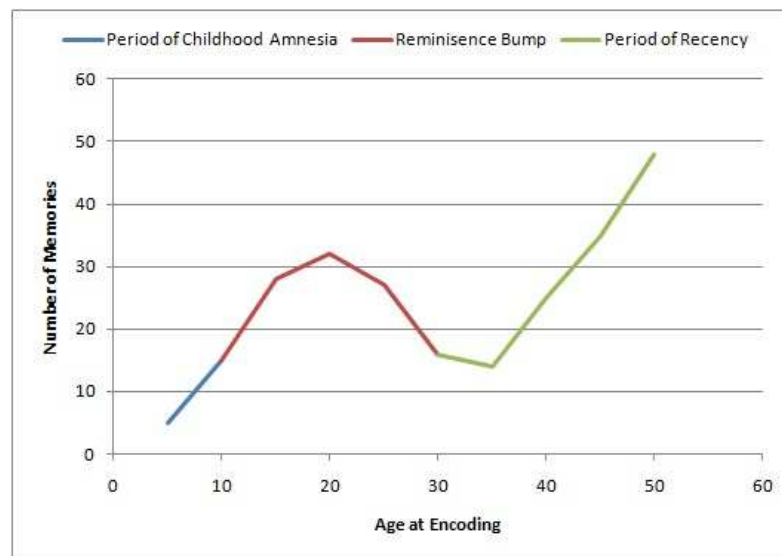
Figure 4.2: **The reminiscence Bump.** An approximated representation of the lifespan retrieval curve

4.1.4 The benefits of reminiscence

As seen in the heuristic model, reminiscence activities produce outcomes that are not limited to the sole retrieval of information from past experiences. These outcomes can be both negative and positive. On the negative side, reminiscing could result in increased rumination and anxiety (when its function is solely to rehash bitter life events). On the bright side, reminiscing can positively affect psychosocial health and well-being.

Most studies in reminiscence have found that positive reminiscence can result in an increase of life satisfaction and a reduction of depression [171], ultimately boosting happiness [74]. To a lesser extent, it has also been seen to improve social interactions [282][180]. However, as it happened with studying the role of age in reminiscing, the different types of reminiscence and its functions produce different outcomes. For example, the model proposed by Fry [147] show how different traits of humour, optimism and empathy tend to support instrumental an integrative reminiscence functions, that in turn are associated with positive mental health outcomes such as self-esteem.

Other studies focused on analyzing the RFS scores association to different measures of psychological well-being. *Bitterness revival* and *boredom reduction* are both negative for mental health. *Conversation* and *Teach/Inform* tend to be unrelated to mental health, although the latter shows a positive correlation with measures of happiness [364]. *Intimacy maintenance* is perceived as negative when it immediately follows the death of a spouse. After a while, however, it becomes positive. In the same way, *death preparation* relationship with mental health varies depending of the context and the life stage of the person.

With respect to psychosocial outcomes, Pinquart and Forstmeier [282] has performed an systematic meta-analysis of more than 128 reminiscence interventions. The analysis found a moderate improvement ego-integrity and the reduction of depression. Small effect of improvements was found for social integration, positive well-being and cognitive performance, among others. These improvements were often maintained in follow ups and the stronger effects were found in *Life-Review therapies*. Particularly,

the improvement effects on depressive symptoms were much larger in depressed individuals and people with chronic physical diseases. Although not part of this meta-analysis, Bryant et al. [74] conducted two studies that explored the relationship between the frequency of positive reminiscence and the emotional experience, finding in both cases that happiness was increased. In both studies, reminiscence was either triggered by using memorabilia (i.e., souvenirs from the past) or cognitive imagery (i.e., mental images of a list of memories). The latter was more effective in improving happiness. Loneliness is also a subject of debate in social psychology, with some studies showing some potential for reminiscence to reduce it [383] [375]

Finally, the practice of reminiscence has an special positive potential for people experiencing dementing illnesses such as Alzheimer's disease. And the positive effect is for both, those afflicted and their caregivers [157]. For example, the use of reminiscence therapies can decrease disorientation upon admission to a nursing facility [345], increase the levels of well-being compared with an activities group [72], decrease depression and increased cognitive function [361], and increase verbal fluency compared with an everyday conversation group [264].

4.1.5 Summary

As seen in this section, there is a double nature of the reminiscence experience, which can be either an individual/private activity or a social/interpersonal one. This double nature combined with the potential positive outcomes or benefits and its cross-generational/cross-cultural prevalence, form together the theoretical framework that motivates the core contributions of this dissertation, that aims at designing, implementing and evaluating a socio-technical application that can both stimulate and facilitating the practice of social reminiscence as a bridge between older adults and their younger counterparts.

4.2 IT for Reminiscence

Information technologies and interactive systems for reminiscence have been mostly crafted for personal use or to support its therapeutic practice. In general, they are designed and built to *stimulate* people to reminisce, facilitate *preservation* of life stories and support *storytelling*. Figure 4.3 shows these three categories as the three basic components of a simple stage-based model of IT-supported reminiscence activities. This simple model can be seen as an over-simplification of the heuristic model we have introduced in the previous section, with the goal of summarizing what are the most common design spaces of IT for reminiscence: people is **stimulated** to remember something, which is sometimes shared with others through **storytelling** and could be also **preserved** for posterity in digital mediums. A combination of these technologies, whatever their focus is among these three simple spaces, can serve for the purpose that motivates this dissertation: facilitating the practice **social reminiscence** (see definition 3).

There has been a recent growing interest, particularly from the HCI community [106] [2], in designing technologies for supporting reminiscence activities. Using the design spaces we have just introduced, we categorized some examples of these technologies and describe them briefly in this section. It is important to mention that the choice for this over-simplified taxonomy follows the goal of identifying a first set of key design spaces where IT can play a substantive role.

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[2]http://www.cs.cornell.edu/~danco/remchiwork/papers-and-abstracts.htm
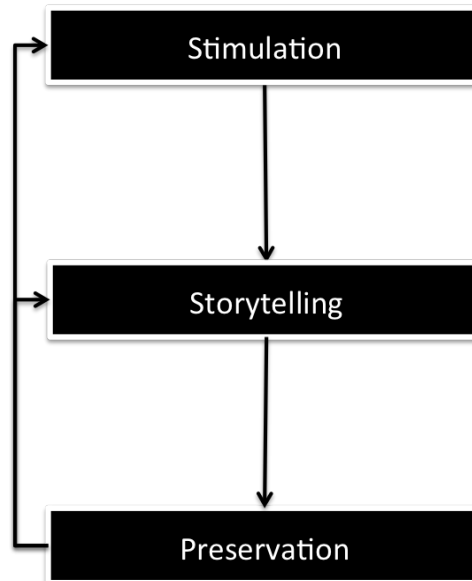
Figure 4.3: Simple stages-based model of reminiscence design spaces

4.2.1 IT for stimulating reminiscence

The first design space of technologies for reminiscence aim to stimulate or trigger people to remember the past in an enjoyable way. Pensieve [104] is perhaps the most exemplary design in this space, with a system that triggers simple and spontaneous reminiscence through random emails containing a mixed of both impersonal (e.g., questions about the past) and personal (e.g., old pictures posted in social networks) prompts to remember the past. In an evaluation study of the system [278], "positive" and "negative" prompts generated same response rates, with negative prompts generating longer responses. In general, people were more likely to reminisce about people or things rather than about places or experiences. Pensieve's main goal was that of requiring the minimal effort from users' perspectives and fit in the natural practice of spontaneous, almost involuntary, simple reminiscence.

> *Do you remember your first job?. How did you get it, and who were your co-workers? (an*
> *impersonal prompt by Pensieve)*

Our work with *Reminiscens* also leverages upon a mixture of personal and impersonal prompts, but opposed to Pensieve, our goal is rather focused on supporting simple reminiscence in its social mode (i.e., for conversation or teach/inform purposes). In a final report about Pensieve, the potential of social reminiscence is noted in users' interviews, which is motivation for our work [105]. When it comes to this type of reminiscence, generic or impersonal triggers (such as generic pictures) have been pointed as better reminiscence triggers [50], a result that somehow validate a priori our choice for using contextual generic pictures to stimulate people to remember.

Similar to Pensieve, a short-lived social network called Proust[3] aimed at stimulating people to remember the past through questions about their lives, inviting them to share their answers in a Facebook-like social network profile. The attempt to give simple reminiscence activities a social dimension on the Web was

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[3]`www.proust.com`

not really successful as the site closed in 2012 [4] (although it kept operating for over a year later after its demise). The failure of Proust might be due to the fact that the social mode of reminiscence take mainly place for *conversation* and *teach/inform* purposes, which were neither properly supported by the site.

Precisely for the purpose of conversation, CIRCA Connect is a commercially available system (originally developed as a academic research project)[5] specifically designed to help professional caregivers in the task of stimulating people with Alzheimer's disease to remember the past in the context of reminiscence therapies. The system consists of a TV-size touch-screen through which the caregiver can select and display a broad range of multimedia triggers including old songs or TV/film videos [162]. Also for stimulating reminiscence, but oriented to a more general population of older adults and with the goals of motivating conversation, Blythe et al. [66] have explored the creation of map-based biographies (with google earth) and the exploration of photography archives. Although engaging and enjoyable, these ideas were also exhausting for participants. They refer to these technologies as providers of "tickets to talk" [304], a concept that is used to name situations or reasons that can serve as an excuse for conversation (e.g., for two people walking their dogs in the park, their dogs are "tickets to talk"). Blythe et al. [66] also designed the *SoundscapeRadio*, a system that provided a constant loop of sounds recorded in different places around the world together with pictures of the places. Both pictures and sounds stimulate older adults to reminisce about the places they have visited or where they have lived in the past. Our design, *Reminiscens*, follows the same idea of using "tickets to talk" to stimulate conversation around the practice of reminiscence. In particular, *Reminiscens* uses multimedia content and questions to stimulate people to remember their past and share it in a intergenerational context. Moreover, *Reminiscens* aims to contextualize these triggers based on people's life stories and interests. Interestingly, as we will mention also in our results, Blythe et al. [66] emphasizes the potential of ludic systems for intergenerational engagement. Unexpectedly, completing a timeline of stories and answering questions in *Reminiscens* represented, for some older adults in our studies, a ludic engagement in the form of a game-like challenge.

The Life Frame [158] is another prototype of a system whose goal is to trigger senior adults to remember their past. It followed an ethnographic study that evaluated the different type of "Mementos" (home distributed memorabilia or souvenirs that refer to people's past memories) like old photographs or objects from past trips that could be found in a typical Italian home. The prototype consisted of a small tablet-based frame that included a collection of personal and family selection of the home "mementos", which the senior could easily browse every once and while.

Social networks are also being leveraged as a source for stimulating memories, since they are increasingly becoming digital repositories of much of our experiences. Timehop[6] and Memoir [7] are examples of journaling applications that benefit from content that people shared in social networks for later displaying timely memory prompts in the form of "What you were doing Today, but X years ago".

Other ways of stimulating reminiscence include the use of music and smells. Although the following are not IT systems per se, they are interesting case studies of reminiscence stimulation to take into account. In the music side, the "Music and Memory" non-for-profit organization[8] uses personalized music with elderly who are either memory or mobility impaired and living in nursing homes across the US. The basic idea is to use iPod personalized music programs in the nursing homes to bring joy and improve the

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[4]Proust closing: `http://www.businessinsider.com/proust-a-site-for-memories-is-going-under-2012-1`
[5]`http://www.circaconnect.co.uk/circa.html`
[6]`http://timehop.com/`
[7]`http://www.yourmemoir.com/`
[8]`http://musicandmemory.org/`

quality of life of senior residents. A documentary of the project [9] shows the many different case studies in which music effectively help to improve mood, social interactions and other aspects by just listening music from their younger years. On the smells side, the Madeleine Camera is a proposal for special device that captures scents (rather than pictures) and relates them to specific memories[10]. Although the system is only a proposal, it holds a potential specially in the context of reminiscence therapies, for which smell kits already with tailored and bottled unique smells for provoking reminiscence exist and are in use [11].

Finally, stimulation of memory is deeply related to both preservation and storytelling when personal stories are used to stimulate people to remember. For example, Hallberg and Kikhia [174] designed a system to be used in the context of reminiscence therapies to help the caregiver selecting and showing multimedia content to patients related to their whereabouts, which were previously recorded by a lifelogging system that tracked their activities and preserved them in a digital format. The content that was recorded by the lifelogging system (typically, a wearable camera that passively takes pictures) is later organized in an activities review interface that the caregiver can use to select content to show as stimuli.

4.2.2 IT for storytelling

Storytelling is not necessarily linked to reminiscence practices, but can be a fundamental part of exercising it within a social context, which is the case of *Reminiscens*. The study of technology for storytelling has resulted in broad corpus of literature under the umbrella term of *Digital Storytelling (DST)* [178]. With its origins roughly traced back to the mid-1990s, DST refers mainly to the use of digital media to allow people to share their life stories. Most work in the area is focused on digital stories that are often a "combination of photographs, drawings or other material with the author's voice" accompanying [178].

In this context, a first example of an interactive system for storytelling is Palaver Tree Online [131], an online community designed to facilitate intergenerational interactions between children and elderly, where the first have the chance to send questions to the older adults with regards to a range of topics, but particularly about history. Memoro[12] is another example of a tool that allows elderly to tell their stories through digital media, in this case through videos filmed by smartphones with the Memoro app.

Taking into account the definition of DST as a digital "combination of photographs, drawings or other material", the TimeCapsule[226] is an example of a tool DST, allowing people to record location-based stories in a digital form through the mobile phones. These stories are later retrieved by others when they are passing by the corresponding location. Similar to the TimeCapsule, GEMS[13] [289] is a location-based storytelling game by which people can record stories that are related to a particular place, and later share them in the platform for others to discover them. They idea behind GEMS is to encourage people to reflect on their experiences and share these experiences about places that are worth visiting. Each player will receive "directives", stimulating him to share a reflection about a particular place or memory. The more a player respond to directives, the more access will she have to the "databank", the pool of secret information about an impending fictional disaster that is upcoming. In an evaluation of the game, the simple use of directive was already effective for supporting the storytelling process, and the tokens

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[9] The Alive Inside documentary: `http://aliveinside.us/`

[10] Demo of the Madeleine Camera: `http://vimeo.com/68778690`

[11] Smell a memory Kits: `http://www.jwt.com/en/news/singapore/singapore/jwtsingaporeandgivaudancreatesmellamemorykits/`

[12] `http://www.memoro.org/`

[13] `http://gems-game.herokuapp.com/`

earned for accessing the fictional story was considered as a "light but encouraging" reward. Another similar mobile location-based game for storytelling is "Making Stories" [330], which suggest activities to do nearby and then, in the future, prompts users to remember activities in which they participated once they are passing again nearby that place.

As with the TimeCapsule, also the Timecard [54] supports storytelling, by letting users curate a timeline of family stories in a digital medium to be later displayed in a special device. The Timecard prototype was later extended to the Project Greenwich[14], which has been used as a framework for authoring personal stories with elderly [348]. Similar to this project, *Reminiscens* also features a timeline as the organizing framework for the stories that are shared in the system. Interestingly, in a field study of the Project Greenwich, participants were asked to create timelines of their lives and did so but adding also contextual information around key events, pointing in the direction that contextual triggers around life stories might indeed play an excellent stimulating role for storytelling, which is one of the design insights that led the development of *Reminiscens*.

In a somewhat different approach, the *Assistive Story Intervention Technology*, or ASSIST [164], is a monitoring application that listens to a conversation with the goals of detecting potential problems in the flow of conversation. If problems are detected, ASSIST provide suggestions to the Facilitator on what to say next to stimulate the narrative and sustain conversation. ASSIST is an example of a design for storytelling that is not intended to directly supporting DST (i.e., the creation and sharing of stories in digital format) but instead is intended to to help a caregiver in guiding a reminiscence session with Alzheimer's patients. In terms of goals, ASSIST and *Reminiscens* share the same objective of supporting conversation around memories, as to facilitate conversation. In this line, it has been noted in previous research that the role of technology in supporting storytelling would be that of providing prompts or assisting the listening process [138]. In other words, the key role that IT can fulfill is again that of stimulating reminiscence, and starting in from this stimulation, stimulating storytelling.

4.2.3   IT for preservation of memories

Perhaps the most addressed design space for reminiscence (although not always with that purpose) is that of technologies that aim to facilitate preservation of people's life stories. A first example of these technologies is the SenseCam[15], a digital camera designed to be worn around the wearer's neck which can passively take photographs without any intervention by the wearer. The SenseCam is both an interesting case of self-logging and a controversial piece of technology. While some studies have identified reasons why such a technology to capture and preserve life stories might be useful (e.g., to help patients with memory impairments [184], to stimulate reminiscence and sharing in family settings [82]), concerns have been raised regarding privacy issues (especially of people who is not wearing the device but being recorded without authorization). Most participants of a study with the SenseCam stated that they would tolerate the technology for "particular purposes", but would prefer to be informed about and to consent to recording and grant permission before any data is shared [259].

The SenseCam is only one example of type of technologies focused on the capture and preservation of life stories, categorized under the umbrella term of *lifelogging* (others being MyLifeBits [153] and the Narrative Clip[16]). As noted by Caprani et al. [82], this type of capturing can provide an augmentation

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[14]Microsoft Research's Project Greenwich: `http://projectgreenwich.research.microsoft.com/`

[15]Commercially available as the Vicon Revue: `http://viconrevue.com/`

[16]`http://getnarrative.com/`

of memory and create opportunities for storytelling and sharing within groups like the family. However, the concept has also raised criticism for a lack of a more human-centered approach in the realization of the grand ambition of augmenting memory and "obsession with capturing everything" that should be revised with a "more precise specification of what it means to support human memory" [312]. Sellen and Whittaker [312] have noticed "focusing on *total capture*" approaches to lifelogging "have failed to explore what practical purpose such exhaustive personal digital records might actually serve", and instead suggest, among other things, "to better understand cueing processes to build systems that genuinely support user requirements for memory support" hinting a focus on stimulation of memory rather than full preservation as better approach.

Less intrusive examples of lifelogging can be found in journalling applications like DayOne[17] or Hey-Day[18], which capture places and pictures you take through out your day and organizes them in a easy to explore later on. Indeed, mobile smartphones makes it easier for a softer kind of lifelogging to be possible, where users have a more ample control on what they preserve for posterity.

Although not in the scope of this dissertation, much of the work in this area is also covered under terms such as the *quantified self* or *the internet of things*, whose purpose is not so much to support human memory but rather to leverage upon sensor technologies to capture all kind of data about human and personal activities (i.e., number of daily steps, sleep hours and quality, nutrition, health vital measures, etc.), which can later support applications for improving health and well-being. We do not cover these in this section, but they are part of how information technologies support preservation of life stories (or rather, life data).

Other systems for preservations are targeting the content we are sharing in social media and networks, organizing them in a way that is searchable and reusable for supporting people's reminiscence experiences. Rememble[19], Memolane[20] and Moment.me [21] are some examples of these technologies, which have not found great success so far [22]. Perhaps the most successful of these systems is the already mentioned Timehop, which is more focused on stimulating people to remember after having obtained content that they shared in social networks. Popular social network services themselves are accommodating the support for reminiscence in their design, which is the case of the Facebook Timeline [23] and the Path Social network[24].

More and more, social media and social network are becoming *technology heirlooms*, a term that refers to digital repositories of human memories and stories [262]. These "digital legacies" we are leaving behind raise questions about how people's digital media could be passed down or inherited within family or community contexts. Examples of technologies that explore these issues in particular are the Timecard, the BackupBox and the Digital Slide Viewer [54]. The Timecard is a custom-made device that allows people to assemble, present and hide away digital content of the family along a timeline. The Backup Box stores the twitter timeline of a person in a local archive of the family. The Digital Slide Viewer presents family pictures in the form factor of a slide viewer. All these prototypes have been tested within family contexts, opening a whole research area on how families would like to treat these archives, mostly

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[17]http://dayoneapp.com/
[18]http://www.hey.co/
[19]http://rememble.com/
[20]www.memolane.com
[21]http://moment.me/
[22]Memolane Shutdown: http://techcrunch.com/2013/02/21/memolane-the-internet-time-machine-app-for-
[23]Reminiscing through timeline: http://ireport.cnn.com/docs/DOC-764348
[24]http://path.com/

mimicking the way physical material heirlooms are treated. While a prototype like the BackupBox was heavily resisted for merging different people timelines into one, the Timecard was appreciated as a good way of supporting both storytelling and preservation of family memories. This shows tensions exists around these kinda of technologies that must be further explored as more and more of our stories are digitalized.
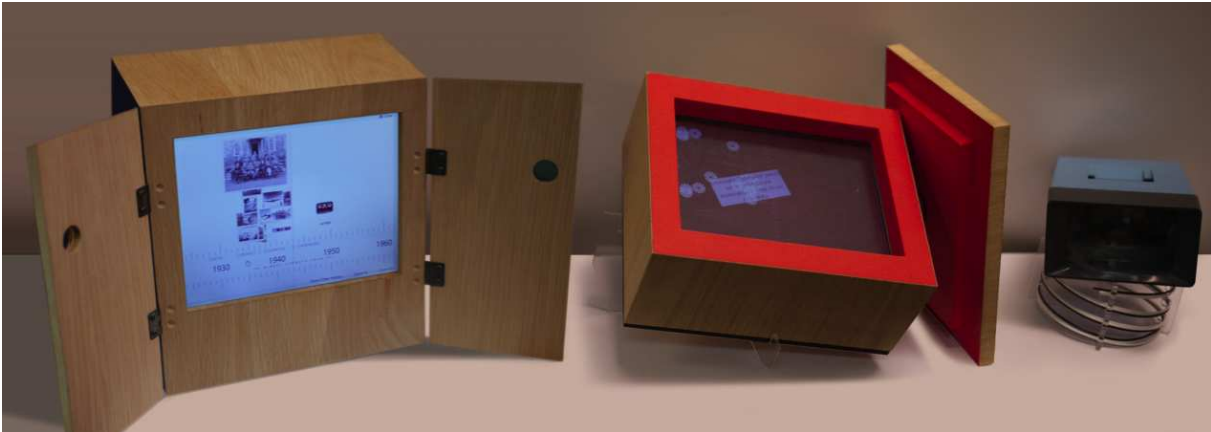
Figure 4.4: Technology Heirlooms prototypes as proposed by [54]

In a community context, one example of a technology heirloom is the already covered TimeCapsule [226], a social network service that leverage upon mobile phones for recording personal/collective memories that are related to a specific place in a community and which can later be retrieved in a contextual exploration, while passing by the place of the memory. The TimeCapsule also allows users to record themselves telling the stories of the places, which makes it interesting not only for preservation, but also for storytelling. Similarly, also this section previously mentioned Facebook Timeline, Path, Rememble and Timecard can be all considered as IT for supporting storytelling (or curation of memories for sharing purposes). In the same way as preservation can provide the basics elements for stimulation, it can also do the same for storytelling, in which case the stories told can later become the preserved memory. In the next sub section, we will briefly explore this last design space: storytelling.

4.3 Exploratory work: Reminiscens

To study this practice and observe how technology can support it in a context of face-to-face social intergenerational interaction, we created *Reminiscens*, a tablet application for organizing personal life stories in a timeline and stimulate people to remember and talk about memories. Reminiscens went from being an *exploration* to become the core work of this dissertation. As such, it will be described thoroughly in chapters 6 and 7.

During its exploration phase, preliminary results related to design process of *Reminiscens* have been published in [273] and [274] .

5

Methodology and research plan

During the whole duration of this doctoral research project, a common denominator of interdisciplinary research principles and approaches have been the hallmark that guided our work. In this chapter, we describe these principles in terms of how they have influenced the research plan. We start by defining the epistemological positioning of the whole project, providing also a conceptual overview of this positioning. Then we present the research plan and explain how these principles were explicitly instantiated in it. Finally, we describe the three main phases of the project in terms of the research activities and methods of each. For each methodology that we used in some form, a brief description of its origins and definitions is included in order to build a complete conceptual background that methodologically and ethically frame this dissertation.

5.1 Epistemological positioning: Participatory Action Research

During the studies and activities reported in this dissertation we have generally used an approach that consisted on spending much of the time in the field working directly with a community of older adults, rather than proceeding by surveys. Our intuition indicated this was the best way to obtain both experience and knowledge about the needs and expectations of the community, in terms that would be better grounded in the local reality. Complementing this approach, our involvement in the community was led by participatory principles, trying always to make progress in our research by enabling the participation of the community at the center of it. This resulted in a series of activities that had a double nature: they were research activities (with methods for collecting data and observation in place) from the perspective of this project; and they were also a genuine participation opportunity from the perspectives of the members of the community, who enrolled themselves because they saw a potential value in being part of the activities. In following these principles, this dissertation is epistemologically positioned under the scope of the *Participatory Action Research* (PAR) approach.

PAR comes from the social sciences as a result of a combination of principles from two different research ethical stances: *Action Research* (AR) and *Participatory Research* (PR). *AR* is defined as "supporting and

engineering change as an integral part of the research process" [300] and it was introduced in the 1940s within the social sciences as an "approach toward social research which combined generation of theory with changing the social research system through the researcher acting on or in the social system"[343]. *PR* has its origins in the 1970s, in the work with oppressed groups of people in developing areas, and it is characterized for being a type of research where people of the community or workplace control the entire research process, including identifying the problem to be studied [173].

Despite having different origins, both AR and PR broadly overlap in the principles that say that the research process should ultimately be guided by the participation and action of the community that will be directly affected by the outcome of the research. Usually they are used interchangeably to refer to the same ideas, although each emphasizes a different aspect (participation or action). Joining both traditions, **PAR** is a "systematic investigation, with the collaboration of those affected by the issue being studied, for the purposes of education and taking action or effecting social change" [163]. With PAR, both *action* for the improvement of the community and *participation* in the community come to be of equal importance, bringing the benefits of both to the research endeavour whose main objective is to produce some form empirical knowledge from the process.

Often, PAR is also viewed as an "an umbrella term for a school of approaches that share a core philosophy of inclusivity and of recognizing the value of engaging in the research process those who are intended to be the beneficiaries, users, stakeholders of the research" [83]. With its aim at improving the opportunities for social interactions of older adults (a part of society that can often be at risk of exclusion), this inclusivity is in fact at the core of this dissertation's goals. For this reason, PAR seemed to be not only a powerful approach for our research but also an ethical one by which both researchers and members of the community are at an equal level, and collaborate with the goals of producing knowledge that supports the improvement of the community. In PAR, "the term **'research'** refers to the scientific activity of producing empirical knowledge, the term **'action'** identifies the object of that research and **'participatory'** refers to the type of practices implemented in conducting the research" [285]. The key of a PAR approach is not in the specific methods that are employed to gather data (i.e., participant observations, surveys, deep interviews, etc.) but in the active involvement of the people whose lives are affected by the issue under study. This includes also the researchers themselves (who are also affected by the research process).

As a research process, the PAR approach involves a "spiral of self-reflective cycles" of the following steps [201]:

- Planning a change (e.g., improve the IT skills of senior citizens through a laboratory of technologies planned by and for them)

- Acting and observing the process and consequences of the change (i.g., conducting the laboratory and collect observations)

- Reflecting on these processes and consequences (e.g., analyzing observations in the look for potential difficulties and results)

- Replanning (e.g., adjust the format of the laboratory to make it easier to follow)

- Acting and observing again

- Reflecting again, and so on...

As examples of each step, we have purposely mentioned the research activities that we have conducted in the initial phase of this project. Other key features of PAR projects include having an empowering

and co-learning nature, the ability to build capacity and change systems, an emphasis on both balancing research and action and encouraging sustainability through long term collaborations [285].

When it comes to the application of PAR with older adults, a recent survey on social gerontology studies that used core principles of PAR in their approach found that few examples exists of PAR being applied in research with older adults [64]. The few that have applied it (10 studies in the survey) highlighted that PAR principles added value to their research projects in terms of research quality and action outcomes, further benefiting the elders themselves by allowing them to acquire new skills. The survey also concludes that, even if the use of PAR principles in these studies was challenging and labour-intensive, "future gerontology should include research with, rather than just on, older adults and their caregivers to utilize these individuals' invaluable knowledge as co-researchers" [64]. In one example of such studies, PAR was used in long-term care (LTC) and assisted living settings with the goal of promoting residents' competences and their active engagement and leadership [320]. The number of people involved in the project (around 50) along with the amount of commitment for participation (1 hour per week during 4 months) speak of why a project of this characteristics might be considered to be labour intensive, with the challenge set on sustaining participation. Despite the challenges, however, PAR was found to be a viable method for stimulating "creative resident-led reform ideas and initiatives in LTC" and it "may be incorporated productively within myriad reform efforts to engage residents' competences."

PAR in this dissertation. The broad scope of "designing IT for intergenerational interactions" added to the high heterogeneity of the target population (i.e., "the elderly") made it very difficult to scope down the project into a more specific set of research questions and goals. Literature review and exploratory works progressively led us to a more concrete interest on socializing within face-to-face contexts, but we still had a lack on understanding about what the real challenges were. Looking for a better way of grounding the project in reality, as the means for finding a more concrete design space to focus on, we needed a more active involvement within a community of older adults to get first hand experiences of their needs and expectations to complement the literature-based and design-based attained knowledge. It was clear at this moment that the project was destined to be an interdisciplinary one, and that the researchers involved would have to understand some approaches from the social sciences in order to get it going. Following this realization, it was decided that this involvement should entail a benefit for both researchers and the community. The interest of researchers was on finding and understanding potential design spaces for IT to play a role in the improvement of the social dimension of active ageing. But what could the interest for the community of older adults be?. After approaching a local community of seniors, it was identified that one such interest was that of learning how to use and engage with modern IT systems. From there on, the PAR-guided research collaboration naturally evolved around the topic of learning the skills to interact with modern IT. Our role, as IT designers and engineers, became that of trainers within a community project where older adults decided what the skills they wanted to learn were. While at the same time we would observe the evolution of the experience on the look for needs, expectations and challenges in their relationship with technology. The laboratory of technologies was both a container of our research and a driver of participation and action by which the goal of increasing social interactions and active ageing were already being achieved in this community. For this reason, the laboratory was extended up to the very end of the project (and will continue afterwards). This approach, and the participatory principles of PAR, remained also consistent in later research activities, albeit non being as explicit as in the laboratory, which we describe further in the following sections.

5.2 Research plan

With the PAR approach in mind as our guiding methodological and ethical framework, our research plan is structured in three main phases with each applying participatory action principles for its development. Figure 5.1 shows a summarized view of this plan, with its three phases indicated as timelines, each including one or more *key research activities* in which one or more *methods* are used for gathering data and analyzing it. Notice that all three phases last up to the end of the project, indicating that they were not self-contained but rather, cyclic, constantly ongoing, processes that continued through all the research once started, with the only difference being when they started. As seen in figure 5.1, our project iterated

Exploration Phase

Key Research Activity:

- Literature review
- Exploratory works
- Exploratory workshops
- The Laboratory of technologies

Methods:

- Participant observations
- Grounded theory inspired qualitative analysis

Design Phase

Key Research Activity:

- Design and engineering
- Participatory design workshops

Methods:

- Co-design
- Participant observations
- Grounded theory inspired qualitative analysis

Evaluation Phase

Key Research Activity:

- Field Studies

Methods:

- Participant observations
- Questionnaires and Interviews
- Diaries and Automatic logging
- Quantitative analysis
- Grounded theory inspired qualitative analysis

Participatory Action Research

Figure 5.1: **Research Plan.** The plan of the research of this dissertation.

cyclically through the following three phases, each with distinctive activities and methods (which are named here and described in detail in the following section):

- **Exploration:** the initial phase was aimed at gaining understanding of the problem domain of active ageing, its social component and the practice of social reminiscence. Literature review and exploratory works (described in chapters 2, 3 and 4) are key activities in this phase, along with some initial exploration workshops with older adults and the PAR project of the *Laboratory of Technologies*, in which we gathered qualitative observations that were later analyzed using an grounded theory inspired analysis. All three activities, continued up to the end of stages of the research project. In particular, the laboratory remains active and it has become a regular participation opportunity for the local community.

- **Design:** informed by the outcomes of the exploration, the research then started to focus its efforts towards the creation of an IT tool that would foster social and intergenerational interactions. Al-

though design was certainly part of the exploratory works, we refer to the design phase as starting with the active and participatory design towards the socializing experience chosen as the core focus of the dissertation: social reminiscence. Participatory design workshops were carried on in this phase, to both engage the community in the research process (through co-design) and gather observations. Using again a grounded theory inspired analysis, observations were turn into insights for design, which together with the insights coming from literature and the exploratory works, acted as input for the specific design and engineering activities related to the creation of *Reminiscens* (described in chapter 7.

- **Evaluation:** once our design was ready and implemented as a concrete tool we used it as a technology probe in two field studies. In these studies we targeted to a deeper study on the phenomena of interest (social reminiscence) based on the close observation of the practice, supported by IT in action. The studies were fundamentally observational, although in the last study we added also some experimental design characteristics in order to validate an hypothesis that emerged in the previous phases. Our evaluation phase has mixed nature between an experimental research (i.e., hypothesis testing, questionnaires, automatic logging of the system usage, statistical analysis of results, etc.) and a more open observational approach with its outputs being also analyzed in grounded theory inspired manner.

In this plan, PAR is explicit in the *Laboratory of Technologies*, which was entirely constructed with the community and had a strong action component in enabling the community to learn new skills by which they were reducing the so called digital divide and engaging in new unexplored modes of community participation such as the periodic writing of blog posts about communities' activities and the support in learning technologies for other members of the community. To a lesser extent the PAR approach is noted in the *Participatory Design* workshops, which emphasized participation more than action in the research process. Finally, also the field studies (which are covered in detail in chapter 8) had an 'action' element in the fact that by participating of the reminiscence study participants were co-creating a digital legacy and a book about their lives that would later be given to them as an outcome of the experience. In fact, as it will be noted later in chapter 8, some participants of the studies perceived the whole experience as an 'action' for them. And even if the study was not designed as a PAR project, its conduction and adjustment were always guided by the ethical stance of empowering the community to control their participation in the process. For this reason, all the research plan lies on top of the PAR approach foundations.

In the following sections, we will describe research activities and methods named before, along with a conceptual discussion of the methods we used for each, referring them to their conceptual origins.

5.3 Research activities and Methods

In this section we expand the description of each of the activities introduced in the research plan and provide an overview of the methods that were used within them, making emphasis on the conceptual background of such methods.

5.3.1 Activities and methods for exploration

We began this research project with the big picture of *active ageing* in mind, with our interest focused in its social dimension. Our initial approach to the problem consisted on a mixture between investigating

the state of the art (Literature Review) and learning by doing (Exploratory works).

Literature review allowed us to gain knowledge on the process of ageing and what does it take to make it a more active life experience (see chapter 2). As we moved forward, we scoped down our work to the social dimension of active ageing, exploring how social support is connected to happiness and well-being as we age, and how can technology help in achieving higher levels of social inclusion of older adults (see chapter 3). By the second year of the project, the focus was clearly limited to the practice of *social reminiscence*, so our literature research naturally shifted toward the interdisciplinary corpus of reminiscence theory, practice and related technologies (see chapter 4). Because it was the original focus, the most extended exploration is that of IT and active ageing, which is also the subject of survey we have prepared on the matter [277].

Exploratory works complemented the literature-based theoretical knowledge through hands-on design experiences on topics related to social interactions and active ageing. The first of such exploratory works was the continuation of an already started project about the design, implementation and evaluation of a mobile application for intergenerational communication called What's Up [119] (see section 3.3). Other exploratory works followed in later stages of the project, always adding up to the stack of knowledge about the big picture problem domain and its different IT-based solutions (see sections 3.4 and 2.5).

Exploratory workshops were conducted at the very beginning, as a first attempt at a participatory approach. These workshops consisted of a couple of visits to a nursing home, were researchers and older adults engaged in the playful testing of new technologies (namely, the iPad). This experience resulted in a rich dataset of qualitative observations that tuned our understanding of the needs and challenges of the older adult population, in particular of those who live under the close care of nursing home facilities. These workshops were also the seed that sparkled the idea of constructing a PAR project of continuing exploration and participation. An important note in this regard is that at the beginning of the project, our group had links with both a nursing home and a community center of older adults. Eventually, our collaboration focused on the later while other members of the research group focused on the first, which is why this dissertation revolves around our work with a more independent living community.

The **Laboratory of Technology** is what followed in exploration, a PAR project of a learning laboratory with an open program of topics, which were chosen with the community. The Laboratory is *action research* in that it allows participants to change their reality (namely, reducing the so called "digital divide" and already enabling community participation) while allowing researchers to explore that same reality in the look for a better understanding of how IT could positively contribute to it. It is *participatory research* in that it is organized in such a way that it tries to maximize the power of the community in deciding what to do next as the program progresses.

With respect to the **methods**, through all the exploration we have gathered two different kinds of data: literature-based conclusions and results in the form of papers or state of the art systems and; on the other hand, our own observations gathered during our exploratory activities and designs, some of which were quantitative observations, while most of which were qualitative in nature. Although not purely, for both types of data, we have used a similar method of bottom-up analysis by which we started from the data and derived from it our understanding of the domain, without an initial hypothesis or structure. Of course, literature eventually provided some structure and previous conceptual constructs, but in general, the approach for deriving knowledge has been always bottom-up.

We find a conceptual background for this type of analysis in a qualitative research approach from the social sciences known as **Grounded Theory** (GT). GT is used to develop theories that are "grounded in data systematically collected and analyzed" [253] without starting from a concrete hypothesis, but rather,

openly building the theory by coding collected data and grouping codes into conceptual categories that eventually lead to the emergence of a theory. GT is common in social sciences, where often the object of study is a social phenomena for which there are no clear initial assumptions. This is not entirely the case for the object of our study, which is up to certain point extensively covered in literature (active ageing and its social components are well researched topics, IT for social reminiscence is not so much), but still, given the richness of the qualitative observations that we have gathered, there was always a possibility of deriving knowledge that was not initially foreseen a priori in the form of hypothesis. For this reason, we used this type of GT inspired analysis with our collected data. It is important to say that in its origins, GT was devised as a method for generating hypotheses that would later be tested in more focused studies. Later on the term was adopted as a way for referring to the type of qualitative analysis that is performed in qualitative studies, but this is rather an evolution of the term and not its initial focus. Our use of GT subscribes to this latter appropriation of the term as we did not purely for generating or refining hypotheses.

Participant observations (PO) is a second important method we have used extensively during exploration (and also in all the other phases of the project). POs are exactly what they say: observations gathered by participants. Is essentially a "qualitative style" of gathering observations of an activity where the observer "seeks to become some kind of member of the observed group" [300]. In both the laboratory of technologies and the exploratory workshops, researchers' were both participant and observers at the same time. Sometimes, we tried to follow an structure in our observations (e.g., counting interactions or occurrences of a particular phenomena), but most of the times an open observation was more suitable (and richer in terms of collected information).

Participant observations has its roots in anthropology and is one of the principal research approaches in ethnographic research by anthropologists. *Ethnography* serves, hence, as a general methodological background for this method. Although many definitions exist, Ethnography can be defined as "the study and recording of human culture" with origins in the late nineteenth century British anthropology [172]. It is considered the chief approach for cultural anthropology and it consists mainly of a "long-term participation and observation to develop deeply contextualized accounts of contemporary ways of life" [172]. This type of true ethnographic research is only possible when researchers are fully immersed in the communities they intend to study. In HCI research, however, this kind of full immersion is not possible nor it is the focus of research to develop such a deep account of observations. Still, ethnography inspired methods (such as participant observations) are often used in HCI for gaining understanding of how technology is used in a specific context [215]. Millen et al. [248] summarizes these methods and how they can be applied in HCI under his proposal of a "rapid ethnography". Since the core benefits of ethnography come from its long staying on field and deep understanding of the culture, the term of rapid ethnographic can bee seen as completely contradictory with the principles of real ethnography.

Still, the ethnographic way of knowing has had an important influence in HCI research lately, mainly in terms of methodological approaches to data collection and analysis. This has led to the application of ethnography inspired methods in many research projects (this included). For this reason, it seems fair to mention briefly ethnography and its "rapid" version as one of the many sources of inspiration for our research methods. As defined by Millen et al. [248], rapid ethnography is based on three key concepts:

- *Focus and key informants:* as opposed to traditional ethnography, field work is stimulated but with a "narrowed" research question that should be well defined.

- *Interactive observations:* as with ethnography, the research should be grounded on the field but with a more heavy focus on gathering observations. To achieve this, rapid ethnography proposes

several approaches like having more than one observer or making the time in the field coincide with activity peaks (it also proposes to use participant observations)

- *Collaborative data analysis:* finally, rapid ethnography also relies on techniques that allow a team of researchers to collaboratively analyze understand their field data. One example of such technique is scenario analysis, by which several scenes or related clusters of events are represented using images from the field site.

In our explorations, we have relied on the approach of having multiple observers focusing at different phenomena, while also the analysis was performed usually in a collaboratively manner. The laboratory itself is still ongoing and in its fourth edition as of the writing of this dissertation. Even though they are part of the exploration phase, both the exploratory workshops and the laboratory are reported in detailed as part of chapter 6, where we present the overall process and results that guided the design phase of this project.

5.3.2 Activities and methods for design

The design phase started once we had individuated one particular socializing experience we wanted to focus our efforts on (i.e., the experience of social reminiscence in an intergenerational context). Following the insights we got from our exploration research activities, and continuing with the PAR approach, the design phase was conducted in two streams: one focused on designing both the experience and the tool for supporting that experience; and the other focused on engineering and implementing the design into a usable socio-technical system.

Participatory Design workshops were organized in collaboration with a part of the community of older adults who was already actively engaged in the Laboratory of Technology. Four PD workshops were held where they explored together the topic of reminiscence, including reminiscing themselves. In these workshops, older adults also participated of co-design activities with the researchers, using low-fidelity prototypes of the proposed system as this was being designed step by step. The workshops represent the core research activity of this phase. The goal of the PD workshops was to present concrete design ideas to the community for both validation and iteration based upon their feedback. A limitation of our application of PD, however, was that the original design ideas started always in the researchers' side, and the community was involved mainly to validate and improve the original ideas. This is not wrong in essence, but it introduces limitations to the process of design because it might be that participants are not really interested in the project at hand. The full detail of the workshops and their outcome are described in chapter 6, after the full discussion about the Laboratory of Technologies.

In parallel, **engineering and technical design** was realized following an agile software engineering approach based, in general terms but not purely, in the SCRUM methodology [309]. The lead researcher of the project conducted the implementation process in close collaboration with other two bachelor students. The team designed and implemented both the platform of Reminiscens and its user interfaces as part of the student's end of bachelor projects[260] [44]. The work was driven by small weekly or bi-weekly cycled iterations of design, implementation and testing following "stories" based on the experience we were designing for [1], and that were constantly being updated based on insights we were getting from the participatory design activities.

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[1]Part of the history of the implementation process is available at: `https://www.pivotaltracker.com/projects/689223`

Although lacking a clear plan for a social change, the workshops in this phase followed the PAR principle of actively involving members of a community in the research process that is centered around them. The PD workshops included also an effort for bringing a benefit back to the community, which in the end resulted to be two-fold: on one hand, the active community engagement and its realization in the community's center raised the interest from other members in participating of similar activities oriented to the fostering of digital or technologies' literacy; and on the other hand, the workshops were also a learning opportunity where participants had the chance of engaging with new forms of technology and learn about them.

With respect to **methods**, the most important method in which we have based our activities in this phase, and that is also closely related to PAR but more focused on design practices, is *Participatory Design* (PD). The origins of the PD have a strong political connotation, rooted in Scandinavian unions' projects for workers inclusion in innovation projects, but the approach has been subsequently adopted according to a rather broad spectrum of perspectives. A common distinction between different approaches to PD underline the difference between the political and the technical aspects of PD [129] or between the "pragmatic, theoretical, and political" approaches [165]. Based on a experience for democratizing the design process at work (the UTOPIA project) Ehn [129] argues that while the political dimension of PD raises questions of democracy, power and control at the workplace, making it a controversial issue from the management point of view, the technical dimension of PD holds the promise that by involving skilled users in the design process, the quality of the products will automatically improve. A different classification underlines the roles of the users, differentiating between design done "for, with, and by the users" [56, 71]. These roles summarize the balance of power between the designer and the user, where PD aims to include the users as peers in the design activities.

As defined by Simonsen and Robertson [328], PD is "a process of investigating, understanding, reflecting upon, establishing, developing and supporting mutual learning between multiple participants in collective 'reflection-in-action'". Typically, participants play the role of designers and users where "designers strive to learn the realities of users' situation" and users "strive to articulate their desired aims and learn appropriate technological means to obtain them". In particular, our interest is set on PD as a design practice for the design of information and communication technologies that ensures that the users who will use such technologies play a critical role in their design. With Carroll and Rosson [87], we contend that PD can support the inclusion of community members in processes related to technology and that this aspect has a central relevance in building a community. The application of PD for community development has also been explored by O'Day et al. [261], who reported about the experience of *Pueblo*, a network-supported learning community where "participants are simultaneously designers of a community and a community of designers".

It has also been argued that PD is related to the Ethnography in a fundamental level [215]. From the point of view of Lazar et al. [215], the focus of ethnography is really about understanding people (their practices, their beliefs, etc.), which makes it suitable for the understanding of problems that are to be addressed by the design and introduction of information technology, prior to the design itself. When it comes to design, however, participatory design can be seen as the process of using an ethnographic approach with the goal of building a system.

The PD workshops we have organized profited from the use of storytelling (i.e., motivating participants to share their stories with the community in verbal or visual ways), low-fidelity prototypes of the potential system we were designing (e.g., paper prototypes and interactive mockups) and co-design activities on top of the presented low-fidelity prototypes. In each workshop, younger volunteers worked as facil-

itators of groups with up to 6 older adults working around the same prototypes or activities. The lead researcher acted, in these cases, as the general coordinator of the activities. As with the Laboratory, **participant observations** where collected in each workshop, which always finished in a debriefing session that bootstrapped the analysis of observations. These observations were later further summarized by using again a **grounded theory** inspired type of qualitative analysis. Each workshop was distilled into a list of most important insights, which informed the design of the tool we were implementing in parallel with the engineering part of this phase.

5.3.3 Activities and methods for evaluation

Finally, the third step of the project was to take the resulting design and use it as a technology probe for a deeper exploration of the chosen human experience it was aimed to support (i.e., social reminiscence), with the goal of evaluating how much the design supported/facilitated/motivated the experience, while at the same time looking for other unforeseen results that could come from the interaction of people with the proposed system while engaging in the practice of interest.

Field studies are the main research activity in this phase, by which we have introduced our design in the 'field' and observed how the interactions unfolded while it was used to support a the experience of reminiscing within a social context. In particular, two field studies where conducted: a short observational study focused on the communities' practices towards a small photo display that they could use to share memories, and a longitudinal study focused on a series of intergenerational reminiscence sessions where older adults and younger volunteers met to talk about stories from the past while using our design. Both studies are described in detail, along the results and discussion, in chapter 8.

With respect to **methods**, once again we have relied upon **participant observations** that where gathered from each session of the studies, and these observations were again analyzed using **grounded theory** inspired coding techniques.

Moreover, despite the potential conflict with the open approach of analysis based in grounded theory, the second field study was also structured in such a way that it followed the lines of an experimental design aimed at validating some hypotheses that resulted from our exploration and design activities (namely, the design had characteristics which we hypothesized would stimulate social reminiscence to a greater extent). For this study in particular, in its a-priori design, we relied upon the *experimental research* tradition within the field of HCI, which is aimed at the validation of a previously stated research hypothesis. In this tradition, experiments are organized in the context of research studies, which if conducted in the field (i.e., outside of the laboratory), are known as "field studies". Experimental research in HCI is characterized by involving multiple conditions to which participants of the study are randomly assigned. Data that results from each experiment is later analyzed with statistical methods (if data is quantitative) or some form of content analysis (if the data is qualitative) [215].

In the case of our studies, we have used a mixed set of methods for analysis that started with a *grounded theory inspired* evaluation of the qualitative observations and then followed with statistical analysis of the structured logs of data generated by our system, which was also enriched with the output of the initial qualitative analysis. Moreover, the qualitative evaluation would continue still in parallel, and independently, of the experimental evaluation even after the latter would have started. For this reason, the experimental features of our studies were mixed with a heavy focus on gathering observations that were as open as possible to allow us not only to discover whether our hypotheses were valid or not, but to also to have the possibility of finding unexpected results that would extend the theories around

the experience of social reminiscence. Moreover, in order to support the data collection during our studies, we leveraged upon a myriad of research methods including post-study *interviews*, *within group experimental design*, *participant observations* (once again), *questionnaires*, *diaries* and *automatically collected logs* of the usage of the introduced system [215, 300]. The detail of how these methods fit within the studies are described in chapter 8.

5.4 Summary

In summary, the diagram in figure 5.2 shows the different research activities described as part of our research plan, along with their outcomes and how they influence each others. The arrows represent how these outcomes informed activities in the following research phases.

The **exploration phase** resulted in an increase of community participation through new channels that were opened by IT and by the learning of new skills (e.g., writing blog posts to inform about community's activities, teach or support teaching of digital skills to other members of the community etc.). For researchers, exploration activities improved the understanding of needs and challenges of the elderly population (with respect to IT). The laboratory had also a fundamental by-product: the establishment of a *trust relationship* between researchers and the community.

Trust had a pivotal role in allowing the organization of the PD workshops during the **design phase**. Each workshop produced observations that were distilled into insights for design that later, together with the increasing understanding of the needs and challenges we were gaining from exploration activities, informed the design of *Reminiscens*; the system we implemented for facilitating and motivating social reminiscence in an intergenerational context.

Field studies in the **evaluation phase** started from the design outcome of the design phase to deepen our exploration of the social reminiscence phenomena, as it was supported by IT. These studies finally resulted in broad corpus of observations, logs, diaries inputs and interview transcripts; which after a detailed analysis resulted in the final contributions of this dissertation, taking the form hypotheses validation (or disproof) and an extension of knowledge and theory based on our observations.
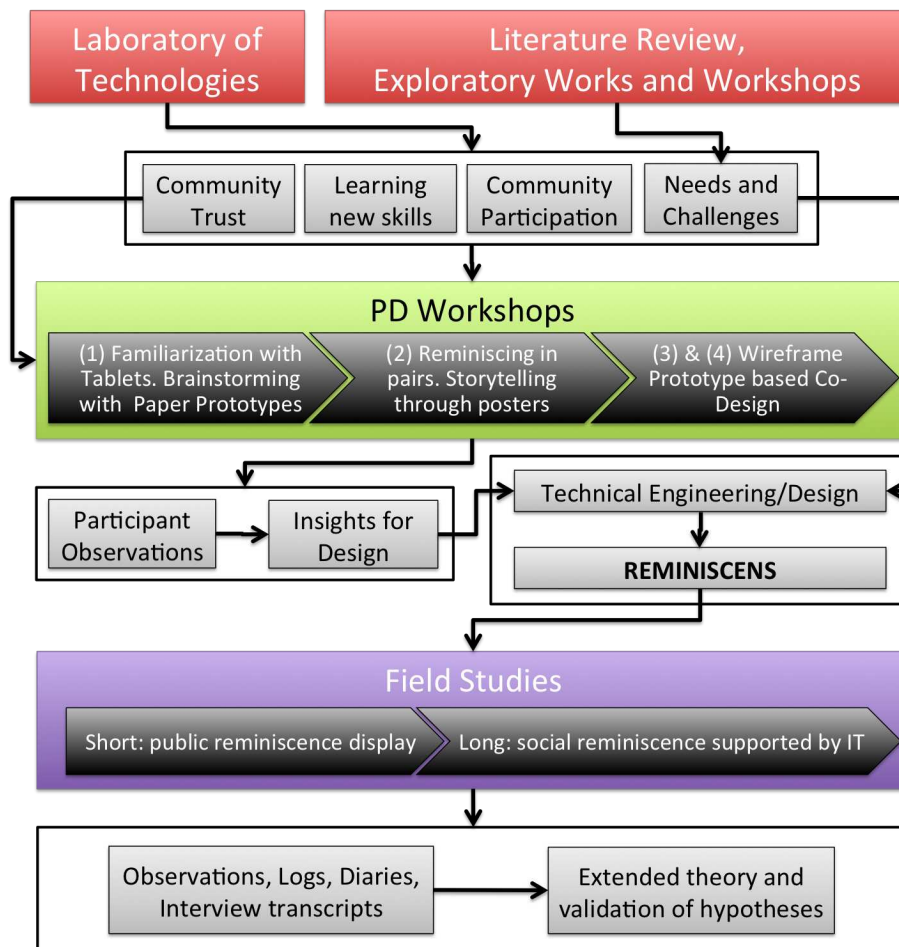
Figure 5.2: Summary of research activities and outcomes for each phase of this project

<div style="text-align: right; font-size: 4em; color: #999;">6</div>

Designing IT for Social Reminiscence

The process for designing *Reminiscens* as been a long, evolving process, where research and design have been most of the time intertwined in a loop of back and forth exploratory exchange. In this chapter, we describe the most important exploratory and design activities that contributed to our understanding of the problem domain, motivated the choice of reminiscence and face-to-face interactions as the focus practice, and informed the design of our proposed technology probe for stimulating intergenerational social interactions.

An ethnographic approach has been used through all of the process to gather observations and insights directly from the field (i.e., places like community centers or nursing homes). The chapter starts by describing the first two visits that motivated the subsequent interest in social interactions (particularly, face-to-face) and where we learned how heterogeneous was our target audience. The Kaleidoscopio "Laboratory of Technologies" follows, where we narrowed down our audience to independent living elderly, and which helped us to understand the general requirements, interests and design challenges of the community we were targeting to. The laboratories also motivated the choice of following a participatory approach to research and design. Finally, the last section of this chapter describes the participatory design workshops by which *Reminiscens* was developed, describing the lessons we learned, how we applied them to our design (showing our early mockups and prototypes) and what were the limitations of our process.

6.1 Research Activity: Exploratory Workshops

During the initial days of this research project, we were looking for activities that would give us insights regarding the many different needs of older adults. With this very general goal in mind, the first research activities we organized consisted of two exploratory workshops held within a nursing home known as RSA Brentonico[1], which is a residential care facility managed by a non-for-profit organization devoted

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[1]RSA stands for "Residenza Sanitaria Assistenziale"

to the delivery of social, housing and assisted living services for both self-sufficient and physically or mentally impaired older adults.

These activities were participatory workshops during which members of the whole research group brought some iPads to the RSA and engaged with the elderly by showing them how to use it. The goal of these workshops was twofold: openly explore topics of interest for the participants, while at the same time spotting the general challenges of using tablets (and technology in general).

During the activity, volunteers engaged with participants by exploring different features of the iPads including browsing the internet, sending messages, taking pictures and many other activities. Observers (and volunteers themselves) were in the site for taking notes about what seemed to be interesting and what sort of problems participants were facing when using the iPads. In this small section, we present a summary of some of the observations and learnings we got from these visits. These observations form the very first raw motivations that eventually led to the design of *Reminiscens* as a way for stimulating face-to-face social interactions.

6.1.1 Observations in Brentonico Visits

In general, the iPad seemed to be easy to use. However, trembling hands, audition problems and visual limitations hindered its use. In particular, when we tried to conduct Skype calls between residents of the RSA, we noticed that the volume of the ipad was extremely low for them to listen. Plus, they were not able to talk very loud making this even a bigger problem. The use of small earphones partially solved the problem although regular earphones did not fit well in their ears. Visual limitations, in the other hand, made it difficult to read web articles (particularly news, which was something many participants asked to see). In several websites there was the need for augmenting the font size. The process of how to do this in the browser was considered difficult to understand by the participants.

Trembling hands and difficulties in dexterity and mobility were also present when writing, scrolling and tapping the device. Doing only "one tap" to open applications was somewhat difficult, probably because the concept of pushing a button was linked with that of "pressure intensity". Scrolling pictures in the gallery, on the other hand, was usually a simple task. Writing was an extremely slow process particularly because it was difficult to find the letters and because when pressing them, usually tapping was for too long time making the letter to come up twice or even more times.

Unexpected situations happened often resulting in participants getting stuck, without knowing what to do next. For example, many times while writing, the touch interface was not responding so they ended up with the wrong word. When looking up to see the resulting word, it was frustrating to realize this situation and understand why it was happening or what to do to fix it.

Regarding the interestingness of content and activities, Google Maps proved to be a hit. Though its usability was not clear (participants did not operated maps directly, but always with the help of volunteers) the interest on finding their houses or places where they used to hangout was strong. The possibility of viewing pictures of these places ("Street View") was regarded as impressive. Taking pictures and sending to their daughters or other family members was also a hit, although several complications came up when trying to put the contact details, since at most what it is known to them is their relatives phone numbers.

6.1.2 Key takeaway: The importance of company

A general observation perceived during these visits was how much older adults living in the RSA enjoyed our visit by the sake of the visit. In informal talks with the director of the RSA and our contact in the place, elders were often mentioning how much they loved our visits and were asking when we will be coming back. This situation was observed also in all the subsequent activities we have organized, and became the key insight that sparked this research project and its focus on enabling face-to-face intergenerational interaction.

6.2 Research Activity: The Laboratory of Technology

In the search for understanding of elderly's needs and interests, we started out a project that took us on a wonderful journey of discovery and learning. Our original goal was a simple one: to go out in the field and talk directly with elders so that we can learn how do they engage with technology and how can ICT add positively to their lives.

How do we do this while offering something of value for them, so that they are motivated to participate? How do we engage them into an activity that is both enriching for them and for us all at the same time? That was the challenge: to avoid dealing with them as our "research subjects" but rather as people with whom to share a common path, although coming from a different history and going to different places.

Led by these questions, we have chosen a Participatory Design (PD) approach and headed off to a local elderly service community center (The Kaleidoscopio Community) for building a participatory experience with them. After some months of exploration, we started a "Laboratory of Technologies" with the goal of helping older adults to learn about computers and where they themselves were going to decide the topics and the program to follow on the go.

The resulting experience became an active collaboration between senior citizens and ICT researchers, that helped us in learning about how to improve our own ICT solution ideas and products while at the same time enabled high level of participation between elderly through the engagement in the lab and the resulting blog that came out of it.

In this section, we describe this activity and summarize what we have learned from it. ICT has proven to be a powerful instrument to enable community participation, but even more so, the participatory approach we have followed has had a considerably positive impact in deepening the relationship between our group and the group of users we are aiming to support. Most of the content of this chapter has also been published in [272].

6.2.1 Research Questions

To design new ICT for elderly and improve what we had already built, a participatory approach was needed to involve our end-users in the design process, not only to have them test our apps in the end of the design cycle, but to talk to them at the beginning of it in the look for a better understanding of their needs and desires. Particularly, we started the laboratory with two main research questions:

- What type of information and activities would elderly share with the world given the opportunities to do so through using ICT?
- What difficulties and challenges do elderly users encounter when interacting with current ICT?

Along with these, a third question was pushed forward regarding the method to use, to make it compliant with the principles of participatory design approach we were using for this research project.

- How can we answer our questions using an approach that is as respectful as possible of the people involved, treating them as research collaborators instead of research subjects?

6.2.2 Program and Development of the Laboratory

The answer to the third of the aforementioned questions is the "Kaleidoscopio Laboratory of Technologies" and its development gave us the insights for answering the other two.

From the 2012 up to now, three editions of the Laboratory were held and the fourth one is ongoing. More than 30 lab sessions have been organized, in which we have engage in teaching older adults how to use and interact with technology, driven by their interests, making our program evolving and participatory. The results and observations reported here refer mainly to the first edition while making only some brief references to the second. The whole experience can be divided in five moments.

6.2.2.1 Exploration

Having in mind the brief of planning a participatory experience that would benefit both participants and researchers at the same time, we contacted an Elderly Service Center oriented to self-sufficient older adults and managed by a local cooperative . The exploration consisted of involving first the people in charge of the center, in the figure of its manager, with whom we organized different encounter along three months of exploring the different possibilities for a joint collaboration. Finally, the winning idea was that of the laboratory, which would be framed with the motivation of helping elders in learning about the use of computers, ultimately giving them a concrete tool for reaching out and share their experiences.

6.2.2.2 Brainstorming

Once the activity was selected, and after promoting the first edition of the laboratory for a month, a brainstorming session with the subscribed participants was organized as the first day of the laboratory. In this session, participants were motivated to imagine themselves as being in charge of the communications magazine of the center and they were assigned with the task of answering the following two questions in a brainstorming session:

- What are the activities of your magazine?
- Who is going to be the reader of your magazine?

The goal of the first two questions was to identify how they visualized the idea of becoming communicators of the center in order to layout a set of topics of interest we could later use during the lab. Two more were drawn with the goal of identifying in general terms what was their background and what expectations they had about learning during the laboratory. This would later support the scheduling of each session around one specific task to perform with the computer and one tool to use for that task:

- What I know?
- What I would like to learn?

The brainstorming for the first edition resulted in a list of 157 post-its, which included the replies of 30 participants who attended the first day. For the second edition, participants were asked to imagine a how would be their days three months after the laboratory would have finished, making emphasis on the things they would with technology. From the analysis of what they have mentioned in this imagined scenarios, the initial topics for the Laboratory were derived, which in this case was more oriented to social networking.

6.2.2.3 Laboratory Sessions

Following the debriefing of the answers obtained in both brainstorming activities, we organized the laboratory to have weekly sessions, resulting in 10 sessions for the firs edition and 8 sessions for the second. Each session was focused on learning one of the tasks that came out from the brainstorming, using a tool selected by us and motivated around a topic that it could be of interest to them.

The task to learn on each session was planned on the go, during a debriefing meeting between the researchers after each day of the laboratory, where we would use our observations to decide the next iteration. The intention was not to cover all the topics, but rather to give enough time of practice for them to learn and us to observe the most.

In the first edition, of the 10 sessions, scattered along three months and held once a week, 5 were focused on writing documents (using open office), 2 on browsing the Internet (using Internet Explorer) and 3 on writing and commenting on a blog (Wordpress). These were the three main subjects that came out from the first session. Other topics of interest to them, which were covered within the others, were the handling of pictures and the use of an USB drive. Using the camera and taking pictures was one that could not be included because of a lack of time.

In the second edition, out 7 sessions, 3 were focused on email (using gmail), 2 on social networking (using Google+), and 2 on copying and moving pictures from camera and usb drives.

Each session was held in a computer lab of the Faculty of Sociology of the University of Trento. This physical environment had some important consequences on the mind setting of the participants, which we will further analyze later. Moreover, the computers in the lab were all equipped with Windows 7 as the operating system, and the user account policies of the university restricted the access for our lab to a very strict limited time.

At the end of the first edition of the laboratory, a Blog[2] was created with the goal of providing them with a concrete ICT artifact that would continue to enable participation in their community. The blog was chosen for two reasons: i) was one of the common topics that were mentioned in the brainstorming, and ii) it was the easiest to deploy and to learn of considered options (which included a full-featured website and creation of social networking profiles)

6.2.2.4 Final Brainstorming

After the final session of the first edition, an extra session was organized in which the initial brainstorming was repeated, using the same questions, with the goal of comparing answers and verifying the evolution of both their knowledge and their expectations for the future.

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[2]`http://test.lifeparticipation.org/kaleidoscopio/`

6.2.2.5 Follow Ups

To follow up the laboratory, participants were invited to visit us in our faculty, for engaging directly with researchers, designers and developers in what we have called the Design with Elderly Workshop. During this workshop, the participants played with our applications in small focus groups and brainstormed about how to improve them, helping us to detect 16 concrete design mistakes plus other 21 usability notes to take care of. The workshop itself, where we conducted both pure and participant observations, plus some concrete interaction analysis, produced a whole other set of qualitative data, which has been analyzed later as part of the analysis of the participatory design workshops that followed the laboratory.

During this workshop, a final questionnaire was also given to them, where we have asked them to answer to open questions about their satisfaction with the laboratory and their intention to continue the contribution to the blog.

Two more workshops were organized, with clearer goals, during the second edition of the Laboratory. The goal of the last workshops was to enabling a participatory design process around the topic or memory sharing. The details of these workshops are introduced here and detailed later the section about the participatory design workshops.

The blog itself is a mean for interaction and follow up. Having been actively updated after the laboratory, it has allowed us and other members of our group to keep in touch with the participants, enabling continuous community participation.

Finally, the laboratory has been so successful in sparking the interest of the Kaleidoscopio community that it has become a tradition and constant running collaboration between our research group and the community.

6.2.3 Participation and Collected Information

A total of 30 people registered to participate of the experience in the first edition, of which 26 attended to the initial brainstorming session, and 15 continued up to the last session. Almost all the participants were women (only 3 were men) and the average age was 68, placing the whole group in the young-old age segment (age 65 to 74)[3].

Figure 6.1 shows the age distribution, although the most important characteristic about the group is that they are all self-sufficient and independent. This was stable in the laboratories that followed the first edition.

6.2.3.1 The Blog

One of our goals, besides answering our research questions, was that of helping elderly users in reaching out to share their experiences through the use of ICT, enabling a continuous community participation and engagement. Following this goal we have analyzed several alternatives during the course, ranging from a full featured website to social network profiles in facebook for each participant and a virtual community within. Eventually, based on the interests for writing and reporting about the activities of the centre (as stated in the brainstorming session), we selected the idea of a blog as the best matching ICT artifact to empower participation in this community. The Blog was both easy to deploy and not too

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[3] Age groups based on the segmentation by Drolet et al. [125]
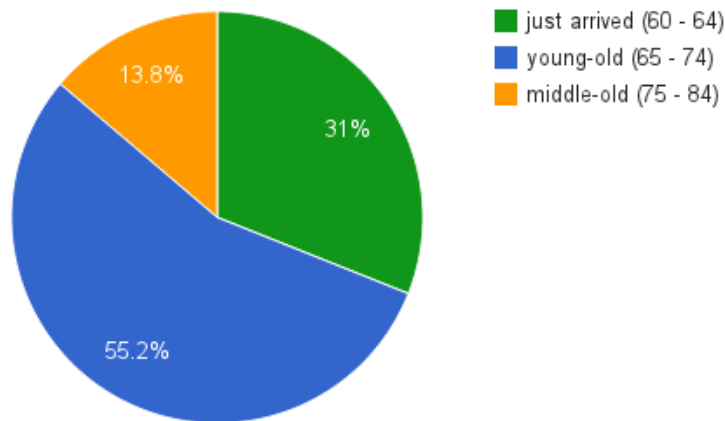
Figure 6.1: Age distribution of participants of the First Laboratory of Technologies

much complex to learn, while it would provide the basis for sharing their thoughts and experiences with a greater audience and not only themselves.

When we asked the participants if they would use the blog to share their activities, more than half replied positively. Figure 6.3 shows the summary of this user intention in number of people (of a total of 15).

Beyond this quantitative data, which is based on a low number of replies, what is really significant is that the user intention is reflected by the real usage of the blog afterwards, having a number of contributors almost equal to the number of people who had a positive intention when answering the questionnaire. Of the 15 participants, 6 have continued to contribute with blog posts. Half of them did so on a weekly basis (just as Figure 6.3) and the other half contributed at least once per month, contributing a total of 99 new articles in 84 days (from the end of the Laboratory in June 1st till August 23rd of 2012). The contribution was higher in August, with a growth of 200% in productivity with respect to the previous month. As of 2014, participation in the blog has declined starting in june of 2013, mainly because other IT related activities (tablet use courses, subsequent laboratories of technologies) drawn attention from the blog. Still, 1 or 2 blog post per month are still produced mainly by one of the first lab participants who are still highly interested in following with this activity.

While the participation has been good and sustained so far, the interaction through commenting has not followed the same path. Only 38% of the articles were commented, and mostly by the same group of authors plus facilitators, although this will probably change if the blog is better promoted.

6.2.4 Analysis and Discussion

The whole experience of this laboratory has provided us with highly rich dataset of qualitative information. A preliminary analysis of this information is discussed in this section, which will be later on

Figure 6.2: Home Screen of the Kaleidoscopio Blog

extended on a future work including more formal methods of analysis. The analysis follow the two research questions expressed at the beginning of the paper.

The first research question that motivated this experience was what type of information and activities would elderly share with the world given the opportunities to do so using ICT? All of the observation notes taken during the laboratory, text items resulting from brainstorming sessions, questionnaire answers and blog posts written by participants make in its whole a highly rich well of qualitative data we have just started to dig into.

From the point of view of our research, there are two things we would like to learn: which topics of interest are more common between elderly and how do they interact when sharing what interest them most. Although there is much more room for further analysis, this section briefly reports the insights we have gained along these goals.

The second of our research questions was what difficulties and challenges do elderly users encounter when interacting with current ICT? Analyzing the observations taken during the laboratory, and given the nature of our activity, we have found two main types of difficulties: those related to the usability of the technology and those related to the problems when trying to learn ICT. Following, we discuss our findings along these two main categories.

6.2.4.1 Sharing Interests

By analyzing what they write on the blog, we can find information about what type of activities should ICT for sharing support if it aims to help older adults to reach out and share their lives with the world, enhancing their social interactions.

With its 3 months of independent activity, the blog is still young, but by reading the articles posted so
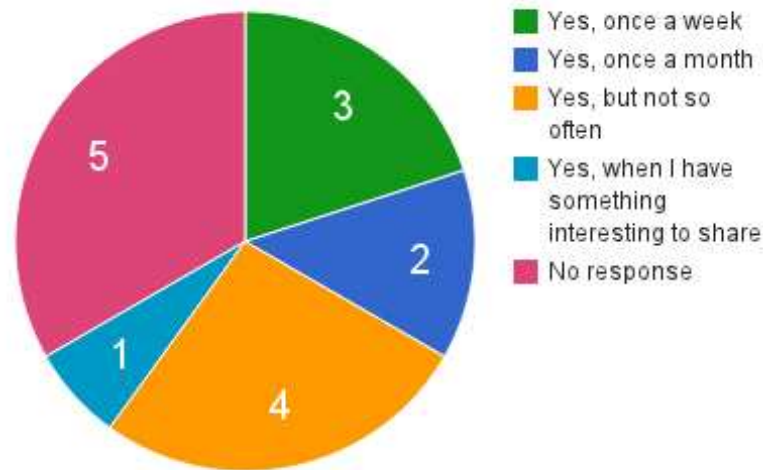
Figure 6.3: Blog use Intention of the participants

far, the three most important subjects they have shared are recipes, excursions and poems. A new trend, started on the last month of activity, is that of sharing wisdom pieces like phrases and short stories with an underlying message. We can think of this as a set of initial insights to guide the design of early prototypes for applications that support sharing of elderly life experiences.

Some interviews with people that often visit the centre have been also posted, making it seem as if the "journalist" role can have a very positive impact on them. Reporting interviews was one of the most commonly mentioned "activities" for the imagined magazine of both brainstorming sessions.

Also from the brainstorming sessions, the three main topics of interests (regarding learning ICT) were writing, making and sharing pictures and documenting interviews and activities of the centre.

Moreover, in the initial brainstorming, one of the most common answers to the question what would you like to learn was related in some way or another to blogging (e.g. some answers were "enter a blog and a social network", "set things up with a blog", "to tag and to blog").

And finally, even if many did not have computers at home or knew very little about them, most were familiar with terms like "twitter", "Skype" or "social network".

6.2.4.2 Interaction Patterns

The second set of insights to discuss have to do with how was the interaction both during the laboratory and when sharing things through the blog.

From this experience, the main conclusion we can draw is that elderly love to work in pairs. Or more

generally, they are highly collaborative. Even though each person had a computer of its own during the laboratory, many times we had found him or her working together on the same computer. And more so, several articles (around 30%) were actually signed by more than one person, or at least mentioned by name several others.

This means that thinking on multiple-authors collaborative blogging platforms has a great potential of use within older adults. And even more so, it also gives an idea of the level of engagement produced in this type of experiences and the potential of social ICT for these target users.

While they enjoy very much collaboration, they also like to express their individuality and ownership on the posts, which means that there is a need for having a way for each author to claim what it is his or her contribution, by enabling multiple author signatures so that they can see these articles as one of their owns and not only on the profile the user whose accounts was used to write it. This is something that came up on visits that we have realized to the centre after the laboratory.

We have seen how seniors have shown to be highly interactive and social when they have the opportunity. However, the little degree of commenting in the blog poses a challenge to the sustainability of this participation in the future, leading to the question of how much will this participation go on without an engaging audience that provides feedback and support.

One possible reason of the low amount of comments interaction is that the blog has not yet been officially promoted outside the centre. One of the authors also claimed not understanding how the comments work.

Moreover, according to both the coordinator of the centre and one volunteer, the blog has become one of the most important activities and even "the passion" of the authors, who are regularly coming only to write something in the blog. More importantly two out of the six regular authors have only started to frequent the centre because of the Blog. Friendship has also been triggered after blogging several times in pairs.

The Blog had also given new roles to some of the participants by enabling those who are more experts to become guides of the others. One of them in particular, who was always mentioning during the laboratory how difficult and how bad she was with the computer, have become one of the leading authors of the blog with 20% of the articles under her authorship.

While participation is certainly enabled, conflicts have also appeared when one of the authors posted too many articles on the same day, overshadowing other contributions.

6.2.4.3 Usability Difficulties

One of the most common difficulties we have seen our participants to tackle once and again, is the complexity of having to engage with an user interface (UI) that has multiple applications running all at the same time. It was often confusing to them how to go from one application to another, and instead of simply switching contexts (e.g. using ALT+Tab in Windows), the usual approach for most was to open the program again from the menu. This seems to indicate that most elderly users will benefit more from an UI that is organized to be wizard-guided or sequential.

A second very common problem had to do with the use of the mouse. Moving, clicking, positioning and dragging are considered difficult tasks for elderly [346] and this experience was no exception. Very often, they would find themselves moving text around when all they wanted to do was to select a piece of text, and these situation take us to the next important complication: undoing.

In the many cases where something unexpected happened (e.g. moving text instead of just selecting it with the mouse), it was unclear for most how to go back to the previous state, even after having explained several times the use of the undo option. This generated great anxiety and many times we heard the participants loosing confidence and saying "I am just never going to good for this" or "Forgive me, but I am just very bad at this".

Other problems were more connected to the incorrect mental models they had about computer and its different parts. One recurrent example was that many elders thought that once the USB was connected to the PC, everything should automatically be stored there. Understanding that the USB drive was different than the hard drive required us to use real life examples of real documents being move from one box to another. And this led to another problem in the use of files: understanding the notion of copies.

During practices of writing in open office, they were using the laboratory PC and then we were asking them to save the files in their USB drives so to take them home. However, once multiple copies of the same file were created, they were often loosing track of which was the latest version. Regarding the blog, the most important complication had to do with the fact that Wordpress' interface is overloaded with options, which in most of the times they won't use nor need. Before explaining, some people thought that saving in the blog meant also that the file was saved in their computer. There is a need for a simpler version of a blog with emphasis on the writing and content production experience rather than on organizing, tagging and categorizing the content. Regarding the content production experience, a common pattern was that of attaching a picture found online to the blog post (Figure 6.2). To support this, we installed a plugin of wordpress that allows users to access google images directly from the blog post editor. Even with this feature, it was more common to just open another browser window, go to google, search the picture, download, and then insert it inside the post.

From this brief discussion, it becomes clear that direct manipulation [319] and natural user interfaces [235], leaving behind the mouse and getting closer to things as they are in real life, are in fact the key for developing user interfaces that fit the needs of elderly, or at least, of elders who fit the characteristics of this group: self-sufficient, independent, highly active and mostly part of the young-old cohort (aged 65 to 74).

6.2.4.4 Learning Difficulties

The most important learning difficulty we have observed has to do with the different paces for learning that each participant had. These differences seem to become even more important, resulting in a very heterogeneous group with some people advancing very fast and practically self-learning, while other need of constant assistance to keep up with the laboratory. We have come to learn that slow information presentation and multiple repetitions, as noted by Mccort and Stanton [242], along with annotated step-by-step guides can be very useful tools to overcome barriers of learning in older adults. Many needed to write down everything step by step in order to follow these guides back when needed.

In particular, one problem for many had to do with the difficulty of doing two different things at the same time: following the explanation in the front of the laboratory while at the same time trying to do what it is shown in the main screen of presentation. One method we tested during the lab was to start by having an explanation session without any computer nearby and then got to practice in the laboratory. This has shown to be effective as a technique to get their attention.

The rapid pace that the laboratory sometimes had was a source of anxiety for some of the participants, and a couple of them left the course for this reason. It is fundamental to follow the progress of participants

closely and reassure them when they feel stressed for not keeping with the pace.

Figure 6.4: Laboratory disposition of participants according to expertise

The physical environment we had chosen posed also some important challenges on the mind setting of the participants. Originally, it was our intention to have sessions of mostly practice and not too much of teaching, but the disposition of the laboratory made people feel like in classroom and then everyone was taking more an attitude of student than that of someone who has come to practice and proactively ask question about things it does not know.

This disposition made it difficult also to us to personally follow to the people who were sitting in he middle of the tables, because there was no central corridor. Figure 6.4 shows this disposition, that later became an opportunity for more collaboration when we had realized the high degree of diversity in expertise and in pace. Dividing people in three categories of expertise, we have placed people who knew more about computer at the centre, where they could help with the activity of personal tutoring while we concentrated on those that needed the most assistance. This collaboration, in the spirit of participatory design, was also one of the key factors enabling the participation in this community.

6.2.5   Key takeaways: the choice for a participatory approach

In this section, we have presented an overview of a Laboratory of Technologies for elderly, planned and executed following a participatory approach. We have seen the potential of such approach not only for gathering valuable research feedback, but also to enable highly interactive community participation. We have realized through this experience that information technologies, mixed with a motivating participa-

tory environment, can empower participation of seniors in their communities.

We have described in detail our approach, heavily based on grounded theory and participatory design. An analysis of the observations we have gathered show that this is a highly suitable approach for a research phase where learning and exploring potential threads of work is the focus. For ICT, this approach can be especially suitable to gather requirements and inputs of target audience, useful for a future technology design process.

The information we have gathered helped us to produce preliminary answers for our initial research questions about the most common topics of interest, interaction patterns and the difficulties that older adults might have when dealing with ICT. We have seen how a simple ICT artifact (the blog) in a participatory context can enable community participation and engagement by creating close links between elderly who share stories together.

The most challenging part of a participatory experience is the post-experience. During such experiences, not only do you learn important lessons for your design or research, but you also deepen your relationship with the participants. And this of course has both a positive and a negative side. On the negative side, your analysis could be later on biased due to close relationship you have built. On the positive side, that same relationship has allowed you to build enough trust as to bring these participants back for future collaborations. This is, in the end, the most important outcome of this approach: **the relation of trust that is built with the target audience.** The trust we developed in these laboratories, where both researchers and participants had a role and something to gain and, particularly, where participants were actively involved in decision process of what to do in the lab, was the key for the future collaborations we held later in this research project.

The laboratories themselves can be seen as a *Action Research* project, because they not only helped us gain understanding, but it issued a social change in the community we targeted: **the laboratory was both the an input for research and an instrument of social participation and active ageing.**

Furthermore, following the insights we have learned about topic of interests, interaction patterns and difficulties in the use of ICT of elderly, the next logical step is to design new technologies that reduce or eliminate these difficulties maximizing sharing, henceforth closing this triangle with innovation. The following chapters delve into the specific design experience we have conducted to follow up this work.

6.3   Research and Design Activity: PD Workshops

Driven by the motivation for exploring reminiscence as a potential practice to foster social interactions in face-2-face interaction scenarios with the elderly, we officially started our work of crating an application that will empower individuals in the sharing and exploring their life stories. Named after the Latin version of the word, we envisioned *Reminiscens* as a tablet application to share, explore and rediscover our life stories in a fun way, having a bonding moment with our families in the process. To do so, the idea is to enrich people's life stories with related and relevant information that can motivate storytelling and conversation.

To design such application while at the same time evaluating its feasibility, potential usage scenarios and features, we have prepared a series of Participatory Design workshops around the topic of memories sharing and storytelling. In this section, we describe these experiences and what we have learned from them, along with the limitations of our approach. A summary of the insights described in this section has been published in [273] and an analysis of the asymmetries of knowledge and cultures within these

workshops has been submitted to an upcoming (at the time of writing this dissertation) conference of participatory design [230] .

6.3.1 Research Questions

We begin with the goal of understanding the impact of sharing and exploring personal life memories on the social well-being of elderly and how much could ICT contribute for motivating conversation and face-to-face social interaction around personal memories.

Our intuition is that by automatically providing enriched contextual information around personal life stories, ICT would potentially trigger the reminiscing process and facilitate the interaction with elderly while talking about their memories. Based upon this intuition, we explore the process of reminiscence trying to answer the following research questions:

- What content or artifacts are interesting for aiding the reminiscence process?
- In what scenario does reminiscing takes place? (where and with or to whom)
- What tool can best support the user experience of reminiscence?

6.3.2 The workshops

To explore our research questions, we have organized a set of participatory design workshops in which we engaged with elderly and observed them while they were remembering and sharing their life stories with each other. Four half day workshops, distributed in 6 months, averaging 20 participants, aged 60 to 84, and 5 to 8 facilitators each were organized with the same group.

Through all the duration of the workshops, facilitators and participants engaged in reminiscing activities (via questionnaires, storytelling and storytelling collage). Following a Participant Observation approach, facilitators took notes of every single interesting behaviour they have observed during the activities. Observations were semi-structured and focused in different aspects of the reminiscing process. The guides we have used for observations in each of the workshops are included in the appendix (see appendix D). Using a grounded theory approach, observations were analyzed and synthesized into the insights reported in the following section.

1st PD workshop: familiarization with tablets   **In a nutshell:** the goals of this first workshop were two-fold: i) to familiarize participants with tablets and its uses, and ii) to have a first brainstorming around the topic of reminiscence.

In the first workshop, we used our own tablet applications[4] for helping them to familiarize with the target technology. After half day familiarizing and playing with tablets, we showed them the very first paper prototype of our tool for reminiscence and brainstormed with them about what they understood and what was there to change (see Figure 6.5). This prototype was further tested after the workshop in informal meetings and interviews with some members of the group.

2nd PD workshop: reminiscing and storytelling   **In a nutshell:** the goals of this second workshop was to reminisce and observe the experience as it unfolded, as to gain insights about triggers and modes

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[4]Apps developed by the Lifeparticipation group: www.lifeparticipation.org
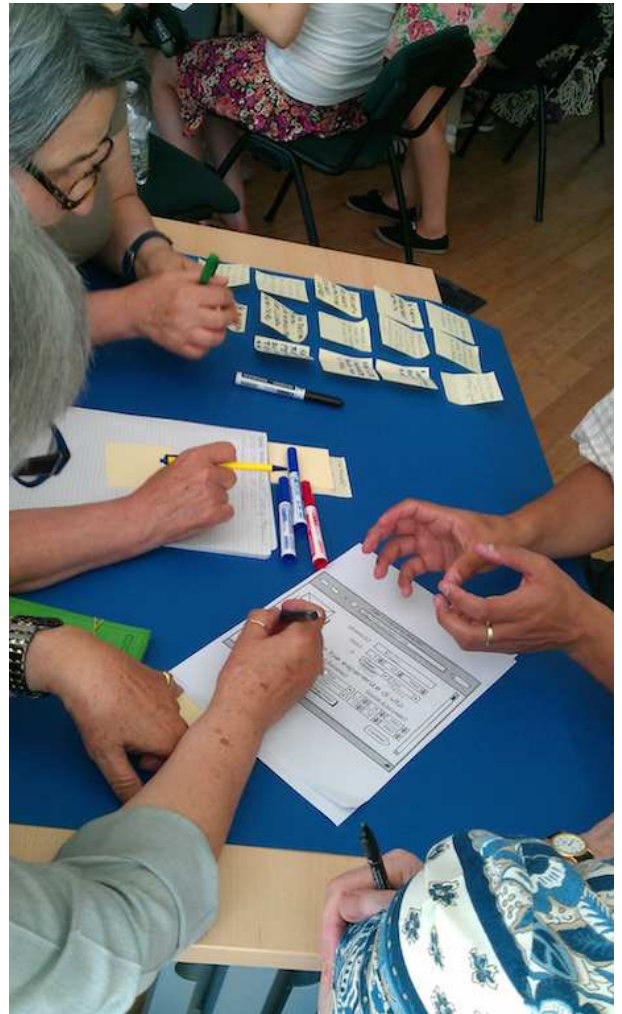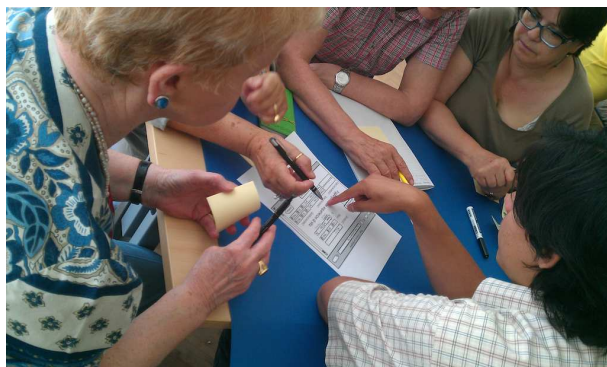
Figure 6.5: **PD Workshops.** Participants of the first workshop, brainstorming around the first paper prototype of Reminiscens

of reminiscence in the community.

The second workshop was fully devoted to the topic of reminiscence and storytelling. From the experience of the first workshop, we understood that a proper contextualization was needed to motivate the activity and make them understand our purpose. In other words, we had to trigger them reminisce and observe the experience. With goals of triggering reminiscence and observe them in their engagement, we asked them first to interview themselves in pairs using a life review questionnaire, which also helped us to collect some bootstrapping life stories from the participants with their consent. Then we conducted four thematic focus groups to explore how our life stories and memories are shared, with whom and in which settings. The discussion was done in the midst of a participatory design exercise by which the participants created a poster of one of the life stories categorized under one of the following themes: school times, work, travels, friends, affections, music, films, books and others. During the creation of the poster, participant had to use or create all the artifacts they thought were important to include in order to aid storytelling (Figure 6.6).
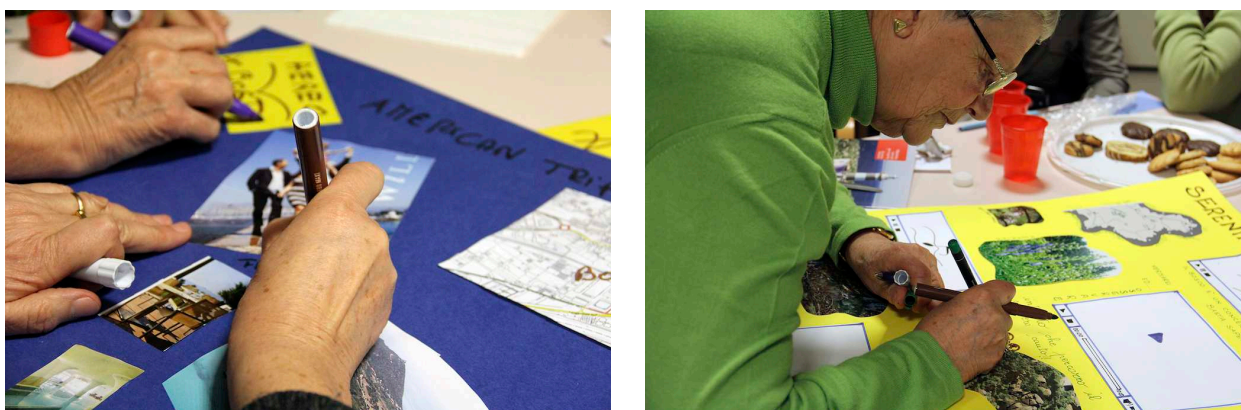
Figure 6.6: **PD Workshops.** Participants of the second workshop create posters to represent stories they shared in a first moment

3rd and 4th PD workshops: co-design   In a nutshell: the goals of the last two workshops was to co-design the final version of *Reminiscens* and clarify what was the contribution made by participants of the workshop.

Combining our intuitions, observations and questionnaires from the second workshop, we created a wireframe prototype of the tool. We played with and co-designed on top of this prototype during the third and fourth workshops, using both digital and paper versions. Facilitators observed which content seemed to raise more attention and interest, and which content or feature was confusing.

Using the answers to the questionnaires of the previous workshop, we created the prototype with real information some of the participants and other pre-defined relevant information related to some of their life stories, shared during the first workshop. During the workshop, they tested the wireframe and using paper versions of it, co-designed with us some blank spaces we have placed intentionally (Figure 6.7). Volunteers observed which content in the prototype seemed to raise more attention and interest, and which content or feature was confusing.

Finally, following a recommendation by a PD expert, the last workshop was also devoted to the comeback
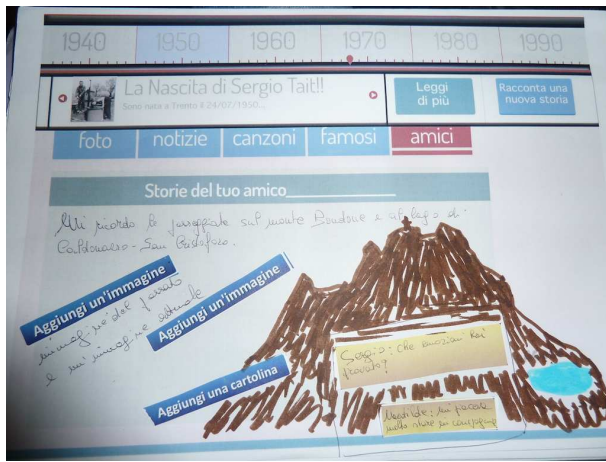
Figure 6.7: **PD Workshops.** Left, an annotated printed screenshot with both opinions and insights about how participants imagine using the tool; right, participants testing the wireframe prototype of Reminiscens

of the work done in the previous ones. We have realized in the previous version that a comeback was needed to make it clear what was the contribution they have made to this research. A video was prepared summarizing the experience with the goal of making more clear the outcome of the workshops and analysis behind. Moreover, in order to reconnect with the previous work, done in earlier workshops, posters were brought back and participants were asked to reproduce them, only this time using a digital tool [5]. The goal of this was to evaluate how storytelling was translated to a digital realm and how collaborative was the experience.

Figure 6.8: **PD Workshops.** Collaborative digitalization of posters with and without assistance using glogster

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[5]For the digitalization of posters, an online web tool was used, available at: http://www.glogster.com/

Focus groups. Two focus groups were organized to discuss with participants their reflections about the research activity. The first, was held before the last workshop and the second after the it. These focus groups gave insights mainly related to the research activity in itself (namely, the PD workshops)

6.3.3 Insights and Evolution of Reminiscens

The workshops informed our design in three domains: i) which content stimulates reminiscence, ii) in which scenarios does it takes place (where and with or to whom), and iii) which features can best support the user experience of reminiscence.

6.3.3.1 The content of reminiscence

The most important insight from the workshops is that triggers are fundamental for motivating reminiscence, especially "visual" triggers. Common triggers we have observed are post-cards and tourist guides from past trips, personal printed photos (particularly those related to travels, family and moments of pride) and newspaper articles. The use of visual cues was noted also in posters (Figure 6.9).

- Post-Cards from old trips, sometimes with the emphasis placed more on the back message rather than the front picture.

- Tourist Guides from past trips

- Environmental sounds ("sounds of nature") and music from old times.

- Personal pictures from old memories (particularly those related to travels, family and moments of pride)

- Newspaper articles. In particular when they contain something impressive (e.g. "the picture of a dancer without arms")

The easiest theme to explore was travel. Work-related stories were often associated with jokes and funny subjects as it was with school-related stories. Affections triggered opposite reactions: half reacted happily and ready to tell; half said it belonged to a personal sphere of their lives ("this story is only mine"). All this, however, can be very different in a more intimate context (e.g. family). When asked about old friends, in some cases there was a noticeable desire for finding them again. However, remembering those who had passed away can be a difficult theme and there was an emphasis on marking that these friends had passed away.

6.3.3.2 The scenario of reminiscence

Most participants would share their stories to "whoever wants to get in game" ("chi ha voglia di metersi in gioco!") confirming results of previous research (Thiry, 2012), changing only the level of detail according to the audience.A common scenario in the past was to meet with friends and explore old "slides" pictures.

Storytelling is described as a "fun activity", but not everyone is ready to do it publicly. Many expressed that memory exploration is also pleasurable when alone, because they can stay longer in "important pictures". Social reminiscence seems to be an experience for which half participants are very much interested, while the other half remain reticent. Reminiscence in general is however generally accepted

Figure 6.9: **PD Workshops.** Posters created by participants in the first workshop, showing their use of visual triggers

as a good activity, with some exceptions of people who "don't like to look back" ("a me non piace guardare al passato") or "I'm not interested in the past" ("a me non interessa il passato").

6.3.3.3 The experience of reminiscence

Most participants did not want to write and would rather just talk about their stories. Usually, there was a need of anchors for storytelling (e.g. initial questions about life). Moreover, when they tell their stories, the usually do it in epic ways, with eloquence. Once storytelling started, life was usually referred to as divided in stages (before and after marriage, before and after parenting). Therefore, a timeline metaphor was used for navigation in the prototype with two flavours: one divided in years and the other in stages (e.g. childhood). The year-based timeline proved to be simpler, while the stages-based timeline had problems concerning what was part of each stage (e.g. "does childhood include also my initial school years?"). It was very difficult to come up with titles for stories.

The collage itself is great user experience (particularly for group storytelling). Just doing the collage seemed to be perceived as engaging and fun: "it seems I am back to primary school" ("mi sembra di tornare alle elementari"). A highly important element of most collages were *cultural references* that just point out to a particular characteristic of the times or the places to which the story is referring to, not really linked to or part of the story being told (Figure 6.10).

Figure 6.10: **PD Workshops.** Analysis of posters with notes about how visual cues were made of both visual triggers of memory and cultural references

6.3.3.4 Evolution of Reminiscens

All these insights informed our design and influenced our original ideas. Figure 6.11 shows how our design evolved from a simple paper prototype, passing through an intermediate version (which already integrated some of the insights we got from the first workshop), up to the last prototype used in the last two workshops and later implemented with what was learned from them.

In the last prototype, the focus is placed on stimulating reminiscence by displaying information related to the context of personal life stories (i.e. triggers), categorizing these triggers into those we found were the most important (Figure 6.11c). Moreover, to provide storytelling anchors we introduced contextual questions before adding new stories (Figure 6.12a). The story editor was changed to be drag-and-drop driven, emulating the creation of story posters that was so much enjoyed during workshops and produced so much collaboration (Figure 6.12b). Voice recording was also added. After the workshops, we realized also of the potential for collaboration to tell stories about shared experiences. We included then a "collaboration" feature in our story editor, to allow users to invite others to contribute to the story. Finally, due to the importance of physical items of memory, we plan to include the feature of automatically cropping pictures, so that it will be easy to digitalize printed pictures (Figures 6.12c and 6.12d).

6.3.4 Reflections about the PD process

Working with elders entails taking into account that they are more fragile than younger people, sharing characteristics with other users with impairments [331]. We were aware and prepared for this issue in our previous experience in retirement homes, but we did not expect this to be relevant for this group of younger and autonomous elders, without significant physical or cognitive signs of decline. Nevertheless it turned out that the nature of reminiscence is too emotionally strong for some participants. In this sense, trust was key to maintain participation. Elders going to the daily center build trust in the staff, trusting the people working with or supported by the staff. We based our "approach to the elders" on building trust with them, but as it turned out, we were actually gaining an even more important trust relationship with the staff, who effectively became a gatekeeper of our relationship with the elders. Trust is also a long-term investment, which makes PD a costly endeavour.

Furthermore, the need of many facilitators for the workshops forced us to involve several volunteers, many of them available only for a limited amount of time, making it difficult to have appropriate debriefing sessions. A PD process like this would go much better if there are at least 2 or 3 researchers following the whole process and doing the analysis together. Another insight is the relevance of the time between workshops. When we left for more than one month, participants and researchers both took more effort in rebuilding the context for collaboration. Moreover, finding the proper mix between the unknown and the familiar is important, balancing "stability" with elements of "novelty" not only in content and features, but also in the relationship with researchers. It was reassuring for participants that some facilitators were always present. Finally, as it is probably common with users who had little experience with technology, abstractions such as video component images were complicated to grasp in co-design. It is better to replace them with simple, self-explanatory, labels that textually explained the meaning of the component.

A critical aspect also emerged in the focus groups with participants, when they discussed their understanding of the process. When asked to describe what they were doing and what was their contribution, before the last workshop, there was a clear confusion about the meaning and the goals of the activities. This confusion responds to two main reasons: the lack of proper contextualization about the project and
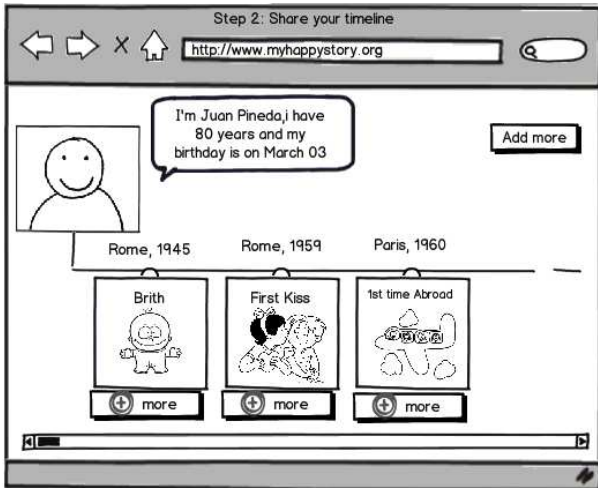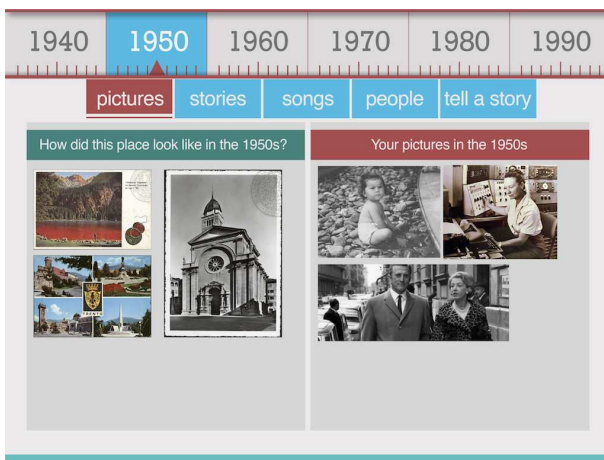
Figure 6.11: **PD Workshops.** Evolution of the design of Reminiscens. (a) First paper prototype focused on visualization through a timeline; (b) Second version focused on stimulation through questions and related information (c) Third version with the main screen focused on stimulating reminiscence with contextual cues; (d) Final version, with both contextual triggers in the form of media and question plus a timeline
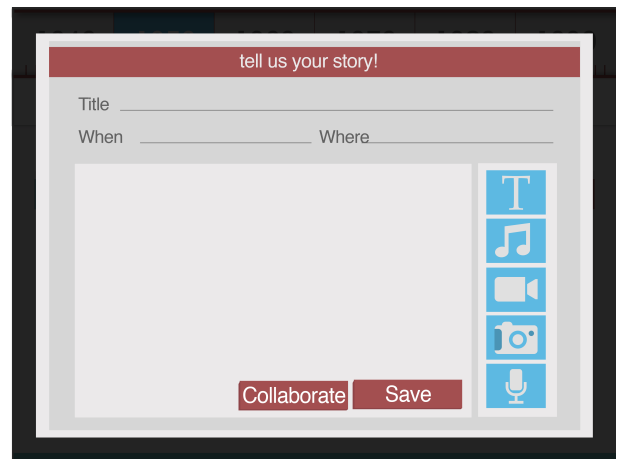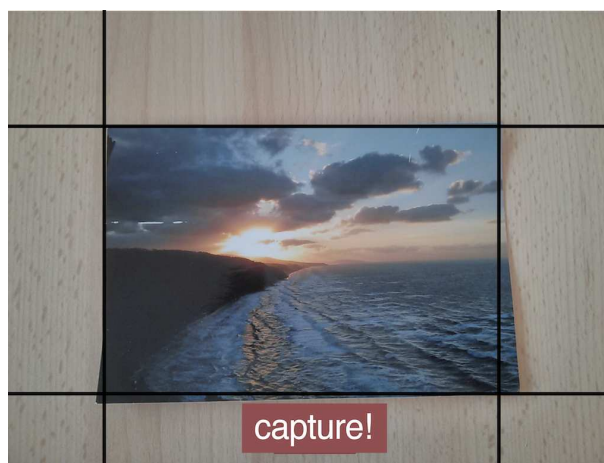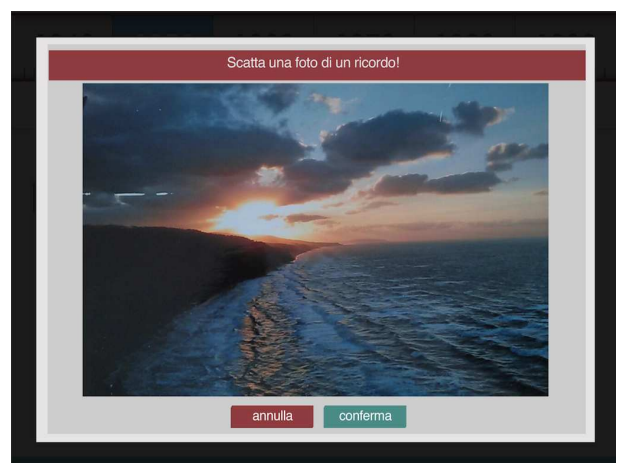
(a)			(b)		
(c)			(d)		

Figure 6.12: **PD Workshops.** Final prototype features. (a) Contextual questions as a starting point for storytelling. (b) Drag and Drop life story editor with voice recording support and a collaboration button; (c) Digitizing physical memories with the tablet's camera (d) Digitizing physical memories with automatic cropping of images.

the lack of involvement of the community in the selection of practice around which to co-design.

In fact, the choice for reminiscence was made by the researchers, informed by observations and literature, but was not actually consulted with the community. This is not wrong in itself given that there can be different levels of involvement in a participatory design process. In the case of Reminiscens, we can talk of "design for the user" by which the end user is not involved in the decision-making process but rather in activities that allo them to communicate their requirements and feedback about the system on the making [56].

In order to improve involvement and participation during the workshops in cases like our own, it is important that both researchers and participants share the vision and goals. This means that we would have probably had even more participation had we involved only people who is already interested in the topic and is would be interested in interacting with a socio-technical system of the likes of *Reminiscens*. In the same way, another limitation of our process was the little involvement of younger participants as co-designers in the same role as the older adults (to really create an intergenerational interaction scenario). This was partly compensated by the presence of younger facilitators who were actually participating of the activity.

Moreover, the critical aspects mentioned in the previous paragraph were partly solved thanks to a better contextualization and connection to the work done in the initial workshops (namely, the posters) that we achieved in the last workshop through the comeback video and the digitalization of the initial posters. It is possible that, for future PD processes in which some of the participants might not be *a priori* interested in the topic, the solution to engage them will come from a better strategy of motivation and contextualization that render the goals of the activity, and its expected outcome, much more clear and motivating for participants.

A final note about the participatory design process has to do with the impact of cultural backgrounds. The lead researcher of the PD workshops in this project was actually coming from a different country, and this became a limitation at the time of analysis. This was particularly spotted when analyzing the posters and stories shared during the second workshop, where several popular local cultural references (e.g., name of popular old TV shows, specific phrases from the region) in the contribution gave by the participants were not identified by the researcher. Only when someone who knew about this references was involved in the analysis, they were identified and actually appeared to be relevant for the purpose of storytelling.

A similar kind of "cultural impact" came from the computers engineering background of the lead researcher. At the beginning (the first 2 workshops) there was a focus on capturing design ideas through a heavily "structured" approach expressed in how the observation guides were created, which were much more complex than those of the last two workshops. Heavy structure gave place to a more open approach for the observation and organization of the workshops, with a focus more on the experience than on gathering information. It might seem counter-intuitive, but the last workshops rendered a richer output thanks to this open approach.

6.3.5 Key takeaways: insights for design and the importance of socializing

The participatory design workshops for Reminiscens confirmed our intuition that IT's role in stimulating reminiscence can be played mainly by the provision of timely contextual triggers: content that is somehow related to people's stories. This content can come both in multimedia format that emulate physical artifacts that bring back memories (e.g., pictures of old postcards, videos of songs from the past, news-

papers pictures referring to past historical events, etc.) or in the form of anchors for storytelling such as life review questions.

The workshops also helped us observe reminiscence in its social mode, in a intergenerational group context (volunteers and observers were also younger listeners in the workshops). There was a clear distinction between people who are ready to tell their stories in this context and those who prefer not to. Usually, the second group was divided in between those who are not interested in revisiting their pasts and others who like better to listen or explore the stories told by others. The workshops were before everything, a social gathering for participants and the hight engagement that they have shown both between themselves an with (outsider, younger) volunteers reinforced our motivation for continuing our work int he design space of intergenerational social interactions.

6.4 Summary of Insights from Research Activities

The most challenging part of a participatory approach to research is what happens after the experience, when the times comes to summarize everything we learned into a small set of key insights. Participatory experiences are so rich in terms of observations, that is often difficult and time consuming to narrow them down to a close list of key realizations. In particular, during the different research activities we organized, not only did we learn important lessons for our design or research, but we also deepened the relationship with the participants. And this of course has both a positive and a negative side. On the positive side, we developed a trust relationship that allowed us to continue the work in future collaborations, and still having an active participation level from the community. On the negative side, this built trust may bias the analysis carried out after or during the experience due to the attachment that has grown between the researchers and the community. Every activity reported in this chapter gave us a fundamental bulk of insights and learnings that helped us to refine our design and our general approach to this domain. The following is a summary of the most important insights we learned:

- The "elderly", as a user group, is a highly heterogeneous group that cannot only be described in terms of chronological age. People of the same age might have different physical and mental abilities that are important to take into account. Therefore, in our experience, each elder is a unique and special person.

- Technology-use self-efficacy (individuals perception of their own capabilities) is generally low and the complexity of some technologies usually introduce stress and frustration, potentially affecting individual's self-esteem in negative ways.

- Self-confidence in their capacity to learn, however, it is usually strong, which results on a high level of interest for acquiring knowledge about how to use technology.

- Direct manipulation and physical interfaces (particularly touch devices) are easier to use than traditional desktop computers with pointer devices. The mouse, in particular, is a source of stress and frustration probably due to its many usage variations from one program to another.

- Physical limitations such as trembling hands, however, can hinder the usability of touch interfaces and require attention from an interaction design perspective (e.g., by introducing delays on buttons)

- Traditional desktop program user interfaces with multiple opened windows of programs running in parallel can also become a source for stress.

- Step-by-Step or wizard like interactions is often simpler to understand. The simpler the interface,

the better (particularly for the "old old" group, aged 85 or more).

- While learning ICT, the need for precise step-by-step guides is also noticeable.

- Older adults love company and talking face-to-face with others, particularly with younger people. These kind of interactions needs to be further explored from an ICT perspective.

- Once online sharing is enabled, elderly can become quite active and productive at it, but to maintain this over time there must be clear benefits.

- There is a particular interest in resources related to our life stories such as the map or pictures of places where people used to live or songs from people's youth.

- When sharing stories from the past, it is often difficult to remember exact details about the time and place, but there is always an approximated idea (e.g., "this happened before or after my marriage", "it was during the 1960s", "this is a part of my trip to Boston", etc.)

- Usually, instead of writing stories, there is a preference for sharing them verbally as in a conversation.

- Heterogeneity of "elderly" makes it difficult to identify a closed set of themes of interest. However, there are some particular themes seem promising such as memories from past travels, wisdom sharing and pictures from their recent trips and experiences.

While following these insights and the lessons we have learned about topics of interest, interaction patterns and difficulties in the use of ICT, *Reminiscens* was iteratively designed and redesigned during the whole process, seeking for a way to reduce or eliminate all these difficulties and maximize sharing and company. Our initial goal was that of helping elderly to share, explore and rediscover their life experiences as a bridge for interacting with younger people, where the young can learn about these experiences and perhaps help to preserve them for the posterity.

And finally, although our goal was to learn with these experiences, during them we have already (and successfully) enabled a high level of community participation and social interaction, with ICT research and tools being fundamentally an excuse (admittedly, a good one). Using the words of Sacks [304], ICT tools, and the participatory action research activities we conducted around them, were excellent "tickets to talk" that enabled intergenerational social interactions between researchers, older adults and the many volunteers who helped us during the process.

Figure 6.13: The "Kaleidoscopio Group" after finishing one of the Reminiscens PD workshops

7

The Reminiscens System

As we have seen in chapter 4, interactive systems for reminiscence have been mostly crafted for personal use or to support its therapeutic practice. With *Reminiscens*, the intention of this research project was to expand the design space for reminiscence by exploring its potential as a bridge for intergenerational social interactions in face-to-face settings.

Reminiscens is the outcome of the research and design process described in chapter 6. Following insights from this process, we have chosen to implement it as a tablet application, taking advantage of "direct manipulation" interfaces that we have seen as easier to use in the previous chapter. The goal of *Reminiscens* is to facilitate conversation around personal memories, and ultimately, motivate face-to-face social interactions and company: the kind of interactions we have seen older adults hold dear.

In its original design, *Reminiscens* supports the three main stages we presented in chapter 4: *stimulation* through contextual triggers in the form of questions and multimedia, *storytelling* by supporting recording of stories in audio and *preservation* by facilitating the digitalization of physical pictures using the tablet's photo camera. In this chapter, we describe the architectural elements that form the *Reminiscens* platform, its technical details, the contextual stimulation algorithm and the user experience features that define its user interface for both the tablet and the web version of the UI.

7.1   Reminiscens Platform

The Reminiscens platform consists of the backend architecture that supports the storage of people's life stories and the knowledge base from where the content for stimulating reminiscence is obtained. Figure 7.1 shows and overview of this platform and all of its components, including also the client applications that make Reminiscens user interface (UI). In this section, we describe each of these components, emphasizing the method for creating and maintaining the knowledge base. Moreover, we also formalize the personal life stories conceptual model and the algorithms used for creating the stimulation context that is presented to users in the UIs, for motivating them to remember the past.
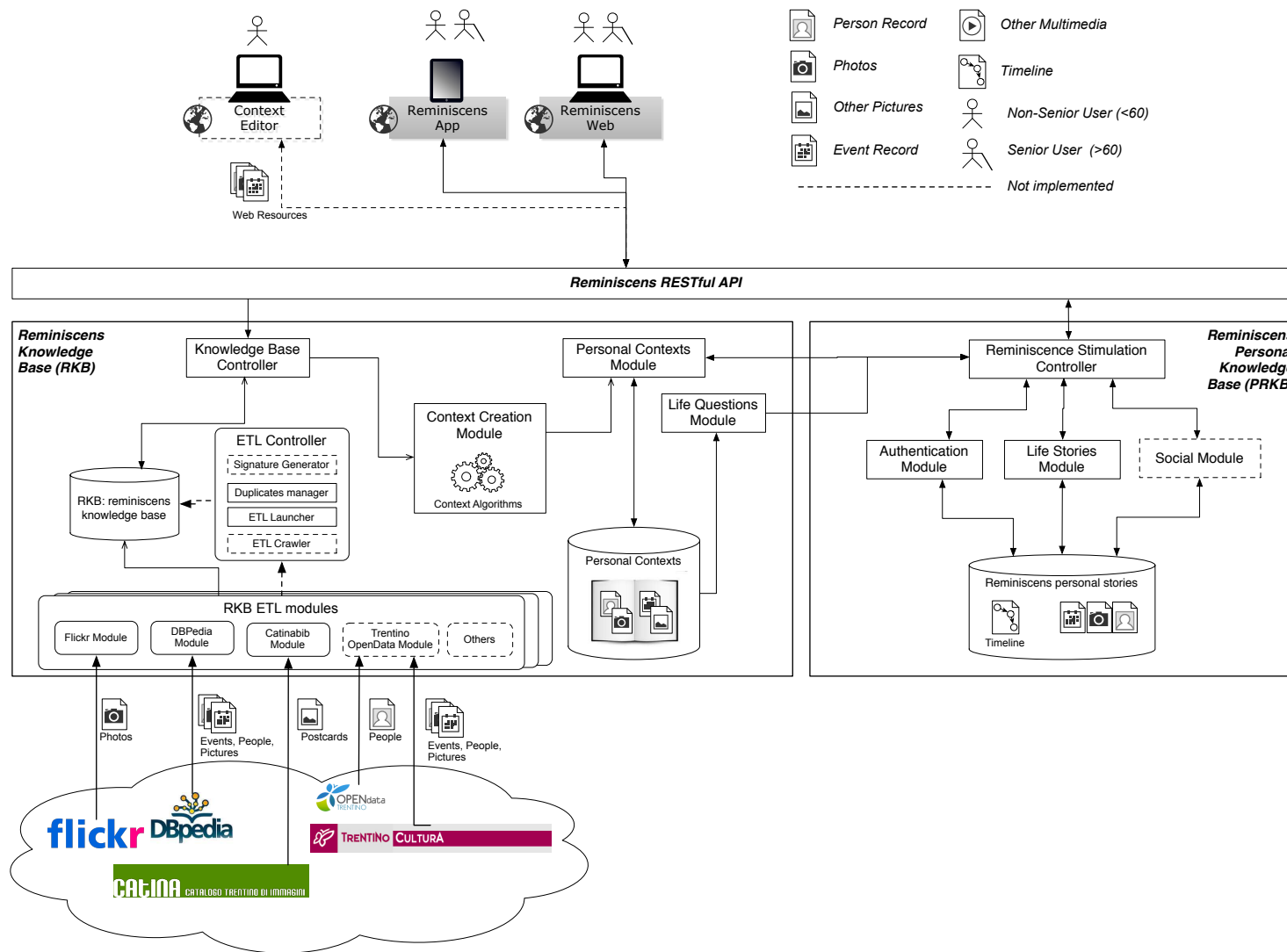
Figure 7.1: **The Reminiscens system.** Architectural overview of Reminiscens' platform

7.1.1 The Knowledge Base

The knowledge base of Reminiscens is a repository of publicly available multimedia that relates to the past and can serve for the purpose of stimulating people to remember their old time memories. It is organized in the following architectural modules (as seen in Figure 7.1), each fulfilling a specific task:

- **Knowledge Base Controller:** this module controls the logic for accessing and updating the knowledge based content through the *RESTful API*. It limits the interaction of client applications to a controlled set of available content in the knowledge base.

- **ETL Controller:** the extraction, transform and load (ETL) controller implements the logic for extracting meta-data from the web, transforming it into the data model of the Reminiscens knowledge base and then loading it to our meta-data store of Web multimedia resources for stimulating reminiscence. Only meta-data is stored, while the actual resource is in the web, with our knowledge base containing all its description plus its URL. The choice for limiting our system to storing only meta-data was made to avoid potential copyright issues. The ETL Controller is divided in four sub-modules:

  - *Signature Generator:* for every new item in the knowledge base, it generates an unique hash-based signature (based on the meta-data) that uniquely identifies this resource. Signatures are used to aggregate multimedia that is available in multiple URLs but refers to the same content (i.e., a song which is available as a video in YouTube and as a regular music in Last.fm).

  - *Duplicates Manager:* for every new item in the knowledge base, compares its signature with the content already available in the knowledge base. If a multimedia resource with the same signature already exists, it controls the type of the new entry and inserts it only if this type is not available yet.

  - *ETL Launcher:* provides a command line interface for launching the different ETL modules in order to bring new content to the knowledge base.

  - *ETL Crawler:* automatically and periodically launches different ETL modules to further enrich the knowledge base.

- **ETL Modules:** standalone programs that implement the specific ETL logic for a single data source. In this project, we have implemented ETL modules that connect to *Flickr* [1], for obtaining pictures; *DBPedia* [2], for obtaining meta-data about old time events and famous people from the past that are available in Wikipedia; and *Catinabib* [3], for obtaining old postcards related to the Trentino region. Other ETL modules can be developed and later plugged in to feed new content. We have focused our ETL processes in collecting content that is locally relevant to the target community, following the insights we got during exploration that indicated how important places are to stimulate people to remember their past.

- **Context Creation Module:** creates the personal context (set of multimedia resources curated for a specific person, based on his or her life stories) that will later be used to stimulate reminiscence of the related person.

- **Personal Contexts Module:** stores and manages the personal contexts that are created for each person in the system.

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[1] https://www.flickr.com/
[2] http://dbpedia.org/
[3] http://www.catinabib.it/

- **Life Questions Module:** stores and manages the access to a database of life questions (e.g., when did you learn to ride a bike?), used also to stimulate reminiscence. Questions were added towards the end of the engineering process, after we observed their potential during the second PD workshop, when we asked participants to tell their stories through a questionnaire-driven storytelling.

To populate our knowledge base, we have concentrated our effort in collecting resources that were more or less in the lines of what we have observed during the PD workshops, where pictures of visited places, physical mementos (i.e., souvenirs that remind us of old times) like postcards and old newspapers cuts were seen to be important. Old postcards were obtained from a local public repository (Catinabib). To mimic newspapers, we have collected a large list of historical events from DBPedia. Based on the potential importance of popular cultural references (also observed during workshops), we included old italian popular songs and, after one of the members of the community suggested it, small video clips of old films and italian TV shows. Most of the songs were added semi-automatically from a list of italian songs contributed by one of the researchers. Table 7.1 summarizes the number of resources in the knowledge base by category. Similarly, table 7.2 summarizes the number of resources by their source. And finally, table 7.3 summarizes the number of resources by the decade to which they are related. In total, Reminiscens' Knowledge Base indexes 3388 multimedia resources at the time of writing this dissertation. Given that the system was prepared mainly for people who were born roughly between the 1940s and 1950s, more effort was set on collecting content that could be related to their youth (e.g., the 1960s, 1970s and 1980s), which is reflected in the distribution of content by decades.

Table 7.1: **Reminiscens Knowledge Base.** Summary of collected multimedia resources by category.

Category	Amount
Song	1656
Event	633
Photo	559
People	491
TV	46
Film	3

Table 7.2: **Reminiscens Knowledge Base.** Summary of collected multimedia resources by their source.

Source	Amount
DBPedia	1168
Contributed (by researchers)	1077
OPENdata Trentino	463
Flickr	343
Catinabib	208
Youtube	89
Wikipedia	40

Table 7.3: **Reminiscens Knowledge Base.** Summary of collected multimedia resources by decade.

Decade	Amount
No Date	462
<1900	77
1900	22
1910	22
1920	30
1930	61
1940	48
1950	64
1960	312
1970	316
1980	198
1990	452
2000	999
2010	325

All the content in the Knowledge Base is available to client applications through a RESTful API [4] that allows everyone to read the content, but limits the edition and creation of new meta-data of multimedia resources to registered users of the platform. Moreover, the whole platform (including UIs) have been developed as free open source projects, with all the source code made available online[5].

7.1.1.1 Context creation algorithm

In order to create a personal context, the *Context Creation Module* executes an algorithm that leverages upon personal life stories information (e.g., place and time of personal stories) to the subset of the content in the knowledge base that is more likely to trigger the person to remember another story. A formalization of the life context algorithm can be defined as follows. It starts from a knowledge base M, defined as a set of meta-data items about online multimedia resources. We formalize such knowledge base as follows:

$$M = \{\langle caption, URL, category \in MCAT, type \in MTYPE, D, L \rangle\} \tag{7.1}$$
$$MTYPE = [picture, audio, text] \tag{7.2}$$
$$MCAT = [photo, song, event, person, tvmovie] \tag{7.3}$$
$$D = \langle decade, year, month, day \rangle \tag{7.4}$$
$$L = \langle country, region, city, place \rangle \tag{7.5}$$

We have limited our knowledge base in only three media types ($MTYPE$) and five possible categories ($MCAT$) for simplification purposes, but this can be easily extended to support more types of multimedia and a more fine grained set of categories for content. As mentioned before, the knowledge base contains only meta-data, while actual resources reside on the web (i.e., the name of a song and its URL

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[4]The full documentation of Reminiscens' RESTful API is available at: `http://docs.reminiscens.apiary.io/`
[5]Reminiscens Project Source Code at Github: `https://github.com/cdparra/reminiscens`

are stored in the knowledge base, while the actual song might be a video in youtube), in order to avoid potential copyright issues an simplify our infrastructure requirements.

To produce the context for stimulation, our algorithm takes as an input the following: a timeline T, a set of categories K, a distance ratio δ (which defaults to 50km) and a time period ρ (which defaults to a decade). The timeline T is basically the set of (date,location) pairs corresponding to a person's life stories. As mentioned before, the idea of using places for curating the contextual triggers of reminiscence comes from observations that were gathered during **exploratory workshops**. These observations indicated how exploring in the map for places where people lived and resources related to those places was engaging and motivated people to remember and share their stories.

$$Timeline \quad T = \{\langle D, L \rangle\} \tag{7.6}$$

K is a set of keywords that we want to use as category filters, which must belong to our fixed list of available categories $MCAT$. The distance and period of times can also be limited to a fixed list.

$$K = \{x : x \in category\} \tag{7.7}$$
$$\delta \quad (km) = [10, 20, 50...] \tag{7.8}$$
$$\rho \quad (years) = [1, 2, ..., 10] \tag{7.9}$$

The choice for using decades as the unit for defining time ratios comes from the observation during the **PD workshops** of how a decades-based timeline was simpler to understand and use as a metaphor of navigation by older adults. Using these elements, we can formalize our algorithm in the following equation:

$$Context \quad C = \{\langle m, r \rangle : m \in M \wedge \tag{7.10}$$
$$x = dist\,(m.date, t.date \in T) < \delta \wedge \tag{7.11}$$
$$y = dist\,(m.location, t.date \in T) < \rho \wedge m.category \in K \wedge \tag{7.12}$$
$$r = ranking\,(m, x, y)\} \tag{7.13}$$

The algorithm just presented defines the context as a ranked set of multimedia resources m that belong to the knowledge base M. Each of these multimedia resources are selected according to the following heuristics:

- The date and location of m are within a distance δ and ρ of at least one of the item's in the timeline T (or of the closest item in T). The distance function $dist$ defines the logic we use for calculating the distance between dates and locations. In our algorithm, we rely in a simple euclidean distance, which is defined as the absolute value of the difference between two numbers or by the following formula if the points are in plane. For example, if $u = (x_1, y_1)$ and $v = (x_2, y_2))$ are two points on the plane, their *Euclidean distance* is given by $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

- The category of m is among the keywords in K

- Each resource has a ranking r that is function of how its own quality and its distance both in time and place. Notice that the distance function $dist$ could be defined in such a way that it weights also the trust we have on the location and date information of m

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Implementation of the algorithm. The original algorithm suffered some modifications in the implementation, namely:

- For each person, the system creates a cache where contextual items are placed (managed by the *Personal Contexts Module*).

- New contextual items are placed in this cache every time a new story is created, so instead of using the full timeline T, only a subset of it (namely, the new story) is used for updating the contextual items to display in the system.

- To experiment with some level of diversity in the multimedia to display, three levels of geographical distance were defined: *world* (distance range is infinite, meaning the whole world is included), *region* (the distance is defined as the radio of the region of the stories) and *city* (the distance is defined as the radio of the city of the stories). In each iteration, **2 elements of each level** were inserted in the system.

Moreover, after we realized the potential of question-driven storytelling in the second PD workshop (described in the previous chapter), **Life Questions** were also added as a part of the context, but without storing them in the context cache. Questions are sent to the user by a real-time algorithm that uses the decade in which the user is currently focused in the client application. Four type of questions are defined based on the stage of life to which they correspond: *childhood*, *youth*, *elderly years* and *general*. Depending on which decade the user is focused, it receives two questions related to the stage of life to which that decade corresponds in his timeline, and two general questions which are not related to any stage.

7.1.2 The Personal Knowledge Base

The personal knowledge base is in charge of managing all the personal stories and multimedia shared by users of the system through the client applications. We store these stories using a very simple *Personal Life Stories* model shown in 7.2. In this model, every person can share the story of one or more **Life Events (LE)** in his or her life. Each LE can be associated to zero or more **Mementos (M)**, which are multimedia resources that remind the person of that event. The choice of the word "memento" echoes the notion that any physical souvenir (e.g., a postcard from a trip, a coffee cup of a city bought during a trip, etc.) can remind people of their past memories and used to tell the story of that memory. This was observed during the **PD Workshops** in the souvenirs brought by participants and is also grounded in literature [158].

Each LE is defined with a **Time Interval (TI)** that identifies when the LE took place in terms of a period of time (i.e., starting and finishing dates). The use of TIs is based on the possibility that a life story might expand for a long period of time. During the **PD Workshops**, we observed that sometimes people do not remember the exact dates of an event and instead, they can identify roughly when in their lives did the event take place (i.e., during childhood, in my twenties, in the 1960s). For this reason, TIs can be just partially defined, requiring only an starting *decade*. Optionally, TIs can also include both the starting and finishing dates by parts (i.e., July of 1940, form 1963 till 1969). Later on we realized that it was easier for people to just say the approximated period of time in which a story started, which is why only the starting point is required, while the ending is optional. Internally, we refer to this type of dates as "Fuzzy Dates".

Similarly to TIs, each LE includes also a fuzzy **Location (L)** that includes the *country* and, optionally,

the *region*, *city* and specific *place* within the the city.

The original simple model included also the definition of a **Network** to which people could belong and where stories could be shared (e.g., the "Jameson Family" network). This is implemented by the system but not yet exposed through the API, which means it is not available for client applications.
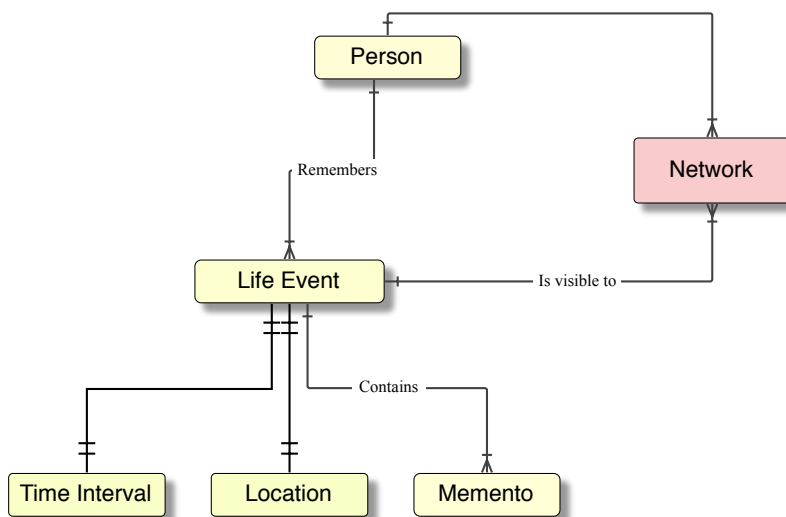
Figure 7.2: **The Reminiscens system.** The simple conceptual model of personal life stories

7.2 Reminiscens User Interfaces

To support the practice of reminiscence in a face-to-face setting, the main user interface we designed is a tablet application that allows users to insert life stories using text, audio and pictures that can be digitalized using the camera, and then automatically asks the platform to create a personal context of multimedia content available online and centered around each decade of the stories in the personal time-line created by the users. The choice for using a tablet was based on observations we have gathered at the very beginning of the research project, during the **Exploratory Workshops**, and was later reinforced by further observations in the **PD Workshops** and also in much of the **Literature Review** (see chapter 2). However, we also decided to implement the same UI as a website to allow users to further curate their stories from remote (i.e., from home). The creation of the website responds to the fact that most of them did not have a tablet and we also wanted to gather some extended observations about their practice outside of the face-to-face settings. A third planned UI, which was just partially implemented at the time of writing this dissertation, was supposed to support the curation of the personal context to allow people in certain networks (e.g., the close family, professional caregivers conducting a reminiscence therapy, etc.) to enrich the context with content they know will be motivating for a specific person, based on their personal knowledge about that person's interests. The curation of the context remains a future exploration. From here on we refer to all these UIs collectively as *Reminiscens*.

Reminiscens stimulates people to remember by suggesting contextual multimedia (music and old movie clips, pictures and historical events information) and contextual life questions that can both serve to

stimulate conversation around stories. The material is previously gathered from the web and loaded into the *knowledge base* described in the previous section. All the content is organized within a timeline divided in decades, which in turn serves also as a metaphor for organizing the storytelling process and supporting the navigation through the content in the system. During the **PD Workshops** decades were seen as an easier metaphor for navigation than a timeline based in life stages (e.g., childhood), which created conflicts in the definitions of "what should be included within each stage".

Figure 7.3 shows the main screen of the application with its key features. On the top we can see the **Timeline** (Figure 7.4) divided in decades, to organize stories and support their navigation, from the old memories to the more recent ones. Below the timeline, the **Main Menu** give options to view the list of *Stories* (as text boxes) in each decade, or the list of *Pictures* (as thumbnails) within these stories. The button *Tell us* (Raccontaci) is the entry point to start a new story from scratch, and the remaining two buttons serve to *Refresh* the displayed content and to *Exit* (and logout) from the system.

Figure 7.3: **The Reminiscens system.** Main screen of Reminiscens' UI.
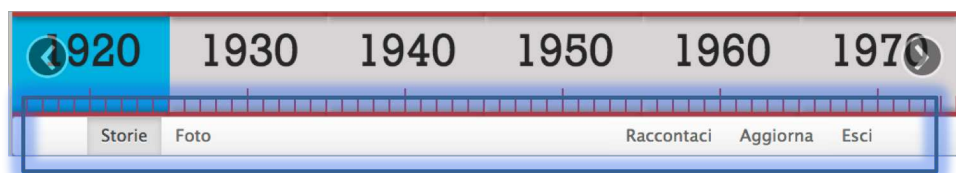
Figure 7.4: **The Reminiscens system.** The timeline, divided in decades, as part of Reminiscens' UI.

Also in Figure 7.3, on the right side, the **Personal Panel** shows the life stories inserted by the user and corresponding to the decade that is in focus (highlighted in the timeline). Personal stories are the first

strategy for stimulating one to reminisce and share stories. On the left side, the **Context Panel** contains the contextual multimedia resources prepared by the context creation algorithm discussed in the previous section.

In the first version of the system, the context was divided in five different screens accessible through the main menu. It was done in this way because we thought that exploration of the context would drive the interaction more than storytelling. However, during our **Field Study** we realized that the feature that guided the storytelling process was the actually the timeline. For this reason, we replaced the original version by putting all the context content in the main screen, and shifting from one category of content to another every certain amount of time. In the new version, the **Context panel** refreshes every 5 minutes, loading a randomly selected category of content every time. The different categories are presented according to the type of multimedia they aggregate. For *songs*, only one is displayed at a time (see Figure 7.5) and they are all currently associated with a youtube video of the song, which is shown embedded in the **Context panel**.

Figure 7.5: **The Reminiscens system.** The main screen, with the context displaying a resource from the 'Song' category in the form of a youtube embedded video.

Photos are displayed as a list of up to 6 thumbnails. *Historical events* are shown similar to personal stories, within text boxes. *Famous people* resources are displayed one at a time, combining a summarized textual biography and a picture of the person. When the study was about to begin, we added a fifth category to include videos of *TV Shows and Movies*, following indications of one of the members of the community. Tapping in any of these resources will open it in detail (same for personal life stories) allowing the user to respond to the content with a new story or simply view it (or play it) in detail (see Figure 7.6).

Stimulation **Life Questions** (see Figure 7.7) appear under the menu. Only one question is displayed

Figure 7.6: **The Reminiscens system.** A story opened in detail view (similar view for contextual multimedia).

at a time and the user can choose to either *answer* the question by creating a new story, or *to request other questions*. *Tell Us* ("Raccontaci"), *Answer the Question* and, below the detail view of life stories, *Edit* all lead to the same *Story Editor* screen (Figure 7.8). To facilitate storytelling, this editor features a simple UI to insert the story in a textual format. The editor also allows users to add a picture taken with the device or from the gallery, insert the basic meta-data of the story (place and time) and attach an audio recording of the story. Audio recording is another example of a feature we did not foresee at the beginning, but was added after realizing how important verbal storytelling was during **PD workshops**. Also based in our insights from exploration, adding pictures from the camera responds to the realization that most of the personal mementos exist in a physical form and not in digital. For this reason, we envisioned the feature to facilitate the digitalization and preservation of physical mementos.
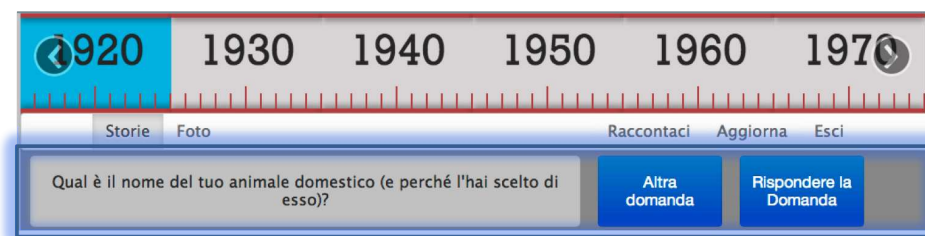
Figure 7.7: **The Reminiscens system.** The timeline, menu and (highlighted) one of the life questions related to that decade.
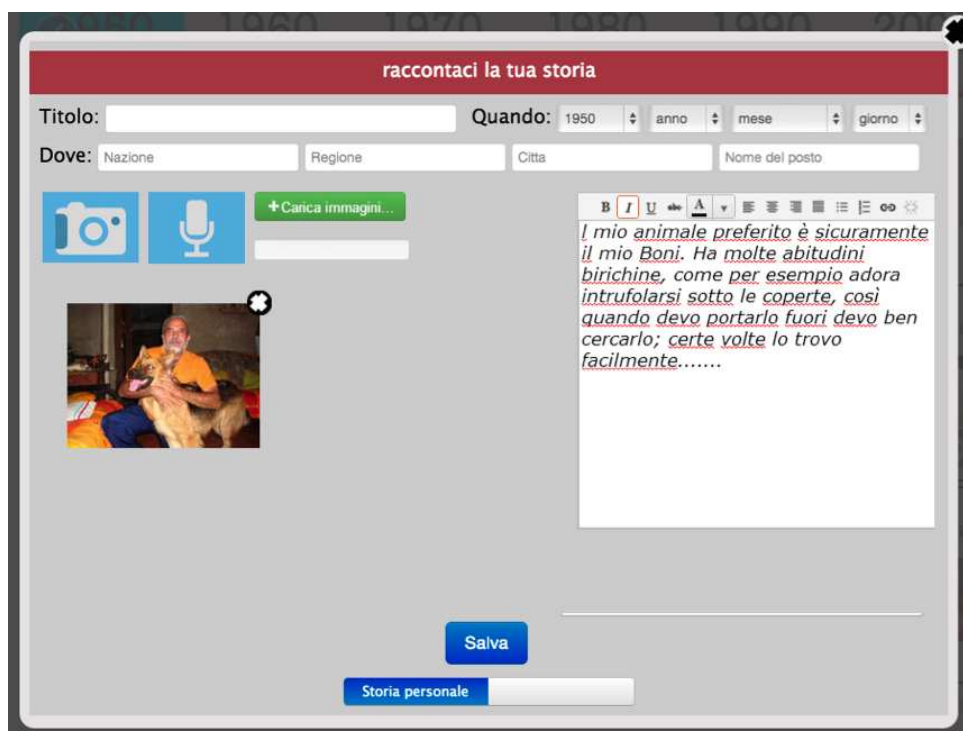
Figure 7.8: **The Reminiscens system.** The story editor, featuring the possibility of adding pictures taken with the Tablet (i.e., for digitalizing physical pictures) and record audio account of stories (audio storytelling).

7.2.1 Key Features

The idea is to use *Reminiscens* (the tablet version) in the context of social reminiscence sessions between older adults and younger people. In these sessions, participants will use the system as a mean for stimulating memories, facilitating conversation and enabling the digitalization of stories. The key features to support these activities are the following [6]:

- **Question-driven stimulation:** users enter new stories by answering suggested life questions related to a particular period of life (e.g., childhood). Examples are "Do you remember the first time you rode a bike?" or "Where were you when Martin Luther King gave his famous I have a dream speech?".

- **Contextual Exploration:** users will view contextual public content, related to places or events that took place around their own life stories. The contextual content might include:

  - Pictures of nearby landmarks, as they were during (or close to) the period of time in focus.

  - Postcards related to nearby places and corresponding to the period of time of the stories.

  - Historical events that took place during the time of the stories.

  - Information about famous people that were born during the times of the stories or who were active in that period of time.

  - Songs from the time, available as videos in youtube.

  - Small clips or full videos of TV shows and movies from the time of the stories.

- **Simple Storytelling:** users can add personal life stories into the system. Each story can include one or more pictures, a title, an approximated date, an approximated location and one or more audio recordings of the story.

- **Simple Exploration:** users can view their own stories, organized in a decades-based timeline.

7.2.2 Limitations

Although the design included the possibility of adding audio recordings to the stories, the implementation did not arrived in time for the study, so this feature remains in our list of features to implement.

Moreover, two other characteristics we planned to include but did not have the time to properly design and implement are: *collaborative storytelling* and *social sharing*. For the first one, we intended to add the possibility for users to send *ask for help* requests to people in their network. Invited people would gain edition rights over a story and asked to help in the task of completing or enriching it (e.g., sharing the story of my trip to Italy with the old friend who went with me and might have some other materials to add). For the second, we intended to allow users to directly share the stories they inserted in the system (or any other content) by sending them via email to a list of contacts in their network.

Finally, another limitation in our implementation has to do with the story editor, which in principle was designed to work as a drag-and-drop editor, but was implemented as a simple form in the end due to a lack of time.

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[6]A demo of the implemented prototype is available at: `https://www.youtube.com/watch?v=Hze1GoGu4Xg`

8

Field Studies

This dissertation has thoroughly presented so far a broad conceptual framework for the motivations, questions and problems of this research project. We have discussed in detail our participatory research and design activities, and extended the state of the art with initial insights about how to support social reminiscence with IT. And finally, we have described in detail the resulting interactive system we propose for supporting social reminiscence (*Reminiscens*) as the means for stimulating (rather than mediating) intergenerational social interactions.

In this chapter, two **Field Studies** (one short and one longitudinal) are reported, where *Reminiscens* and an additional prototype were used as technological probes for the study of the social reminiscence phenomena, within a conversational and intergenerational context. We start by revisiting our core research questions, expanding them with hypotheses that were drawn along the design phase of the project. The **Field Studies** aim at extending the state of the art with new realizations about the experience of IT-supported intergenerational social reminiscence. Additionally, the studies evaluate the correctness of our hypotheses. Both **Field Studies** are presented in terms of their plan, methods, results and analysis of the outcomes.

8.1   Revisiting Research Questions

Chapter 1 introduced the research questions that served as the starting point of this dissertation. Answers to the first group of these questions (the general research questions) refer to the role of IT in enabling social interactions and active ageing, and they have been covered in the first chapters, with a literature review and through exploratory works, which will be revisited and summarized in chapter 9. The remaining questions have been also explored in previous chapters, and will be deepened through field studies that are presented in this chapter. Before presenting our methods to answer them, let us briefly revisit them:

- **RQ1.1** *IT to stimulate reminiscence:* can IT stimulate the practice of reminiscence in a social and

intergenerational context?

- **RQ1.2** *IT to stimulate reminiscence:* how can IT (which technology, which designs, which interactions, what content) stimulate the practice of reminiscence in a social and intergenerational context?

- **RQ2.1.** *IT to stimulate social interactions:* can IT-supported reminiscence systems facilitate increased and sustained intergenerational social interactions?

- **RQ2.2.** *IT to stimulate social interactions:* how can IT-supported reminiscence systems facilitate increased and sustained intergenerational social interaction?

- **RQ2.3.** *IT to stimulate social interactions:* is IT-supported social reminiscence enjoyable?

As an answer to questions **RQ1.1** and **RQ1.2**, our explorations and participatory design process led to the choice of a tablet application that first, stimulates reminiscence by using contextual triggers that leverage a person's life stories to provide interesting multimedia and questions; and second, stimulates social interaction by enabling collaboration in the preservation of memories by entering them into the system in the form of text, pictures and audio. We call our system by the name of *Reminiscens* (see chapter 7 for the system details). Preferably, but not only, the application is used in face-to-face scenarios. We argue that such a tool will make of reminiscence an enjoyable practice and will motivate elderly to interact with others, ultimately increasing their well-being.

Based on these questions and our research experience, we complement our open and participatory approach to research with a couple of hypotheses to be validated in these studies, which read as follows:

- **H1.** Contextual triggers, in the form of multimedia and questions that hold a relation with personal life stories, will increase the number of memories a person recalls and shares.

- **H2.** Contextual triggers, in the form of multimedia and questions that hold a relation with personal life stories, will motivate intergenerational conversation (i.e., between elderly and younger people).

- **H3.** Collaboration in digitalizing memories will stimulate intergenerational social interactions, making it an enjoyable practice both for older adults and younger people.

Contextual triggers that hold a relation with personal life stories can include pictures of visited places, events occurring near the place and period of time of the personal stories, songs from the past, impersonal questions related to the period of time of the stories, etc (seen chapter 7 for more details). Particularly, we focus on gathering contextual content from the web, using multiple sources and curating the suggested content in a semi-automatic way.

The two field studies we present in this chapter provide us with both qualitative and quantitative data that allowed us to validate (or disproof) the hypotheses presented herein and expand knowledge in the state of the art with additional and unforeseen findings.

8.2   Short study: the public reminiscence display

The first of the field studies we conducted is in fact a short exploration of the potential of a public display for stimulating both social interactions and spontaneous social reminiscence in a community center setting. This section describes the detail of this short study starting by its goals in section 8.2.1, the methods we used in section 8.2.2 and the results we think are worthy of mention in section 8.2.3. A brief summary is also included in section 8.2.3.3.

8.2.1 Goals of the study

The main goal of this study was to validate how much of social interactions and reminiscence could be triggered in a community setting, through the use of technology, thereby addressing our research questions but relaxing the intergenerational dimension. Specifically, the goals read as follows:

1. To stimulate reminiscence in a community through the sharing of pictures from their past experiences (related to RQ1.1 and RQ1.2 about stimulation of reminiscence).

2. To analyze the content of shared memories by the community, in the form of pictures (related to RQ1.1 and RQ1.2 about stimulation of reminiscence)

3. To observe and classify the types of social interactions triggered within a community of older adults around this sharing (related to RQ2.1 and RQ2.2 about social interactions)

8.2.2 Method

For the first goal, a simple public display (i.e., a photo frame) was deployed in the Kaleidoscopio Community Center (CSA) during the summer of 2013. The photo frame was prepared to received pictures via email, from people of the community. Additionally, it was already preloaded with a predefined set of old pictures from *Reminiscens* knowledge base (as memory triggers). Upon receiving a contribution the system automatically posted the picture also in the CSA's facebook page, where members of the community who could no longer attend to the center were able view the shared pictures. For each picture, the subject of the containing email was used as a caption or description of the shared memory/experience.

For the second goal, the research team followed the interaction in the Facebook page (authorized by the community) and qualitatively classified shared pictures based on the captions and the photos themselves. Finally, for the third goal, weekly random observation days were scheduled to watch how people interacted around the photo frame.

The first two goals were achieved, but an unforeseen event prevent us from realizing the third. Although the display was active for almost a little more than 2 months (from the last week of june/2013 till the first week of september/2013), the original intention was to leave the photo frame active for a length of half a year, and conduct regular observations at the center in the last 3 months. The study, however, finished abruptly before we started our observations, due to the unfortunate event of the photo frame being stolen from the CSA. For this reason, we refer to this study as the "short study" and we discuss only conclusions we have based on the analysis of shared content, some minimal observations (of only one observation session) and some notes we took from informal interviews with the CSA operators and volunteers. Moreover, because our focus was shifting towards the preparation and execution of the long study (described in the next section), we were not able to replace the photo frame in short time as to continue with this study.

8.2.2.1 The Reminiscence public display Prototype

For the purpose of this study, we leveraged upon existing technologies in order to deploy a prototype of the system. Given the goal of publicly sharing memories in a community setting, we used a digital photo frame for displaying the memories (in the form of pictures) and linked the photo frame to a given email address that people used to submit their memories to the frame. Using a public poster located at the CSA, we asked people to send pictures of their memories and to describe the memory in the subject

of the email. The email was connected to both the digital photo frame and the CSA public facebook page through a simple IFTTT recipe[1]. IFTTT ("If this then that") is an online service for automatically connecting several social services APIs in a simple workflow driven by the common conditional operator "IF".

The call to action of the poster was placed as a printed panel aside the digital photo frame and it was also published both in the facebook page and in the photo frame itself. Through this call to action, people from the CSA were invited with the following message (originally in italian[2]):

> *Do you have any photo that takes you back to the past and makes you remind of good old memories?. Would you like to share it with the community of the CSA? Send an email with the photo you've chosen to csa.kaleidoscopio [at] gmail.com, and it will appear in the digital photo frame of the CSA and in its facebook page:* `https://www.facebook.com/kaleidoscopio.trento`*.*

> *Next to the frame, there will be a small diary. If you can think of some memory or thought related to the photos, leave a comment and write as well as pictures you brought back the best memories. (**Reminiscence public display call to action (Figure 8.1a)**)*

8.2.3 Results and Discussion

Although our data and analysis is limited, some interesting results have emerged from this short study, which actually go a little bit **against** our initial hypotheses regarding the stimulation of memories (H1), but provided preliminary confirmation that IT-supported reminiscence practices indeed created interesting opportunities of socializing (H3). There was not enough information to reflect on whether contextual triggers stimulated conversation(H2).

8.2.3.1 Shared content

In summary, 115 pictures were shared while the frame was active, half shared by the *CSA Team* (49.6%) and half shared by members of the *Community* (46.1%). The remaining 5% corresponds with set of preloaded pictures that were supposed to act as triggers (Figure 8.2)

When analyzing the content of the shared pictures, a first analysis was to see whether they referred to a personal or community memory (Table 8.1). When classifying the pictures, we found that, as it is expected, almost all of the memories shared by the *CSA Team* referred to a community memory. In contrast, memories shared by members of the community themselves were partly referring to a community memory and partly to a personal experience. A couple of pictures from the community, however, referred to a personal experience or reflection (according to the picture description) that was anchored with a public image (found online). We called them the **personal/public** memories because they support a personal memory with a public multimedia. This type of multimedia played also an important role in the second study, as we will see later. Of course, some of the pictures did not refer to any memory, but instead to either a joke or a randomly selected content from the web. An issue of this type of sharing is that most of the participants did not consider the copyrights of the content when shared. For them, everything online seems to be freely shareable.

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[1] `https://ifttt.com/recipes`
[2] To avoid the a considerable increase in the length of the dissertation, only English versions of quotes, notes, observations and other materials are used throughout the dissertation

(a)
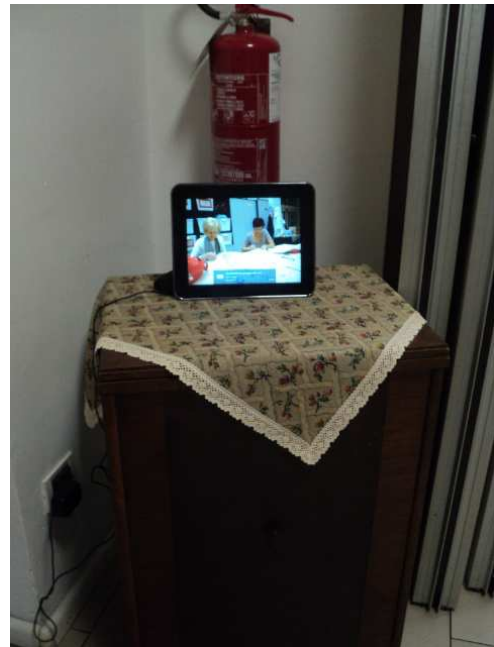
(b)

(c)

Figure 8.1: **Settings of the reminiscence public display.** (a) Reminiscence public display call to action; (b) The reminiscence public display at the Kaleidoscopio CSA; (c) A regular day at the Kaleidoscopio CSA. The public display at right.
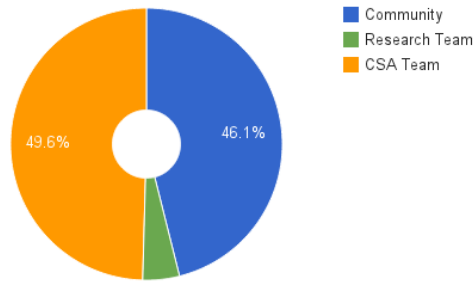
Figure 8.2: **Reminiscence public display.** Origin of shared pictures.

Table 8.1: **Reminiscence public display.** Origin of shared pictures vs type of memory contained in the picture (personal, community or public)

	No Memory	**Personal**	**Community**	**Personal/Public**
Community	4	17	**25**	7
CSA Team	0	1	**56**	0

Another interesting result comes from the *age of the memory* shared by the Kaleidoscopio community (Table 8.2). We categorized memories into three groups according to how old was the memory contained in the picture. If the picture was about the present moment (or the current month) the memory was *very recent*. If the picture was from up to two years ago, the memory was *recent*. Anything older was in the *past* category. As seen in the table, the vast majority of the shared content was recent or very recent. Although this is not an strong conclusion, it seems like older adults social reminiscence is mainly **reminiscing about the present or the recent shared past.**

Table 8.2: **Reminiscence public display.** Origin of shared pictures vs age of the memory contained in the picture (very recent, recent, or past)

	Past	**Recent**	**Very Recent**
Community	7	38	8
CSA Team	0	57	0

The little number of *past* memories that were shared are most likely coming from participants responding to the specific request of either the *Research Team* or the *CSA Team*, when asked about what was the experiment about. Either the case, one interesting aspect about this very small group of pictures (which we see expanded in the longitudinal study) is that they were all supported with *public* multimedia. That is, they are *personal/public* type of memories as they used public multimedia to represent a past experience or reflection about the past. One reason of this usage is simply that they do not have media of their past memories. Another is that it is enough for them to represent their past experiences with a related picture (not necessarily the picture of the experience) in order to communicate the memory. Another potential reason might be the public character of the display and its location. Members of the community

might have chosen to share only recent memories because they though old ones were not interesting for the community, or simply because they do not want to make them public for the whole community (including the strangers who occasionally just come to take some coffee). The content posted by the CSA team, which was almost entirely related to the present, might have also influenced members of the community into sharing similar content.

Finally, one last analysis was done regarding the themes of the shared memories (Table 8.3) and found something that we have already seen in the PD workshops: the most common theme of the shared memories has to do with *experience of a trip.* Be it a full-fledged vacation abroad or small excursion to somewhere nearby, these are the memories that are most commonly shared in the context of the public display experiment. Interestingly, when looking at the pictures shared by the *CSA Team*, memories from the technology related activities at the CSA appear in the top 5, indicating both how much the community center is promoting these activities and how much proud they feel about the way they are working.

Table 8.3: **Reminiscence public display.** The four most common themes of the pictures shared through the display

	Excursions	Travel	Technology	Friendship
Community	**23**	**10**	2	4
CSA Team	**13**	2	**8**	5

8.2.3.2   Social Interactions

Due to the unfortunate event of the photo frame being stolen, we could not gather enough data about how the public display triggered (or not) social interactions in the community. We could however, gather one day of observation and some information from an interview with one of the CSA coordinators.

The public display raised much interest, both according to our only day of observation and to the words of one of the coordinators of the CSA. But, it did not trigger people to stay around the display to talk about the shared content in the place of the community. It was rather an "interesting technological artifact to stop by and watch" (Interview with CSA coordinators, January 2014)[3]. This can be appreciated in pictures from our day of observation (Figure 8.3). The pictures also show a limitation of our experiment: the placement of the display and its low size made it difficult for people to see the content (Figure 8.3a). This can be one of the reasons of why the display did not trigger much face-to-face conversation in the community. This limitation is also the result of a process of negotiation with the CSA. While we would have liked to place and curate the presentation of the display ourselves, the reality is that the CSA needs to control the settings to accommodate the activity within their many heterogeneous activities. This is reasonable because it is their space, but at same time is a limitation for us because we have no way of controlling the impact of the settings. Moreover, the problems of placement and presentation also underline how important are aesthetics and ergonomics for the adoption and use of IT within a community settings.

On the other end, participation in facebook was not high but was perceived by the one of CSA coordinators as important because it allowed the community (mainly operators of the CSA) to stay engaged with other members who are no longer able to attend, and make them still feel part of the community. The need for enabling social interactions of the community with those who are no longer able to physically

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[3]All the names of participants and stakeholders of our research activities are anonymized
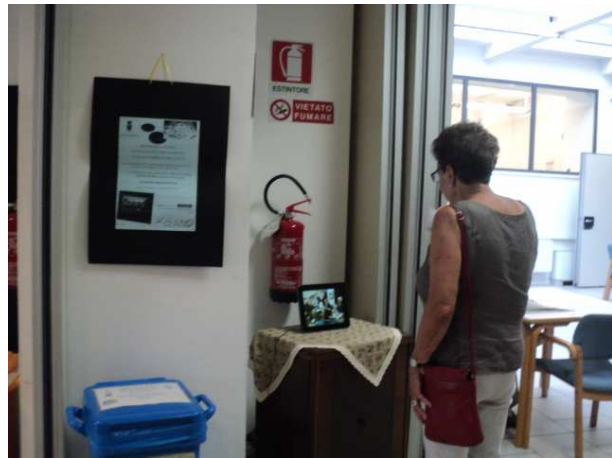
Figure 8.3: **Reminiscence public display.** Members of the CSA Community interacting with the reminiscence public display

attend the activities of the community is once again evidenced here (and pointed out several times by the CSA operators throughout our studies)[4].

8.2.3.3 Summary

The reminiscence public display was not really used for reminiscing, but rather for sharing recent or very recent memories, which refer either to shared community experiences or to personal memories, both to a similar extent. The most common themes of these pictures were travels, excursions or vacations of the members of the CSA.

From the CSA perspective, while the display did raise interest and has a potential to become an artifact for sharing community experiences, the key aspect of the experience was rather that allowing members of the community to share their experiences in a simple way (i.e., sending a picture via email) was also a mean for them to reconnect with members that can no longer participate of the activities of the CSA or who are simply away at present.

> *The public display was a way of being present in the center even when people was away* (**Interview to CSA coordinators, January 2014**).

Moreover, one of the coordinators of the CSA also argued that the interest in public community reminiscence (from his perspective) is low, and that for that purpose, it is better to aim to a specific group of people where the interest for sharing their stories and reminiscing is already natural.

8.3 Longitudinal study: intergenerational social reminiscence

The second and most important study we conducted consisted of a longitudinal series of reminiscence sessions that brought together narrators and listeners into a one hour, weekly meetings of sharing stories while using *Reminiscens* to support the **stimulation** of memories, facilitate **preservation** and aid **storytelling**. The study lasted for 3 months and had **16 older adults narrators** share their stories with **17 younger listeners** along **74 sessions** of social intergenerational reminiscence. In this chapter, we describe the study in detail, present its results and discuss its most salient observations based on the analysis of our field notes, session imagery, participant diaries, questionnaires and post-study interviews.

In the following, we will start by defining the goals of the study in section 8.3.1. We will then introduce the methodological details of the study in section 8.3.2, followed by the analysis of results in sections 8.3.3, 8.3.4 and 8.3.5. To finalize the chapter, we offer a brief summary of the results in 8.3.6, which is expanded later in the conclusions.

8.3.1 Goals of the Study

The study consisted of a series of IT-supported, social reminiscence sessions where older adults (the narrators) shared their life stories with younger people (the listeners) within the context of a conversation in which IT (i.e., a tablet with *Reminiscens*) was used for (i) stimulating reminiscence in narrators (RQ1.1 and RQ1.2); (ii) facilitating storytelling and preservation of memories (RQ2.1, RQ2.2 and RQ2.3); and,

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[4]Initial evidence of the need of enabling "remote, mainly synchronous or real-time, participation" of homebound elderly was found and introduced as part of the exploratory work presented in section 3.4

(iii) motivating social interactions between narrators and listeners (RQ2.1, RQ2.2 and RQ2.3). In doing so, we expected to:

1. Openly observe and identify the most salient aspects of IT-supported social reminiscence for intergenerational engagement.

2. Validate the potential of contextual triggers in stimulating reminiscence (H1).

3. Validate the potential of IT-supported reminiscence for facilitating intergenerational social interactions (H2 and H3).

8.3.2 Methods

8.3.2.1 Intergenerational sessions of reminiscence

In order to maximize our observation of the social reminiscence phenomena, as supported by IT, we organized the whole study around the realization of as many reminiscence sessions as we could. During the whole duration of the study, **social reminiscence sessions** were held, each lasting up to an hour, during which stories from the past were shared, discussed and digitalized using *Reminiscens*, which also provided contextual stimuli. Each session involved:

- One or two older adult **narrators**, whose stories would be the subject of discussion during the meeting, and upon which the contextual triggers of *Reminiscens* would be produced for stimulating memories.

- One younger **listener** interested in knowing about those stories and helping narrators to preserve them by using *Reminiscens*.

- One or two **observers**, represented by researchers whose role was that of assisting in the case of technical problems, gathering *participant observations* about the development of the sessions and acting also as additional listeners who purposely would be less active in this matter.

Before the study, pilot sessions were organized involving a grandparent with his granddaughter, with the purpose of adjusting details in the study. Based on the pilot, we decided to shorten questionnaires (also to eliminate some of them) and to add the role of listeners in the study (in the original plan, listeners were only volunteers without a named role). Sessions of the study were divided in two tracks:

- **The *stable* track:** some narrators and listeners participated along the whole duration of the study forming **'stable' groups** that met between 6 and 8 sessions each with a weekly frequency.

- **The *one-session* track:** some narrators and listeners participated only for one session. The one-session track was aimed at gathering more observations and data about how this activity can work if it is only done in a very occasional manner (e.g., one time only).

During each session, when narrators and listeners were in doubt about were to begin with, observers usually suggested a stage in the life of the narrator to be the focus of the session (e.g., childhood), after which narrators were suggested to share one or more stories related to that period of time, aided by multimedia content appearing in the application.

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8.3.2.2 Data Collection

To support our analysis, we have relied on a myriad of data sources including, field observations, participant diaries, application usage logs, pre and post-study questionnaires and post-study interviews. Below, we describe each of these according to when they were collected in the study timeline. The study was supposed to last for **at least two months**, with sessions being held weekly. In summary, data collected from the study includes:

- *Pre-study questionnaires* of demographics, social engagement and personal stories.

- *Participant observations* of the experience in the form of field notes and participant's diaries.

- *Application logs* portraying the use of the system (*Reminiscens*) both during sessions and when it was used from remote (through the web interface)

- *Participant's satisfaction* in the form of their mood score after each session.

- *Participant's opinions about the experience* in the form of a final questionnaire and post-study interviews.

The different stages of the study, including what data was collected in each stage, is described in the following paragraphs.

Before the study. At the beginning of the study, all participants were invited to a preliminary session where they were informed about the details and duration of the study, gave signed consent to participate and received a brief demonstration of how *Reminiscens* worked. In this first encounter, each participant also compiled the following **Questionnaires**:

1. *Demographics (age and gender):* to ensure the intergenerational character of the study, at least 20 years of difference was ensured between narrators and listeners.

2. *Social engagement:* intended to measure the level of socializing of each participant with the goal of analyzing the impact of this variable on how stories were shared and how engaging the sessions were. To measure this, we used a short version of the *Social Disengagement Index* proposed by [55] (see Appendix E)

3. *Initial reminiscence questionnaire (only for narrators):* intended to gather an initial list of stories that would be inserted in the application to bootstrap the contextual content for stimulation in it. The questionnaire asked questions about where they lived in their childhood, their birth date or year and some lists related to personal memories (see appendix F).

In the original proposal for the ethical committee, we also intended to gather other questionnaires related to participants' well-being and emotional state. We decided not to use them in the end because measuring the impact of IT on these measures was beyond the scope of the dissertation. Moreover, we also considered that asking these questionnaires would have been asking already too much from participants. Instead, we concentrated on the evolution of participants' mood after sessions and along the study as an indirect measure of satisfaction. The original request to the ethical committee and the corresponding response are part of appendix I (in italian).

Before each session. During the week of the session, participants were given a **Diary** where they were asked to collect impressions about the experience. The diary also included a mood questionnaire to collect information about how they were feeling during the weeks of the study. Participants were not

required to compile the diary, and some questions like *how did you feel during the day?,* or *what are your feelings about the reminiscence experience? did remembering your past triggered any emotions on you?* were proposed in the diary for motivating them to share some thoughts (see Appendix H). The diaries are also an example of *participant observations.* Also during the week, narrators and listeners had the option of using the system (*Reminiscens*) from home through a web interface, to allow them to input more life stories, if they felt like, and collaborate with family or friends around these stories.

During each session.   Observers gathered **Field Notes**, considered also as *participant observations*, and some session photos. Field notes were intended to be a qualitative account of what happened during the session and were summarized in a list of the most important observations at the end of each session day. Some sessions were audio recorded to fine tune our observations later on. The decision for using participant observations in this way was made in order to keep our mind open to all kind of potential results that could be the output of the study. Moreover, *Usage Logs* were collected by the application to keep track of the stories being created, the questions that triggered more answers, the multimedia that triggered more stories or the number of pictures per stories.

After each session.   At the end of the session, the **Mood Questionnaire** available in participants' diaries was compiled by each participant, in order to gather a simple measure of their emotion after the experience. The mood questionnaire was designed to give us an indirect measure about their satisfaction with the experience in order to minimize the bias of participants being polite to us by answering positively to questions like "Did you like the session?". The mood questionnaire consisted of an 8-item questionnaire asking participants to give a score of 1 to 5 to indicate their feelings between a negative mood (sad, tired, worried, tense, pessimistic, hopeless, isolated, bored) and a positive mood (happy, energetic, calm, relaxed, optimistic, hopeful, connected, interested). A lower number would indicate a trend toward the negative mood, while the opposite indicates a trend towards a good mood. The overall mood score was calculated as the sum of each of the items scores, giving an overall mood score in the range of 8 to 40. The Mood Questionnaire is available in appendix H.

After the study.   At the end of the study, narrators were invited to continue the use of the website for 1 or 2 months, during which they would have the chance to curate the final content of their stories and add more information if they wanted to. During this period, researchers conducted final **Interviews** with the participants to gather their final reflections about the study. A post-study **Questionnaire** was also compiled to gather participant's opinions about *Reminiscens*, the experience of the study in general and about how much they socialized their experience of the study with other people outside the sessions during the duration of the evaluation (see appendix G).

8.3.2.3   Experimental design

This study was prepared following a mixed approach by which one part of it would be mainly *observational* (meaning, aimed at an open discovery of realizations without any previous assumption) and a another part would be *experimental* (meaning, aimed at the validation of our hypotheses). While the observational part of the study relies mainly on field notes and diaries, the experimental part of the study relies mainly on the use of different versions of *Reminiscens* through different sessions of the study, and the analysis of how these affected the different sessions.

Our hypotheses were introduced in section 8.1, which basically refer to the following statements: H1) contextual triggers will result in more memories being shared, H2) contextual triggers will stimulate conversation, and H3) collaboration in the digitalization of memories through *Reminiscens* will improve social interaction within sessions, making them an enjoyable experience.

Independent variable. To test these hypotheses, each participant group engaged in sessions where they used a prototype of *Reminiscens* with some features available and others hidden, making the *Version of Reminiscens* our independent variable. *Reminiscens* is discussed in detail in chapter 7. In summary, the basic three features in which we focus our interest are:

- **F1: Contextual multimedia.** Reminiscens suggests contextual multimedia (e.g., old songs and pictures) that are related to participant's life stories (by related, we mean they belong to the same decade and located nearby the place of the stories). The focus on evaluating contextual multimedia as triggers of reminiscence comes from both our intuition on how to stimulate reminiscence and from the literature review in chapter 4 (e.g., [162], [50]).

- **F2: Contextual questions.** Reminiscens suggest simple life related questions to motivate the creation of new stories. Questions are related to a decade. The focus on evaluating life questions as a way of stimulating reminiscence is grounded in our observations during the **PD Workshops** of how participants were keen to tell their stories guided by the motivating questionnaires we provided (see section 6.3).

- **F3: Simple Storytelling.** Reminiscens allows users to enter new stories in textual or audio recording form, attaching also pictures to the story. The tablet's camera can be used as an scanner for physical pictures and stories are organized in a timeline divided in decades. Storytelling is the most basic feature of our system, and the way it is designed, focused on facilitating the digitalization of pictures, follows observations from the **PD Workshops** that indicated the elevated importance of physical mementos as reminders of a person's life stories.

We decided to group these features in **4 versions (or conditions)** of *Reminiscens*. Table 8.4 shows what features were included in each version. Condition A (*Personal*) includes only the possibility of inserting new stories or viewing and editing existing personal stories. Condition B (*Questions-only*) adds the contextual questions to the Condition A. application. Condition C (*Multimedia-only*) hides questions and shows contextual multimedia. Condition D puts both questions and contextual multimedia.

Table 8.4: **Reminiscence longitudinal study.** Different conditions of the study based on Reminiscens' features.

Feature	Condition A	Condition B	Condition C	Condition D
Simple Storytelling	X	X	X	X
Contextual questions		X		X
Contextual multimedia			X	X

With these 4 conditions, our experimental design was prepared to test H1 and H2 but not H3. The reason for having only these 4 versions (and not isolating simple storytelling to test H3) responds to the limited number of participants we were able to involve. With 4 versions we ensured that in 8 sessions, everyone could test each version at least twice. H3 will be partially tested by analyzing the impact of the different

conditions in the enjoyment of the session through the means of analyzing the mood scores. Everything will also be qualitatively analyzed based on field notes and other qualitative outputs.

For simplification, we will refer to each version of the app with the following names and numbers: (A) version 1, "Personal" because it gives only access to personal stories; (B) version 2,"Questions only" because the contextual stimulation is only through questions; (C) version 3, "Context only" because the contextual stimulation is only through contextual multimedia; and, finally, (D) version 4, "All" because it contains all the features in a single version.

Dependent Variables.   In order to answer how much stimulation increases the recall of memories (H1) and conversation (H2), the system logs kept track of the following variables for each session of the study:

- Stories created in the session (SS)

- Number of editions to existing stories, during the session (SE)

- Pictures added during the session (PS)

- Questions answered (QS) (i.e., questions that were explicitly answered with a new story)

- Contextual multimedia watched in detail (MS) (e.g., clicking on a embedded youtube video of a song and listen, opening a picture in big, etc.)

Additionally, the after-session mood score of both listeners (MSL) and narrators (MSN) was used as a measure of satisfaction with the experience. The scale used to gather information of mood was part of the diary given to each participant and rendered a general score in the range of 8 (bad mood) to 40 (great mood). We have already described the mood diary and score earlier in this chapter (see section 8.3.2.2) and the scale can be found in appendix H.

Within Group Design.   Due to our limited number of participants plus the nature of the experiment having multiple dependent variables and multiple conditions, we decided that all participants should have the chance to try all the versions of the system (as suggested by [215]). To prevent a bias by a "learning effect" (i.e., the effect of learning how to use a system after successive sessions) [215], 4 different timelines of conditions were randomly assigned to different participant groups of listeners and narrators. In other words, some groups started with condition A and followed with B, C and D. Others started with B, then C, D and A. Others did CDAB and finally, others followed the pattern DABC. Moreover, everyone started the study with at least 3 preloaded stories (one being their birth), to make sure that groups that started with the versions that included the context (i.e., "All" and "Context only") would already have a context to explore. Otherwise, we would have had a bias from the fact that those who use these versions at the end would have a context to explore because they would already have some stories in their timelines from the previous sessions. Those who use these versions at the beginning, however, would have an empty context because their timelines would be still empty.

The *one-session* track.   In our original proposal, a potential bias indicated by fellow researchers was the fact that by doing a longitudinal study where people would meet in more than 4 occasions, it might happen that after some sessions, they would already be naturally stimulated by the routine itself, minimizing the impact of all the other conditions. To address this potential limitation, the idea was to conduct an additional experiment involving between 20 and 30 participants that would attend only the first session of the experiment and would each test a different version of the application (between-group design).

As an interesting anecdote, one of the narrators in this track became so fond of the experience that asked for more sessions and got to participate in 3 more.

Home-Usage option   A web version of *Reminiscens* with all the features (Condition D of the experimental design) was made available through a web page and both narrators and listeners had access to the profile of the narrator to either polish stories that were started during sessions or to prepare before each session. The purpose of this was to give participants the possibility to further work on their stories if they wished to. Additionally, narrators who had a access to a computer to use the system from home, received a complete guide about *Reminiscens* in the form of a "User Manual" in order to help them in this work.

8.3.2.4   Analysis

The mixed nature of our study, with both open observation and hypothesis validation, requires also a mixed approach to analysis. As a first goal, **grounded-theory-inspired** analysis was applied to *diaries*, *field notes*, *questionnaires* and *interview transcripts* in search for answers to our research questions and other interesting, non expected, realizations. In a second term, repeated measures ANOVA using Friedman non-parametric test [215] [5] was used to test for differences in the previously defined *dependent variables* of the study (e.g., number of stories shared, etc.). The Friedman test was selected on the basis that the data we are analyzing is not compliant with most of the assumptions requested by the traditional repeated measures ANOVA (e.g., the data is not normally distributed). The test was applied to the log of sessions, which was enriched with the value of the variables we could extract from the usage log of *Reminiscens*. All tests were followed up with post-hoc, t-tests to compare the effects of each group (i.e., application versions). Moreover, in the qualitative analysis, we have also included data from the pilot study as we think the observations from it also hold a great value.

Limitations.   Given the limited amount of *quantitative data* we had, we did not considered a maximum p-value before running post-hoc tests (usually, a p-value greater than 0.05 means that the differences in variances found by ANOVA are not significant). Statistical analysis was applied mainly as an additional method to the more grounded-theory-inspired analysis of our qualitative data that was much richer and abundant. Furthermore, the analysis of this study was the very last stage of this project and was executed in parallel with the writing of this dissertation. This resulted in *an analysis that is not as profound as it can potentially be given the amount of qualitative data we have gathered*. Much more can be still learned from our data, and this will remain a future work to be done as a follow-up to this dissertation. Another important limitation is related to the design of the study, which in its first drafts was heavily oriented to test the effectiveness of stimulation of different types of multimedia triggers. Because of this initial orientation, in the more extended and actually performed study that we report here, we have missed the important condition of running social reminiscence sessions *without any kind of IT*. This remains as an important avenue of research for the follow ups of this study. One last limitation has to do with the one-session track, for which we intended to involve at least 20 to 30 people. Unfortunately, we were only able to involve 6 additional participants on top of the 9 who were involved for the stable-track. For this reason, we decided not to perform the between-group analysis. Nevertheless, we did include our observations of these sessions in our qualitative analysis.

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[5]We conducted the test using the R statistical package and using these scripts as reference: `http://www.r-statistics.com/2010/02/post-hoc-analysis-for-friedmans-test-r-code/`

8.3.2.5 Comeback

As a motivation to participate, narrators and listeners were told in the first session to consider the experience as a process for progressively building the timeline of the narrators' life, which at the end of the study, would have been transformed into a personal book of their lives. The final **Book of Life** of narrators is, therefore, a comeback to narrators for participating in the study. Listeners appear as co-authors of the books. At the moment of writing this dissertation, books are in preparation and the first one (related to the pilot study) has already been delivered.

8.3.2.6 Ethical approval

This study was also submitted for approval to the Ethical Committee of the University of Trento that approved its execution on July 3, 2013 (see appendix I).

Finally, to have an overview of the thole study in one page, Figure 8.4 shows our methods in a timeline, indicating how the application was used, when measurements took place and what materials were used.

8.3.3 Results: participants and sessions

Excluding the pilot study, 33 people participated in the study, 17 of them in the role of narrators (15 women, 2 men) and 16 in the role of listeners (10 women, 6 men). Participants were organized in 15 groups, 9 of which participated of the **stable track** and 6 of which did so in the *one-session track*. The mean age of the narrators was 76 years old while the mean age of the listeners was 26 years old. Groups were organized randomly, resulting in an mean age difference per group of 46 years old. Tables 8.5 and 8.6 give a summary of age and age difference of per group, indicating the high level of intergenerationality of our groups.

Table 8.5: **Reminiscence longitudinal study.** Narrators and listeners age statistics.

Role	Minimum	Mean (rounded)	Maximum
Narrators	**65**	**74**	**90**
Stable narrators	66	76	90
One-time narrators	65	70	80
Listeners	**18**	**28**	**40**
Stable Listeners	18	26	39
One-time listeners	24	30	40
All	**18**	**52**	**90**

Table 8.6: **Reminiscence longitudinal study.** Summary of age differences in groups.

Study Track	Minimum	Mean (rounded)	Maximum
Stable groups	30	46	70
One-time groups	34	42	50
All	**30**	**46**	**70**

During the whole duration of the study (from September to December of 2013), 78 sessions were held.
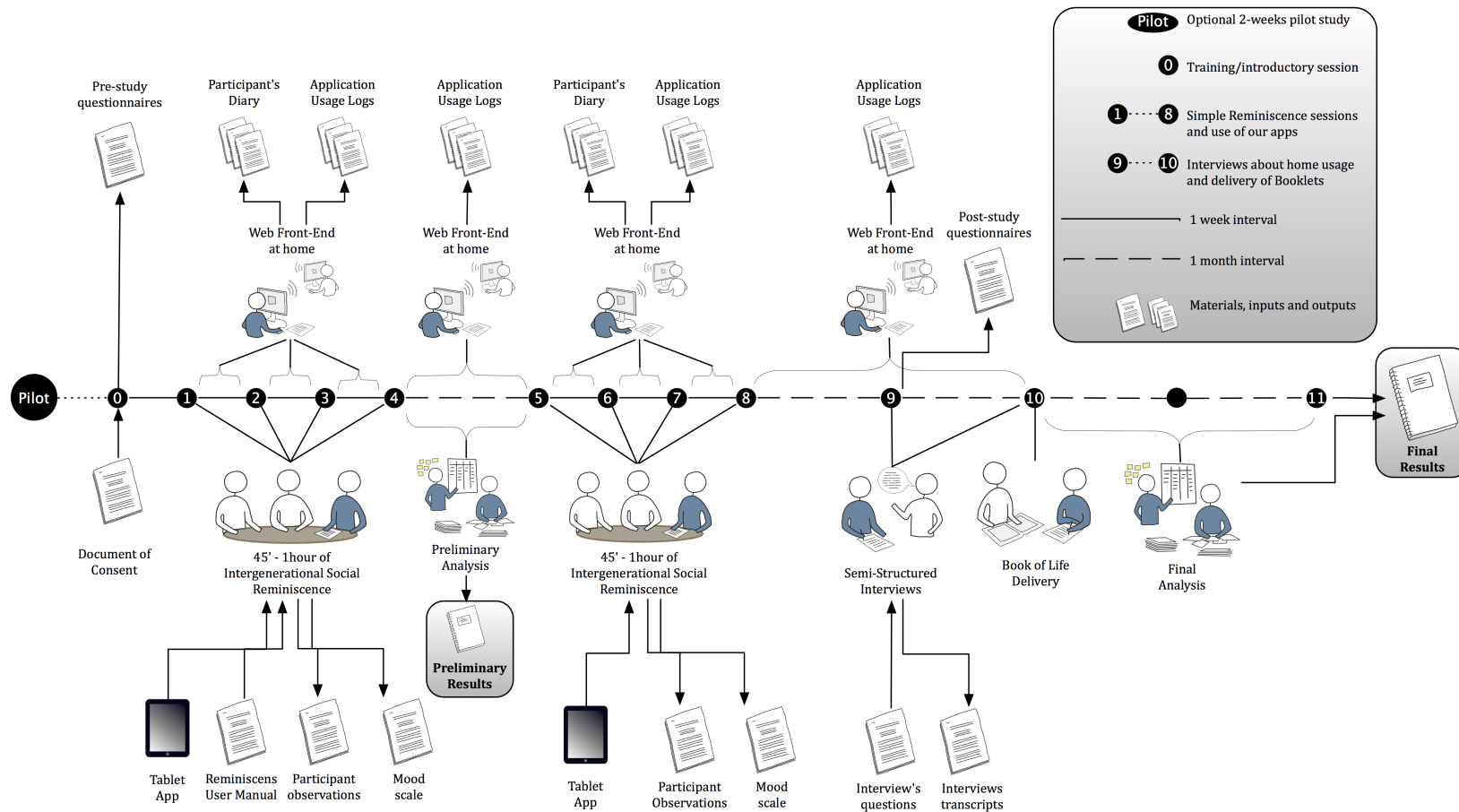
Figure 8.4: **Reminiscence longitudinal study.** Visual timeline of the longitudinal study about reminiscence supported by IT.

Of the 78 organized reminiscence sessions, 4 were organized as a **pilot** involving a grandparent with his granddaughter, which leaves a total of **74 sessions** of the official study. The pilot's 4 sessions were held before all the others and served the purpose of adjusting details about the study. In particular, they allowed us to shorten questionnaires (also to eliminate some of them), rethink the role of the listeners as we realized we were not considering them in their full potential in the design of the study. The remaining 74 sessions are divided as follows:

- **The *stable* track:** 11 narrators and 9 listeners participated along the whole duration of the study forming **9 'stable' groups** (2 of which involved 2 narrators and 1 listener) that met 6 or 8 sessions each with a weekly frequency (*66 sessions in total*).

- **The *one-session* track:** 6 narrators and 7 listeners participated of only 1 or 2 sessions each (8 sessions in total). Of the 7 listeners, 3 participated as substitutes in a couple of sessions of the stable group.

The average duration of the sessions was of **1 hour and 3 minutes**. The shorter session lasted **30 minutes** (a session in which the narrator had to stop the session due to health problems). The longer session lasted **1 hour and 40 minutes** and corresponds to a session of the **one-session** track. In average, sessions of the **one-session** track lasted 20 minutes more than sessions of the **stable-track**. Most likely, this difference in duration is due to the fact that one-session participants knew it was the only opportunity to share their stories, so it lasted a bit longer in order to share a bit more.

Three groups were formed by relatives (grandparents with grandchildren), which in 2 cases included more than one narrator (one married couple and a couple of sisters). A very interesting aspect of these groups is the fact that in two of them, other non-official participants were added after the study started, becoming additional narrators or listeners that collaborated in the storytelling efforts. In these two cases we had also the unique situation in which the stories referred not to one narrator only, but to **2 narrators**, who both collaborated in telling the stories. This was unforeseen in the design, so we needed to adapt our system quickly in such a way that **a single timeline could belong to more than one person.**

In the stable track, each group met once a week to talk about the narrators' stories while using Reminiscens for both stimulating the conversation and facilitating the preservation of the stories. All participants had access to the system also from home, through a web interface, which continued to be available for at least two months after the sessions stopped. During each session, up to two researchers participated of the sessions as additional listeners and observers. Usually, a session would start with the participants selecting a stage on the life of the narrator (i.e., a decade) and then freely develop as participants talked about and digitalized shared life stories. In 10 occasions, sessions were postponed for a week due to either narrators' or listeners' external responsibilities. In the 3 groups, the last two sessions were cancelled because narrators' or listeners could not attend any longer (to the study ended at the 6th session). Figure 8.5 presents the summary of sessions, participants and groups in terms of their numbers.

The full dataset of sessions was extended with the number of stories and pictures added to the system during each session, the number of questions answered and of contextual multimedia watched in detail, and with the resulting mood score for both narrators and listeners.

8.3.4 Results: qualitative analysis

As a first outcome of our study, based on the qualitative analysis of our field notes, participant diaries and session imagery, we realized that our original and simple stages-based model (introduced in chapter
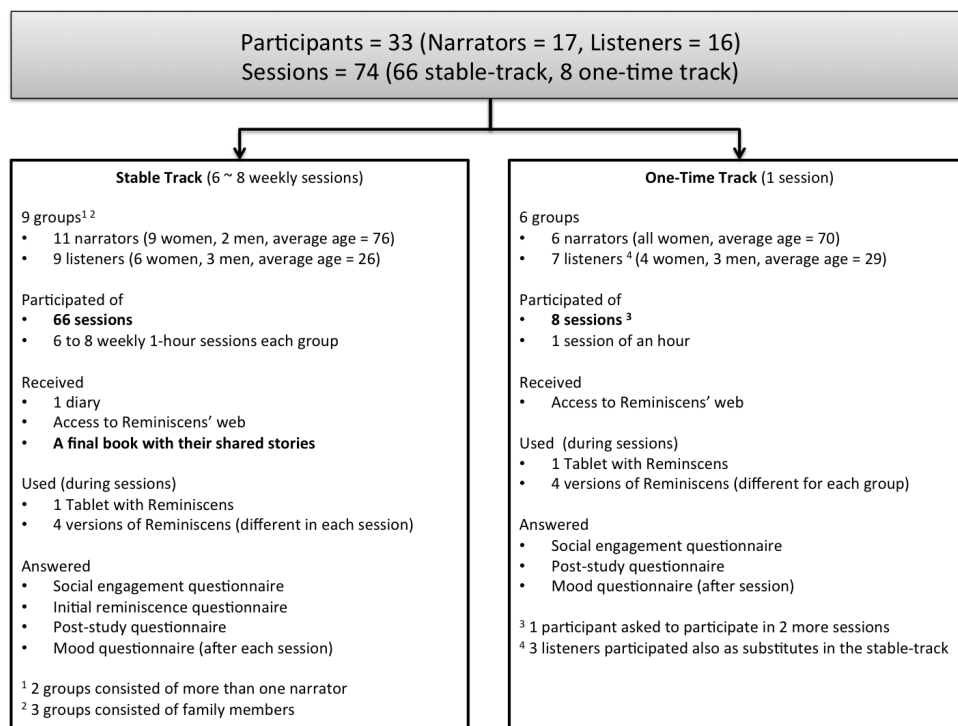
Figure 8.5: **Reminiscence longitudinal study.** Participants and sessions.

4) was not complete. The stages-model originally identified three different stages (or roles) in which IT supports reminiscence practices. During our study, we observed the emergence of other stages we did not anticipated and where IT can potentially prove helpful (and somehow did) during the study. Figure 8.6 shows the model, with the new stages in light gray. We will use these stages to structure the presentation of our qualitative observations in this section.

8.3.4.1   Preparation.

One stage that we did not expected to be relevant but that actually became fundamental during the study is that of narrators preparing their material. Before each session, most narrators would spend the week looking forward to the session and already reminiscing by collecting and organizing their old pictures and mementos. For this purpose, some narrators used their diaries as an extension of their timelines, using them to either continue a story they shared in the last session, or to organize the list of life events they would like to share in the upcoming ones (Figures 8.7b and 8.7c). Other narrators used directly the web version of the system to insert their stories before the session, and then would tell the stories they had inserted during the week (Figure 8.7a).

Contextual questions proved interesting for preparation, as many narrators used them to guide their work from home. IT systems that can work as the *diaries* might also prove useful in this space. *Reminiscens* might benefit from having a way of highlighting new stories recently added or marking some stories as *to be shared in session* to help narrators in finding the stories they wanted to discuss when they are in the
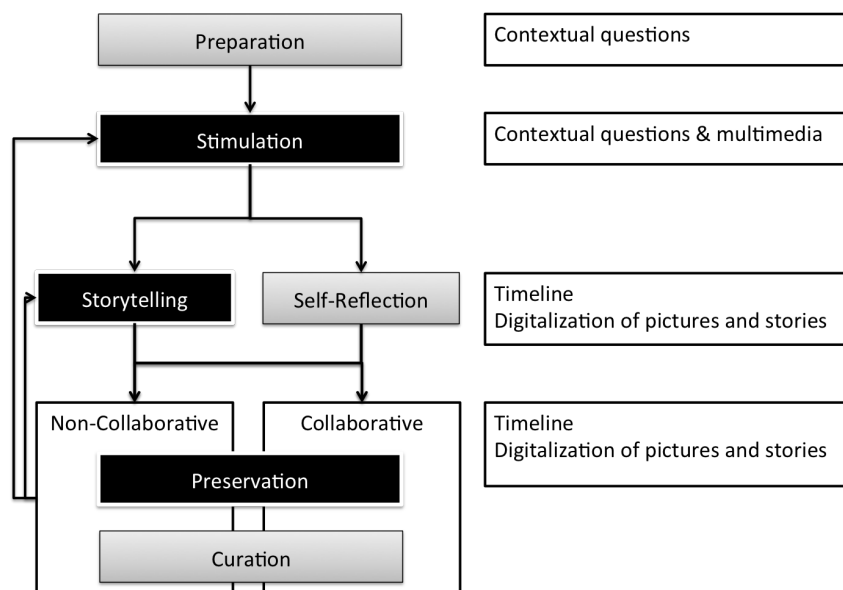
Figure 8.6: **Reminiscence longitudinal study.** Extended model of reminiscence stages where IT can provide some support. In black, stages we planned to support a priori; in light gray, additional stages we observed during the sessions of our study. On the left, features of Reminiscens for each stage.

reminiscence session.

The ability to digitize the stories seem to be the main motivator for narrators, who makes sure to "prepare" very well what are the stories they want to include in their timelines. (Researcher Field Notes, Week 2, 23/10/2013)

[The narrator] has used the diary to prepare the stories to tell and insert into the app. The main driver seems to be the construction of their book, helped by someone. (Researcher Field Notes, Week 3, 31/12/2013)

8.3.4.2   Stimulation (and Engagement).

Stimulation was one of the most important parts of the whole experience, as we expected. However, opposed to our initial hypothesis, suggested multimedia content in the application was not particularly effective at the beginning. Instead, an unexpected way of interaction for stimulating reminiscence was that of googling the context. Many of the listeners used this strategy for stimulating the narrators to tell a story: they either used one of the suggested questions or asked one of their own (e.g., where did you go to school?) and then go outside *Reminiscens* to find content online that was related to the answers, mostly in the form of pictures of places related to their stories. As noted in diaries, this kind of *free exploration* of the context of stories was one of the highlights of many sessions, and supporting within the system would probably be a plus. Sometimes, the free exploration resulted also in the attachment of one of the pictures found online to the story, as related picture (similar to what happened in the short study and much earlier in the blog of the laboratory of technology)

[Is there something in particular you liked to do?] Using the tablet for searching things related to what we are talking about and finding interesting news and images that I know.

154
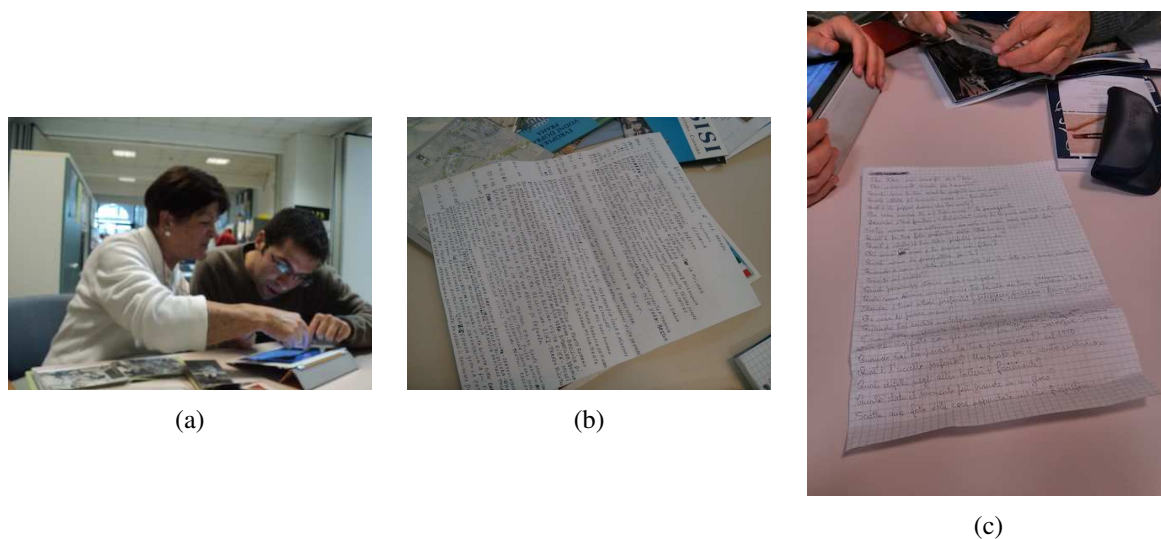
Figure 8.7: **Reminiscence longitudinal study.** (a) a narrator showing what she has added to the system during the week to a listener; (b) and (c) parts of diaries with lists of events to be shared during the sessions.

> *(Narrator 8 Diary, Week 2, 24/10/2013)*
>
> *...through simple touches, it's beautiful to have the chance of searching and seeing what happened many years ago. (Narrator 11 Diary, Week 3, 8/11/2013)*
>
> *During the meetings, I noticed that a lot of ideas for the story come from the display of images on the internet, rather than from pictures or questions that are available in the application on the iPad. (Listener 9 Diary, Week 4, 07/11/2013)*

And even if the contextual content did not appear to be a central part of the interactions in each session, participants (especially narrators) still valued it as a way to support their memory.

> *It is strange, but it's true, I remember well the things from my childhood with even the details, but with the passage of time, memories are more and more unstable, and suddenly they struggle to re-emerge to be told. But the stimulus with a question, a picture, with the tablet helps me to improve. (Narrator 11 Diary, Week 2, 25/10/2013)*

A possible reason of why suggested content was not used as much as we expected was that the content was not easy to discover and navigate. After revising the app interface to reduce the number of menus to follow, putting multimedia upfront, this started to be used more frequently, with a positive result, indicating how important it is to reduce the number of parallel paths of interaction within the application. Initially, the context was divided in five different screens according to the category. By half the study, we changed this to a version by which all the context was in one screen, and changing the category of displayed content every 5 minutes (e.g., the user would first see a list of pictures, and then suddenly an embedded video of an old song).

> *...we have navigated the recommendations of music, artists, etc. on the application. (the narrator) was having fun with this and I think we will continue to do this in the following sessions. (Listener 4 Diary, Week 5, 20/11/2013)*

As for multimedia content, songs were the the most interesting content. Each song, displayed as an embedded youtube video, always helped narrators to remember all kind of stories. Pictures were also interesting, but somehow, had less of an impact, although some narrators loved to see pictures from the past.

> *...I have really loved how with the tablet ... we can go to songs that made me relive my childhood with my mother that used to sing that song [name of suggested song]... (Narrator 10 Diary, Week 3, 30/10/2013)*

> *For me, photography is one the most beautiful things that technology gives us, and it also helps the memory. (Narrator 3 Diary, Week 4, 06/11/2013)*

Still, two problems remained with suggested content: accuracy and relevance. Often, in our field notes, we have found statements like *"that song is not from that decade"* or *"I know that song but I am not fond of that artist"*. This leaves some space for improving our context algorithm through personalization, leveraging on users' interests. Finally, with suggested contextual questions we have also had a positive and unexpected result: a playful interaction, a *ludic engagement* [66]. Several narrators saw questions as a game where they had to answer as much questions as possible.

> *(narrator's name) was highly interested in the questions and insisted to answer them almost as if we were in a race (Listener 13 Diary, Week 2, 25/10/2013)*

> *[Is the session better with the application? In what way did Reminiscens helped you in stimulating narrators?] ...from my point of view, better with the application. Then, during the storytelling maybe we rambled but questions usually helped us. (Listener 13 Interviews, 16/12/2013)*

But they also require some time and reflection.

> *Questions require a longer time for me to reflect and remember. (Narrator 10 Diary, Week, 15/11/2013)*

> *I like the application, even if it takes me quite some time to think. (Narrator 1 Diary, Week, 09/09/2013)*

In particular, questions served as stimulation beyond the session, when narrators were using the system from home. This use of questions-as-a-game extended after sessions stopped, when some narrators continued to get inside the system just to see what new question awaited them that day. To a lesser extent, questions were used extensively in the first half of the study, when both narrators and listeners were still in the phase of getting to know each other. Supporting a more game-oriented approach to stimulating reminiscence is also a potential avenue of improvement for *Reminiscence*.

> *I read the questions and I have felt many emotions to which I responded with pleasure, remembering the days of my childhood and youth. (Narrator 3 Diary, Week, 26/10/2013)*

Also timeline and the possibility of digitalizing pictures were themselves elements of stimulation, by which narrators were making themselves remember what happened at each specific decade. After a while, their own stories became also an element of stimulation.

> *Today I used the application (alone) ... focusing on the period in which they [pictures] were taken ... memories that remained hidden until that moment re-emerged again; Remembering of course made me relive the excitement and sadness of that day.. (Narrator 1 Diary, Week 3, 29/09/2013)*

I used the application to add pictures. It was exciting because every picture reminded me of several times in my life, mostly beautiful, but also some sad. (Narrator 1 Diary, Week 1, 07/09/2013)

And finally, but not least, the intergenerational engagement and the capacity of listeners for motivating narrators to share their stories was key for stimulating them to remember and sharing their stories. This engagement came in myriad of different ways and styles that depended much on the personality of the listeners and of the narrators (as with any conversation). Some preferred to *listen* to the stories first and then ask follow up questions (Figure 8.8). Some were more interested in digitalizing the stories *in parallel* while the narrator was telling the story, fulfilling the role of a *scribe* that preserves the stories of a person for posterity (Figure 8.9). Some were more concentrated in *teaching* or letting the narrator learn how to use the tablet, as they understood their contribution was that of helping narrators to progressively learn how to use the technology (Figure 8.10).
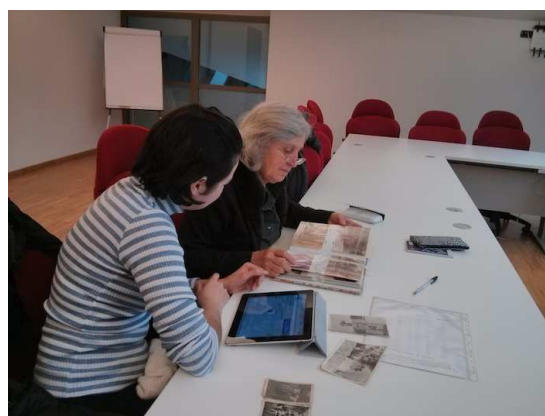
(a)   (b)

Figure 8.8: **Reminiscence longitudinal study.** Listeners focused on listening the stories carefully.
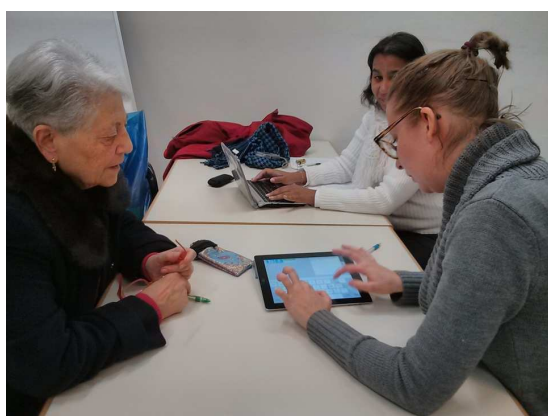
(a)   (b)

Figure 8.9: **Reminiscence longitudinal study.** Listeners acting as scribes, digitalizing stories in parallel while narrators tell them.

(a) (b) (c)
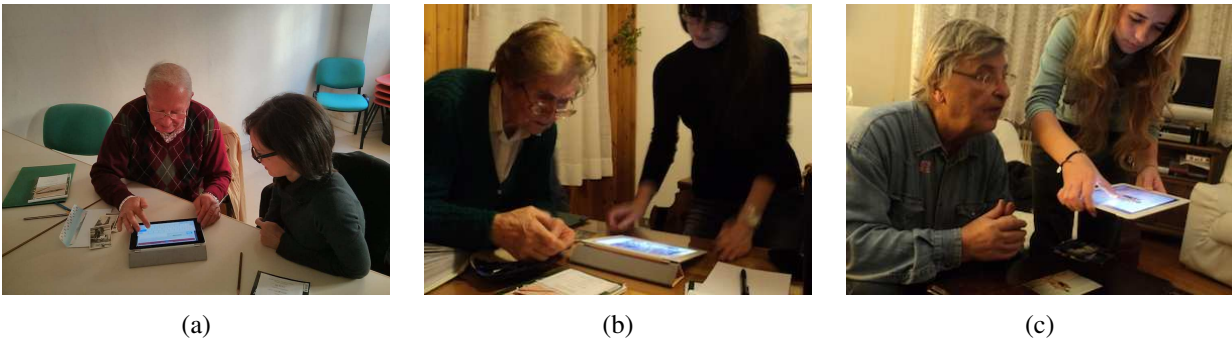
Figure 8.10: **Reminiscence longitudinal study.** Listeners focused on either letting narrators take the lead in writing the stories or teaching (or at least showing) them how to use the tablet.

Usually, sessions with listeners who were focused on helping narrators to learn how to use the technology were more collaborative, with both participants actively engaged in preserving the stories. Depending also of the listeners, the tablet (and *Reminiscens*) was some times neutrally located at the center (8.8a) and others it was in front of the listeners (Figure 8.9b), who took the whole responsibility for putting stories in the system giving little participation to the narrator. Sometimes, listeners were also quite proactive in shaping the storytelling, taking an active role in selecting content to include and stimulating narrators to share stories related to that content in particular (Figure 8.11a). Other listeners were more passive and allowed narrators to select what to include and what not to include, while stimulated them only by asking questions and going deeper into each story that was shared by the narrator (Figure 8.11b). Whatever the case, the engagement was almost always positive and and joyful, in some cases bringing along more people to participate, especially in the family contexts (Figure 8.11c)

(a) (b) (c)
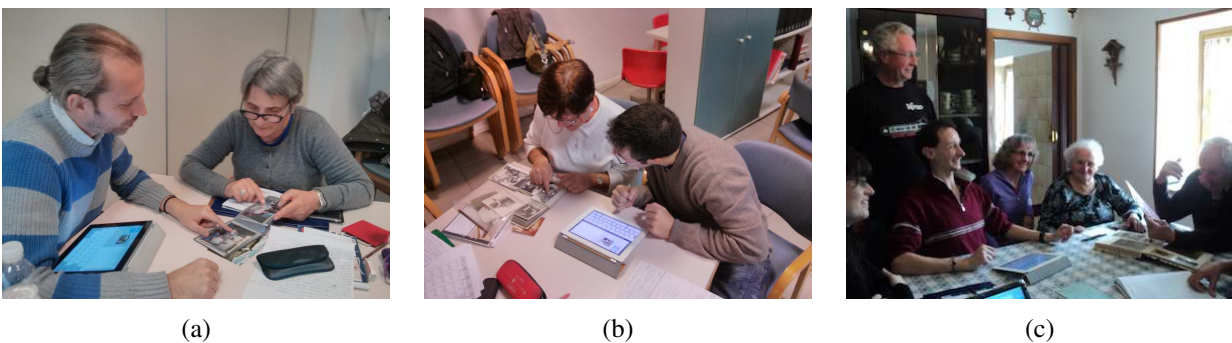
Figure 8.11: **Reminiscence longitudinal study.** Listeners focused on either letting narrators take the lead in writing the stories or teaching (or at least showing) them how to use the tablet.

8.3.4.3 Storytelling and Self-Reflection.

Storytelling is the central part of each reminiscence session and one of the most enjoyable moments of socializing between the older adult and the younger listener (Figure 8.11). And, along storytelling, we have observed a great deal of Self-Reflection (i.e., a serious reflection about one's character and actions).

This is, of course, a natural part of reminiscing and, although our tool was designed to stimulate self-reflection (questions under the "thoughtful" category of our knowledge base had this goal, e.g., "what is the most important lesson you have learned from your parents?"), we realize that it might have been limited when it comes to properly capturing those reflections and their great value. We explore this further in the next stage, but suffices to say that the need for capturing stories while they were told led many times to listeners losing important part of the stories. *Audio-recording* might be fundamental for this. Although *Reminiscens* was designed to have audio-recording features, our technical implementation did not arrive in time for the study, making us leave this interesting feature for a future study. Self-reflection was then primarily found in narrators' (and sometimes, listeners') diaries. Again, having some way of supporting personal *diaries* inside *Reminiscens* can also be an improvement.

> *...this is an aspect of myself that has changed in time. I have always been essentially a solitary person, but I do not suffer from it, I appreciate it. However, with the course of time I have always found myself more and more open to others... (Narrator 2 Diary, Week 6, 27/11/2013)*

> *...I hope I'm able to fulfill her (narrators') desire (of capturing her stories for her children) because I think these life lessons are one of the most important things a person can transmit to others (Listener 4 Diary, Week 3, 30/10/2013)*

The many different self-reflections we have observed during the study reflect the power of the reminiscence practice in affecting the way a person think of his or her ageing experience and about what experiences do they treasure the most in terms of how they shaped what they are. Especially for narrators, thinking of the experience expanded to their daily lives, reflecting about stories even after the sessions.

> *When you are young you think that life is fun and beautiful just up to a certain age, but I think it's beautiful at any age and as we age we experience the joys and sorrows more "deeply". (Narrator 1 Diary, Week, 07/09/2013)*

> *It is night already, and I am not sleeping, thinking of the work we have done yesterday. About my experience in the College I would like to add that it toughened me for life and helped understand the meaning of obedience, renunciation, sacrifice, silence. (Narrator 10 Diary, Week, 21/10/2013)*

Narrators and listeners also reflected about the importance of reminiscence in their lives, finding value both for their "health", but also as a means for reliving their lives and preserving their stories for posterity.

> *I believe this project is good for both the heart and the mind, too bad it is almost finished. For us, older people, these things should be done as a healthy habit to keep our minds active. (Narrator 3 Diary, Week 6, 20/11/2013)*

> *Today I re-read the stories already written on the application and then I relived 70 years of my life, I noticed that the saddest episodes have always occurred in association with episodes of great happiness, pure randomness? I think not!. (Narrator 1 Diary, Week, 22/10/2013)*

> *She [the narrator] asked me today to try to teach her to interact more with the application by entering stories and images that will then draw the diary of her life, which she will leave in memory to her children, in such a way that it can fill the space left by the times when there was no opportunity to tell her stories of life. (Listener 4 Diary, Week 3, 30/10/2013)*

In general, having the chance to share their stories was a satisfying experience, with lots of values for both listeners and narrators.

> *Now I understand the importance of a journal, where you can fix what is important about my feelings and experiences. (Narrator 2 Diary, Week 2, 23/10/2013)*

> *so much difference between the beginning and the ending. At first, this was a didactic learning activity, but by the end it was more about having fun (Listener 13 Interviews,16/12/2013)*

Narrators, in particular, perceived the whole experience of the study as a gift to them, an action that brings a positive change to their lives. This is an important note that transform the whole study in yet another example of participatory action research, at least from the perception of some participants.

> *I think it's a beautiful idea, that of these young PhD students, to think of us older people and create this site where you can write and post photos or other. (Narrator 2 Diary, Week 5, 20/11/2013)*

8.3.4.4 Preservation and Curation.

When we started the study, we were hoping that in each session, one or two stories would be inserted in the system, along with a few pictures, with the goal of preserving them for the future. We instructed listeners to take a leading role in this stage, but always looking to involve the narrator in one way or another. The result was that in some cases, preserving stories took a non-collaborative form where listeners would try to capture the story as it was told, while in other cases it took a collaborative form where listeners tried to involve the narrator as much as possible in the process (e.g., making them take the pictures, showing them the writings, teaching them how to do everything by themselves, etc.). The form of interaction was highly dependent of the listener style of conversation (as we have already noticed in the paragraphs related to *stimulation*). Some listeners were very able of quickly writing up stories as they listened, while others preferred to listen and talk first and then invite narrators to insert the story into the system. The main problem with both forms of preservation was that writing the stories during session interrupted the flow of the story and, therefore, often missed the jewels of self-reflection.

> *...the stimuli and the stories made me recall also my own memories and interest, for this reason it was difficult to write because I wanted to interact (Listener 35 Interviews, 20/12/2013)*

The audio-recording feature would have been a great plus in this context too and the question remains whether this would have served as a better means of story preservation (Figure 8.12).

Collaborative preservation, however, was certainly more engaging and made the interruption less of a problem since it became a powerful way of socializing between the narrator and the listener. We feel, however, that the original design missed some of the potential for collaboration that the whole practice entails. Remains for future work to explore other designs for capturing stories in ways that better leverage the collaboration between both narrators and listeners, which was often pointed as a good feature and indication of better interactions during the sessions (particularly by listeners).

> *[to the question of what you liked of the session] ...at this meeting [narrator's name] interacted more than other times, and has added pictures and memories in a more independent and casual way... (Listener 4 Diary, Week 4; 13/11/2013)*

In the family context, collaborating in preserving family stories might be a powerful driver of interaction and conversation, which was extended to other members of the family who were not officially participants

(a)

(b)

(c)

(d)

Figure 8.12: **Reminiscence longitudinal study.** (a) (c) Non-collaborative preservation vs. (b) (d) Collaborative preservation of stories.

of the study.

Figure 8.13: **Reminiscence longitudinal study.** Collaboration in family. Social reminiscence sessions in family context motivated not only participants, but the rest of the family to join the collaboration in telling family stories.

> *Reminiscence can become a really nice and joyful family activity, where the technology is primarily used to capture the story and make it available to everyone, even if everyone already knows it. (Researcher Observations, Week 1; 19/10/2013)*

Even if our observations indicated collaboration was a big driver for preserving the stories and enjoying the session, non-collaborative preservation of stories was also seen as enjoyable and useful by some of the participants, and listeners felt useful to others in listening to their stories. Moreover, diaries also became an instrument of preservation. Some narrators continued in their diaries the stories they started to tell during the session (as a way to remember what they wanted to write).

> *...I liked to talk [about my stories] while [listener's name] was writing in the tablet what I was saying... (Narrator 8 Diary, Week 3; 31/10/2013)*

> *[This experience helped me to...] Feeling useful to others and listen to fascinating stories that I did not know (Listener final questionnaire)*

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Finally, an important, not foreseen stage, which we have observed is that of curation, where participants (especially narrators) spent time modifying their stories to make them more shareable, thinking mainly of the final book, which became not only the goal of the experience, but also a source of satisfaction.

> *You know what they say, "have children, build a house and write a book to fulfill your life!".*
> *(Narrator Quote from session in Researchers Observations, Week 1, 31/10/2013)*

The quality of the story in its final state of preservation within the system acquired utter importance also when some narrators discovered that not everything they wanted was written, or perhaps it did not reflected the story in the way they wanted to share it. This happened in a couple of occasions, particularly with the groups where the preservation and curation was less collaborative. Most likely, the less collaboration, the less the awareness of the narrator about how stories are being preserved.

> *I was a bit disappointed because (after having remembered and shared so many memories in the previous meetings) I verified that what was written was little or nothing and that among the little that was wrote, it lacked some parts. Moreover, there appears to be a bit of chaos in the logical order of events. (Narrator 8 Diary, Week 6, 28/11/2013)*

> *[the narrator] expressed feeling a little deluded for some reasons: one important story has not been saved, she had the impression that not all the stories she shared has been captured or well written. (Researcher Field Notes, Week 7, 12/12/2013)*

Other sources of frustration are technical problems (e.g., internet connection problems resulting in stories being lost), errors in the system (e.g., a picture is stored with the wrong rotation or out of focus) and limitations of *Reminiscens* (e.g., not being able to edit pictures in detail, lack of search of already inserted stories). Some narrators did not understand the fallibility of the system and gave responsibility for the low quality of the final digitalized story to the listeners

> *[the narrator] says, "can we rotate the picture? because the [listener] has put upside down". For some reason, [the narrator] is not completely satisfied with the listeners' work and constantly give responsibility of any problem to [the listener]. (Researcher Field Notes, Week 8, 18/12/2013)*

The lack of a search feature became a major limitation, preventing participants from actively engaging in it. Search was also important for contextual resources, as most of narrators were looking to complete their stories by going back to questions they had seen before but not answered.

8.3.4.5 Additional notes.

Reminiscence sessions and the collaborative preservation of life stories was generally perceived as valuable experience, which can be a promising activity for intergenerational engagement and, particularly, voluntary work of young people. The role of technology, in this scenario, can be that of leveling the interaction. Older adults narrators contribute with their stories and younger listeners contribute by helping to preserve them. Both meet each other in equal terms around the collaboration for preserving the stories for the posterity. And this collaboration is activated also between older adults, which met in occasions to work together using the web version of Reminiscens in the local elderly community center (CSA).

> *I think it would be interesting to bring together not only seniors, but also younger adults, with young people. It happens that they depend on each of the others, with adults having stories that belong to common periods of time and because they motivate emotions in both. (CSA Coordinators Interview, 0/12/2013)*

...they have given a big importance to this, [narrators] helped each others often. (CSA Coordinators Interview, 20/12/2013)

Coordinators of the CSA saw the experience and the system with goodwill, expressing that they believe the technology can facilitate the process of bringing generations together in a voluntary social work context. This opens the doors for future collaborations aiming at enabling and facilitating voluntary intergenerational work. Figures 8.14 and 8.15 shows a final view to many of the engagement moments during the sessions of the study.

It is often difficult to find young people to help, but with this tool it makes it easier [because] it brings together young people and older adults in a natural and relaxed manner (CSA Coordinators Interviews, 20/12/2013)

Figure 8.14: **Reminiscence longitudinal study.** Some examples of the settings of the social reminiscence sessions.

Figure 8.15: **Reminiscence longitudinal study.** Additional examples of the settings of the social reminiscence sessions.

8.3.5 Results: quantitative analysis

Using the resulting dataset of sessions, we investigated how much the different versions of *Reminiscens* influenced *stimulation* of reminiscence (H1) and enjoyment of the sessions (H3). We did not have any quantitative variable to test the stimulation of social interactions (H2). To look at the effect upon stimulation of reminiscence (H1), we used the number of stories (SS) and pictures (PS) created during the session as a proxy to the recall of memories. And to look at the level of enjoyment (H3), we tested the groups against the self-reported mood of both narrators (MSN) and listeners (MSL). All the tests rendered the same result: there is **no significant difference** between the output of sessions with one version and the output of sessions using another version.

8.3.5.1 Limitations of the dataset.

The results here reported cannot be considered as conclusive due to several limitations of the dataset, including:

- The sample was small, with only 74 sessions, of which only the stable track was considered (66 sessions)

- Technical problems experienced during the study (e.g., internet connection issues, bugs in the application, etc.) resulted in more sessions using the normal full-featured version instead of the one planned for that session.

- In many sessions, narrators and listeners did not complete their mood tracking questionnaire, further limiting our dataset.

- Both the technical problems and the lack of self-reported data made our dataset "unbalanced", which forced us to eliminate some sessions during the analysis to fulfill the requirements of the statistical test we were using (Friedman Test)

- We ran the test first using only the first 4 weeks of the study and then using the sessions of the last 4 weeks. The last four weeks were even more unbalanced because some people left the study in the sixth week.

- During the last four weeks of the study, we introduced a change in the way context was visualized (described in chapter 7), which, as we discovered after the study had finished, did not track the number of times a contextual multimedia resource was opened in detail to view (i.e., clicking an embedded video of song to listen it)

Moreover, the original dataset of sessions was extended with additional scores based on our qualitative observations, to further characterize the sessions. Based on the extended model of stages that we have derived from our observations, the following scores were added to each session:

- Level of **stimulation from contextual triggers**, or how much, according to the observers, the stimulation came from contextual triggers in the system (SC).

- Level of **stimulation from the listeners and observers**, or to what extent, according to the observers, the stimulation came from the interaction with listeners and observers (SP).

- Level of **storytelling of the session**, or how much of the session was devoted to telling new stories (ST).

- Level of **collaboration between listeners and narrators**, or how many of the stories were intro-

duced to the system in a collaborative interaction between listeners and narrators as opposed to an interaction where only listeners would be digitalizing the story while narrators just tell them aloud (C).

In the final analysis we have included only the level of storytelling (ST), while leaving the other scores for a future follow up, after conducting a conversation analysis on the field notes that can be used to refine the calculation of the scores.

8.3.5.2 Statistics per session.

Despite the aforementioned limitations, we conducted our tests and extracted other statistics that we report in this section. First, Table 8.7 summarizes the number of reminiscence sessions conducted in each track of the study, categorized by the version of Reminiscens that was used in them.

Table 8.7: **Reminiscence longitudinal study.** Sessions by version of *Reminiscens* that was used.

Track	1 (simple storytelling)	2 (questions only)	3 (context only)	4 (complete)
Pilot	0	0	0	4
Stable	17	14	16	19
1-session	1	1	2	4

During these sessions, participants created in total around **300 life stories**, including more than **500 pictures**. Table 8.8 summarizes the precise numbers of the content that was created through the system.

Table 8.8: **Reminiscence longitudinal study.** Content generated in sessions, through *Reminiscence*.

Variables	Total	Total Mean/week	Mean/session
Stories (SS)	299	37.38	3.83
Editions (SE)	258	32.25	3.31
Pictures (PS)	514	64.25	6.59
Questions answered (QS)	36	4.50	0.46
Context detail views (MS)	89	11.13	1.14

8.3.5.3 Usage of Reminiscens from home.

Participants used the web version of *Reminiscens* from home, but less than in sessions. Interestingly, listeners engaged in this usage very little, except for the last part of the study, when some of them accessed the system from home to edit stories in order to polish them (e.g., fix grammatical mistakes, improve narration, etc.). More interestingly, however, is the fact that the listeners that made the more use of the system from home are those who participated in a family context (i.e., with their grandparents). Some narrators, on the other hand, used the app from home somewhat regularly (with everyone at least accessing the system once every week). Also narrators used the app from home mainly for *curation* of the content by editing stories. Figure 8.16 shows what percentage of the stories created, editions made, pictures uploaded, questions answered and contextual multimedia watched came from the usage of the application outside of the session. As it is visible, almost half of editions coming from listeners in the family were made from remote.
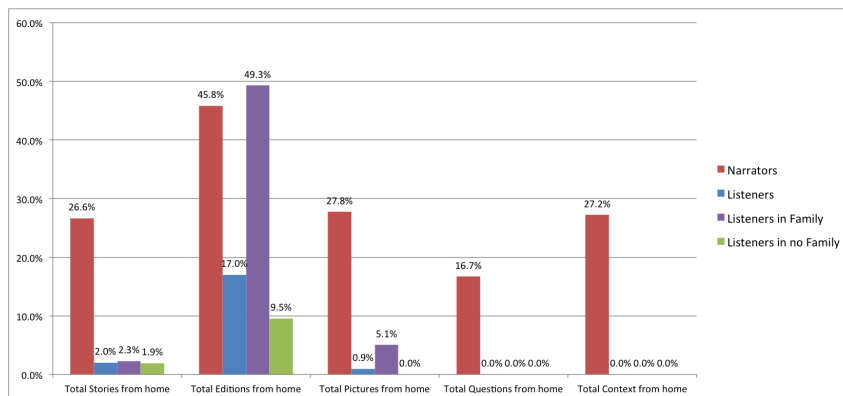
Figure 8.16: **Reminiscence longitudinal study.** Percentage of stories created, editions made, pictures uploaded, questions answered and contextual multimedia watched using the web version of *Reminiscens*, outside of the sessions.

Looking further, the peak in editions from listeners in the family actually comes from one listener, whose grandmother did not have access to the application from home. This listener took the task of digitalizing the stories of her grandmother very seriously, thinking mainly in the final result of the book. The book, in itself, was powerful stimulation for the experience and, most likely, influenced the focus on editions and curation towards the end (and after) of the sessions. Figures 8.17 and 8.18 show how the mean production of content per week and the total production of content per week evolved over time of the study.
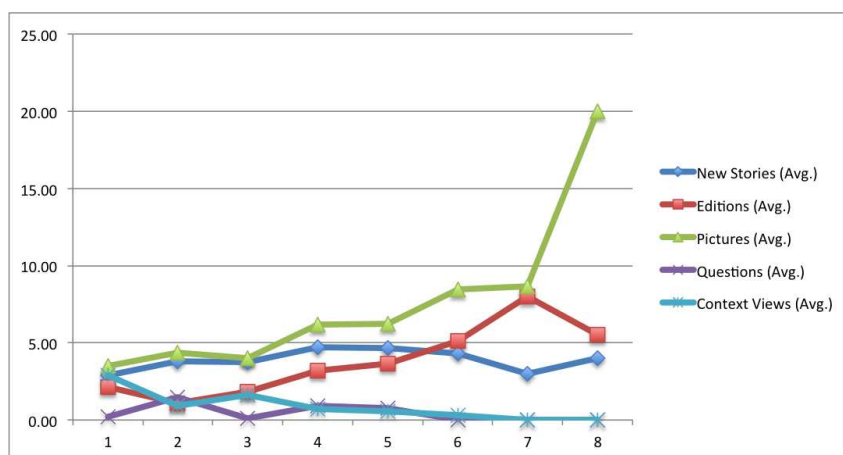
Figure 8.17: **Reminiscence longitudinal study.** Average of content inserted in the system per week.

Although we did observe a shift in the focus of the sessions towards curation of the stories as we approached the end of the study, the evolution presented in Figures 8.17 and 8.18 does not show this. One clear positive trend that could support our observation of the shift of focus is the rise in pictures uploaded through the application. Since many of these pictures were uploaded in existing stories (as a way for completing them), they are also an example of curation. However, there should also be an increase in editions (or at least in new stories) correlated to the increase of pictures. The most likely explanation of why neither the editions nor the new stories show any increase is that there is an error in the way
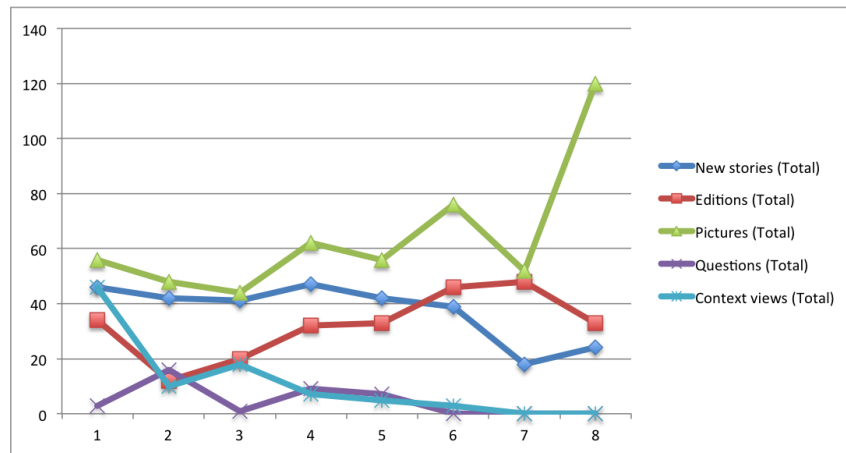
Figure 8.18: **Reminiscence longitudinal study.** Total content inserted in the system per week.

our system was counting them, leaving uncounted a large number of editions that are due to the sole addition of a new picture to an existing story. Moreover, another indication of the shift of focus is the decrease in the number of answered questions. The decrease in the number of contextual multimedia views, however, is due to a technical error we have found later that prevented the system from counting correctly the number of views in some versions of *Reminiscens*.

8.3.5.4 Enjoyment.

One key aspect of our qualitative observations was that the closer we were to the end of the study, the more the participants expressed their feelings of not wanting to leave it. Informally, narrators reported to be happy with the experience and with the opportunity of both preserving their stories for posterity and engaging with younger people. Listeners, on the other hand, increasingly mentioned to be surprised of how much they learned during the whole period of the study. This overall positive satisfaction with the whole experience is reflected in figure 8.19, which shows how the self-reported mood scores we gathered after sessions remained always above 30 (in a scale that goes from 8 to 40).

The evolution of mood also reflects how good all participants were feeling at the end of the study, indicating some level of satisfaction with the outcome.

8.3.5.5 Impact of Reminiscens' versions.

To test the impact of Reminiscens' versions and validate whether the presence of contextual triggers did influence the amount of stories recalled by narrators, we conducted an analysis of variance on our sessions dataset, using the version of Reminiscens that was used in each session as the within-group factor to aggregate sessions, and then analyzing the differences in the means of the dependent variables for each aggregated group of sessions. We did these first applying the test to the first 4 weeks, and then to the last four weeks. In all the cases, the results were the same: **the version of Reminiscens did not influence any of the variables.** Instead, it was the **storytelling itself** and the **interaction and collaboration** with listeners what kept narrators stimulated and remembering stories. *Reminiscens'* role was mainly to create the the opportunity for these interactions to happen.
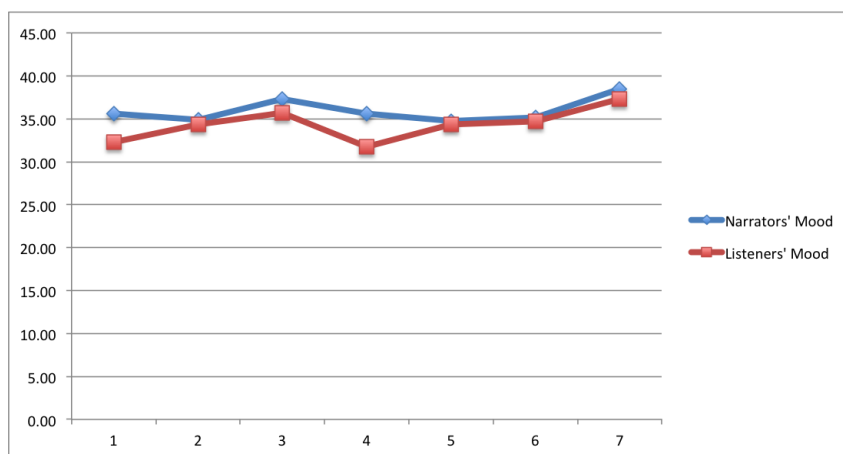
Figure 8.19: **Reminiscence longitudinal study.** Evolution of self-reported mood after sessions (in a scale that goes from 8 to 40).

Here we present plots that summarize how the different versions of *Reminiscens* affected the variables we calculated for characterizing each session of the study. For each figure, the right plot (the *parallel coordinates plots*) shows the *mean values of the investigated dependent variable* for each within-group factor we tested (in this case, for each version of Reminiscens, indicated by the version number). At the left in each figure, box-plots are drawn to show the *differences in the mean values of the dependent variable between each pair of groups* (each pair of versions of Reminiscens). If the difference is significant, it is emphasized by changing the color of the box-plot to green. On top of the box-plots, we show the post-hoc *p-values* that result from the test. The p-values indicate how much difference there is in the dependent variable between two different groups (as a general rule, a p-value less than 0.05 indicates that the difference is significant).

To validate whether our test gives correct results, we started by comparing the effect of the version of Reminiscens in the mean value of contextual multimedia watched in detail (MS, Figure 8.20). There should be a significant difference between the version 4 and 3 with respect to the others because multimedia contextual triggers are shown only in these two versions. As expected, such a difference exists and is significant between the version 4 (the "all" included version) with respect to 1 and 2 (where there is no context). Strangely, however, the difference is not significant for the version 3 (context-only), which means that roughly the same amount of views of contextual multimedia were produced by using versions 3, 2 and 1. The left parallel coordinates plot shows that, actually, for versions 1, 2 and 3 the mean of contextual multimedia resources watched is 0. This is due to a technical problem in our logging system, which did not capture the views from those versions, as we already mentioned in section 8.3.5.3.

Similar to the case of MS, for QS (questions answered during the session) there should be a clear difference between versions 2 (questions only) and 4 (all included) with respect to 3 and 1. Figure 8.21 shows that the lowest p-values are exhibited by this version with respect to others, but they are never below the .05 level of significance. The parallel coordinates plot correctly shows how for both version 1 and 3 the mean is 0, while for 2 and 4 the mean is greater than 0 questions answered per session with those versions.

The remaining figures show the impact of the version of Reminiscens for the other variables we have inspected, namely: stories created during session (SS, Figure 8.22), pictures uploaded per session (PS,
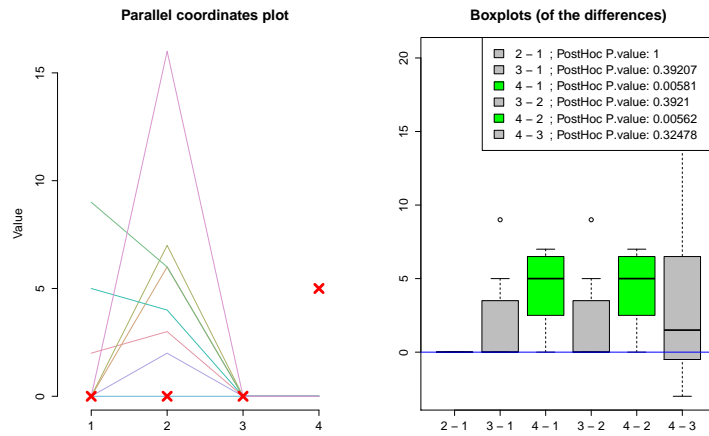
Figure 8.20: **Reminiscence longitudinal study.** ANOVA post-hoc results of comparing the difference in means of the MS variable (contextual multimedia watched in detail during the session) for different versions of Reminiscens. On the left, a plot of the means of MS per group. On the right, the mean differences of MS for each pair of groups.
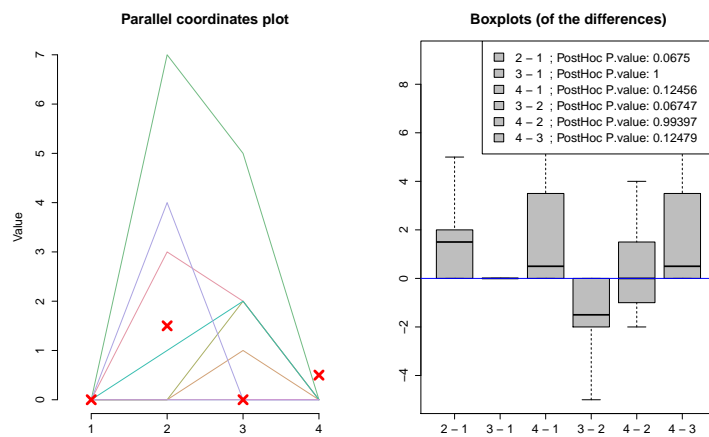
Figure 8.21: **Reminiscence longitudinal study.** ANOVA post-hoc results of comparing the difference in means of the QS variable (questions answered during session) for different versions of Reminiscens. On the left, a plot of the means of QS per group. On the right, the mean differences of MS for each pair of groups.

Figure 8.23), mood of listeners after sessions (MSL, Figure 8.24), mood of narrators after sessions (MSN, Figure 8.25), and one of the qualitative scores we added after the first qualitative analysis, the qualitative level of storytelling (ST, 8.26). As we already mentioned before, no significant difference was found in any case, but there are two interesting results:

- As we already noted before, mood is always high for both narrators and listeners. In the case of listeners, the lower mean happens with the context only version. This can be correlated with the observation that one of the most useful features for listeners (as we observed) was that of questions, which gave them an starting point to interact with narrators.

- Our qualitative evaluation of storytelling shows that the level of storytelling was always high in all the sessions. This because storytelling was at the core of every session and from beginning to the end, narrators were always highly motivated to share and tell their stories.
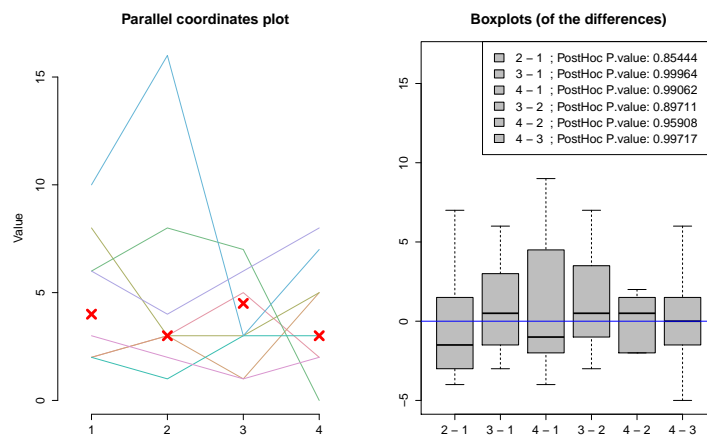
Figure 8.22: **Reminiscence longitudinal study.** ANOVA post-hoc results of comparing the difference in means of the SS variable (stories created during session) for different versions of Reminiscens. On the left, a plot of the means of SS per group. On the right, the mean differences of MS for each pair of groups.

8.3.5.6 Contextual Triggers by categories.

Although the contextual multimedia was not particularly effective in stimulating people to insert stories, some of them were more interesting than others. Table 8.9 summarizes the number of times multimedia resources in our knowledge base were opened in detail. Pictures from the past is the most watched content followed closely by videos of old songs and textual descriptions of historical events. In our observations, we considered that songs were more motivating than pictures when it comes to stimulating reminiscence and this does not match with the numbers in the table. The reason might be actually very simple: watching a song takes considerably longer than a picture. And the type of stories or reflection that resulted from songs were also significantly longer. Additionally, the problem might also be connected to the errors in our logging system (reported in the previous section).

In the case of questions, Table 8.9 shows the most common categories that resulted in a story being created in the system. Similarly, Table 8.11 shows the total number of questions answered grouped by
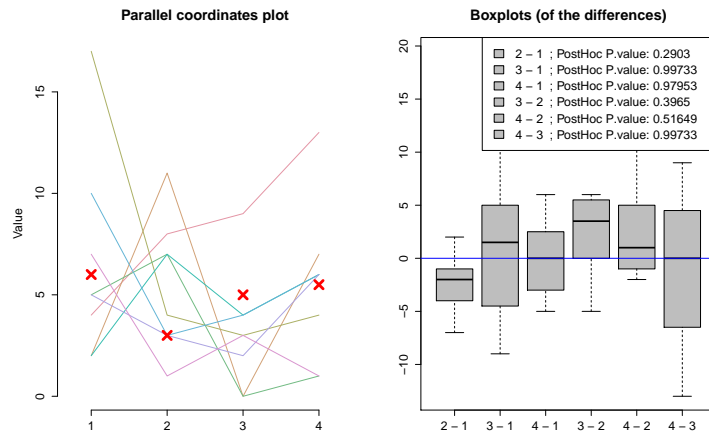
Figure 8.23: **Reminiscence longitudinal study.** ANOVA post-hoc results of comparing the difference in means of the PS variable (number of pictures added during the session) for different versions of Reminiscens. On the left, a plot of the means of PS per group. On the right, the mean differences of MS for each pair of groups.
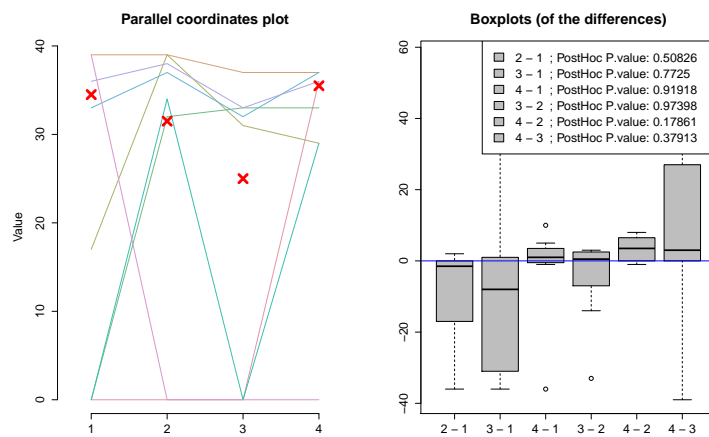
Figure 8.24: **Reminiscence longitudinal study.** ANOVA post-hoc results of comparing the difference in means of the MSL variable (listeners' mood after the session) for different versions of Reminiscens. On the left, a plot of the means of MSL per group. On the right, the mean differences of MS for each pair of groups.
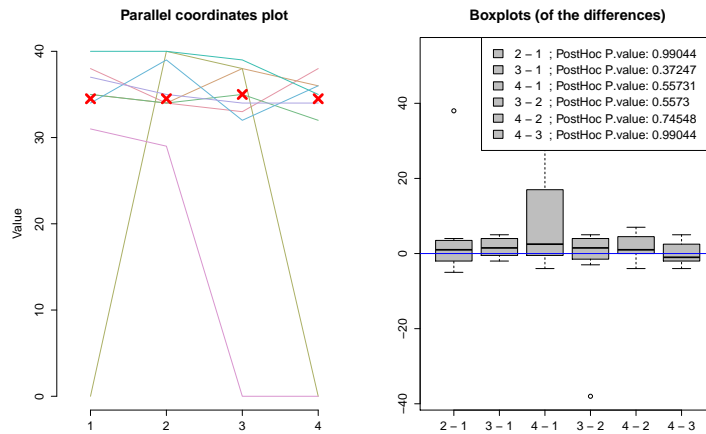
Figure 8.25: **Reminiscence longitudinal study.** ANOVA post-hoc results of comparing the difference in means of the MSN variable (narrators' mood after the session) for different versions of Reminiscens. On the left, a plot of the means of MSN per group. On the right, the mean differences of MS for each pair of groups.
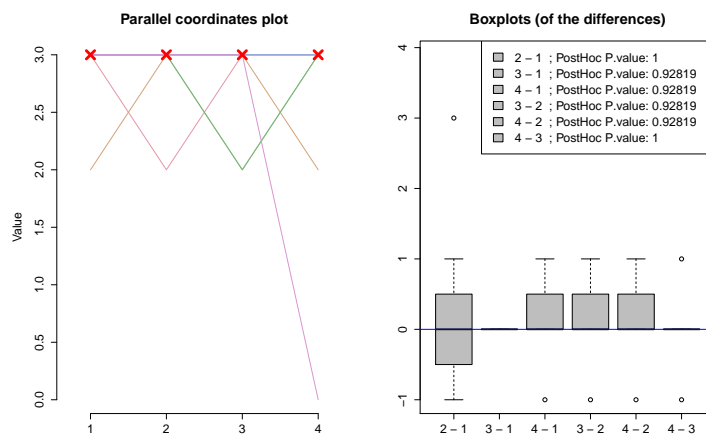
Figure 8.26: **Reminiscence longitudinal study.** ANOVA post-hoc results of comparing the difference in means of the ST variable (qualitative level of storytelling) for different versions of Reminiscens. On the left, a plot of the means of ST per group. On the right, the mean differences of MS for each pair of groups.

Table 8.9: **Reminiscence longitudinal study.** Activated contextual multimedia triggers by category

Category	Watched in Detail
Film	2
People	1
Photos	240
Song	64
Event	62
TV	4

the chapter of life to which they correspond. The social dimension appears in the first ranks of the list with questions related to *Family* and *Friendships*. Interestingly, also *thoughtful* questions (i.e., questions with the purpose of stimulating self-reflection about life) are also in the list of most answered questions. When it comes to life stages, questions related no particular stage of the life and the ones related to the childhood were the most answered during the study.

From these tables it also appears clear that questions were better in stimulating reminiscence than multimedia. The reason might simply be that the call to action for answering questions was a first level feature of the application (was always visible in the main screen). For contextual multimedia, on the other hand the call to action appeared only when the resource was opened in detail.

Table 8.10: **Reminiscence longitudinal study.** Activated contextual questions by category

Category	Number of stories	Number of Questions
Family	32	20
Entertainment	25	16
Friendships	15	11
Thoughtful	12	11
Career	6	5

Table 8.11: **Reminiscence longitudinal study.** Activated contextual questions by life chapter

Life Chapter	Number of stories	Number of Questions
All times	90	64
Childhood	48	27
Adulthood	6	5
Old age	2	2

8.3.5.7 Questionnaires.

Finally, the last piece of quantitative information comes from post-study questionnaires that both narrators and listeners compiled at the end of the study. Tables 8.13 and 8.12 summarize their responses in basic descriptive statistics. The post-study questionnaire was slightly longer for narrators since it asked them to rate how much they agreed with sentences related to the use of *Reminiscens* to stimulate them to remember. For some, questionnaires were printed and for others an online version was shared.

Not everyone returned the compiled questionnaire. In total, 11 narrators and 14 listeners returned the questionnaires after the study. Except for the questions about the order of importance of the potential stimulation aspects of reminiscence, all the questions used a 7-points agreement scale that went from *absolutely disagree* (1) to *absolutely agree* (7) (see appendix G).

A noticeable result from the questionnaire is that both narrators and listeners considered that the most stimulating aspects of the experience facilitated by *Reminiscens* were "the fact of telling my story aloud" and "the possibility of uploading my pictures and write a story for them". In other words, the best stimuli for reminiscence is to provide the opportunity for **Storytelling** and **Preservation** of stories for the posterity. This is in line with the fact that storytelling was always a hallmark of the sessions. For narrators, also "the fact of sharing my stories face-to-face" (**face-to-face social storytelling**) and "knowing that at the end of the study, there would be a printed book" (the **comeback**) are of equal importance.

When it comes to contextual triggers, **songs** and **photos** (in that order) where the two most important triggers for narrators, while for listeners, the ranking was **photos** followed by **questions**. This coincide with our observations that questions were an important element but more for listeners than for narrators.

Narrators report slightly more frustration and anxiety with respect to the sessions than listeners, but both report very little of it. In opposition, there is a general agreement that "it was fun to attend the sessions of reminiscence", and also that they "will miss the sessions".

8.3.6 Discussion

The goal of this study was to investigate how IT-supported reminiscence sessions can stimulate inter-generational social interactions, and validate whether contextual triggers in the form of multimedia and questions could serve as a stimuli of memory in social reminiscence settings. In order to investigate these aspects, we organized a series of *social and intergenerational* sessions of reminiscence supported by *Reminiscens*; an interactive system designed for the purpose. Our observations indicate a high level of intergenerational engagement through all the duration of the study. Narrators and listeners alike entered the game quickly and remained engaged until the end. In general, *Reminiscens* was able to (i) stimulate reminiscence in narrators; (ii) facilitate storytelling and preservation of memories; and (iii) motivate social interactions. But the study offered also a a broad range of other interesting results which we have reported in the in the previous section. In this section we provide a brief summary of our observations, which will be later extended and discussed further in the conclusions.

8.3.6.1 Stimulation of reminiscence and storytelling

Contextual triggers within *Reminiscens* were no more effective than other stimuli in activating participant's memories, but still they were praised by participants as a nice way of stimulating their memory. Free exploration of contextual content that was outside of the system (i.e., google) was actively searched by participants and can be seen as a confirmation of the potential of contextual triggers for stimulating reminiscence (hypothesis H1). Contextual questions were useful for both listeners (as a way for finding conversation topics) and narrators (as a guide to storytelling and also as a game). However, the most important stimulation came from meeting face to face, sharing and preserving stories for posterity. Much of the stimulation depended also on how listeners and narrators interacted while sharing narrators' life stories.

The timeline acted also as an stimulation feature that guided the storytelling, but it was limited for

Table 8.12: **Reminiscence longitudinal study.** Summary of narrators' responses to the post-study questionnaire (Qty. stands for Quantity).

Narrators (n=11)	Mean	Me-dian	Mode	Min(Qty.)	Max(Qty.)
About Reminiscens					
The application motivates me to share my personal memories.	5.45	6	6	1 (2)	7 (4)
I want to use the application again.	5.73	6	6	1 (1)	7 (4)
I would recommend the application to my friends and family.	5.45	6	6	1 (1)	7 (4)
I usually do not feel motivated to share my memories, but "Reminiscens" helped me do that.	5.8	6	7	3 (1)	7 (4)
It was fun to participate in the sessions of reminiscence with the application "Reminiscens."	5.64	6	7	1 (1)	7 (5)
I like all the types of content displayed during the study	5.55	6	6	1(1)	7(4)
I was motivated to tell my stories when I saw the questions in the application	5	5	7	1(1)	7(3)
I was motivated to tell my stories when I saw the photos from the past in the application	5.36	6	6	1(1)	7(3)
I was motivated to tell my stories when I listened to the songs of the past in the application	5.9	6	7	3(1)	7(4)
I was motivated to tell my stories when I read about the lives of historical figures in the application	4.5	4	4	1(1)	7(2)
I would like to continue to use the application from my house.	5.36	6	6	1(1)	7(1)
About Reminiscens: Put in order of importance. Which is more important?					
a. Contextual photos	3.45	4	1	1(3)	6(2)
b. Contextual songs	3.2	3.5	1	1(3)	6(1)
c. Contextual historical events	4.9	4	4	1(1)	8(3)
d. Contextual questions	4.36	4	4	1(2)	7(3)
e. The fact of sharing my stories face-to-face	2.8	2.5	1	1(4)	8(1)
f. The fact of telling my story at loud	2.45	2	2	1(2)	5(1)
g. The possibility of uploading my pictures and write a story for them	2.64	2	1	1(4)	5(2)
h. Knowing that at the end of the study, there would be a printed book of all the stories I shared in the system	2.55	2	1	1(5)	7(1)
About the sessions:					
I felt frustrated during the study.	2.36	2	1	1(5)	6(2)
I felt anxious during the study.	3.09	2	2	1(2)	6(2)
I felt anxious when approaching the time of the reminiscence sessions.	3.55	4	1	1(3)	6(2)
I will miss the sessions of reminiscence	5.18	6	6	1(1)	6(7)
It was fun for me to attend the sessions of reminiscence.	5.82	6	6	1(1)	7(3)

Table 8.13: **Reminiscence longitudinal study.** Summary of listeners' responses to the post-study questionnaire(Qty. stands for Quantity).

Listeners (n=14)	Mean	Me-dian	Mode	Min(Qty.)	Max(Qty.)
About Reminiscens: Put in order of importance. Which is more important?					
a. Contextual photos	3.07	2	1	1(5)	8(2)
b. Contextual songs	4.93	5	4	1(1)	8(2)
c. Contextual historical events	6	6	8	3(2)	8(5)
d. Contextual questions	4.29	5	7	1(3)	7(3)
e. The fact of sharing my stories face-to-face	3	2	1	1(5)	7(2)
f. The fact of telling my story at loud	2.79	2.5	1	1(6)	8(1)
g. The possibility of uploading my pictures and write a story for them	2.71	2	1	1(6)	8(2)
h. Knowing that at the end of the study, there would be a printed book of all the stories I shared in the system	4.36	4	4	1(3)	8(3)
About the sessions:					
I felt frustrated during the study.	1.36	1	1	1(9)	2(5)
I felt anxious during the study.	2.07	1.5	1	1(7)	5(1)
I felt anxious when approaching the time of the reminiscence sessions.	1.64	1	1	1(9)	4(2)
I will miss the sessions of reminiscence	4.5	4.5	3	3(4)	7(1)
It was fun for me to attend the sessions of reminiscence.	5.93	6	6	4(2)	7(4)

navigation as getting to a story required too many interactions (thinking the decade to which it belongs, move to the decade, iterate between stories in the decade). Search and other ways of categorizing the content can improve navigation substantially. Storytelling itself was also a powerful stimulation feature. Exploring narrators' stories, without any context, resulted in the same number of other memories being recalled than when the context was available. The difference was that the timeline-driven storytelling was guided and focused on important life events, whereas questions and contextual multimedia driven storytelling gave more diversity to stories. An interesting pattern in storytelling was the use of public content for anchoring personal stories, which happened also in the short study. Some life stories had a picture found online instead of a personal photo to represent the story. Finally, the final book was another element of stimulation, specially towards the end of the study. Narrators liked the idea of having a book of their lives and wanted to make sure that it was complete.

8.3.6.2 Intergenerational engagement and collaboration

Reminiscens worked well as the excuse for engagement. It generated a high level of collaboration between narrators and listeners. When narrators and listeners collaborated less, the result was clearly a reduced satisfaction. The most enjoyable collaboration happened right there at the time of sharing the story face-to-face, and probably because of this engagement, some narrator brought other members of the family to participate, making the timeline no longer a "personal" story, but one that was shared by more people. IT (in this case *Reminiscens*) put narrators and listeners at the same level by giving both a somewhat equal *role*. Narrators contributed with their stories and listeners helped in preserving them.

This resulted in satisfaction for both sides and facilitated the involvement of younger listeners. Collaboration was also enabled between narrators themselves, outside the sessions, particularly to curate and extend stories created during sessions. When listeners were rapidly writing a story while at the same time narrators were still in the middle of telling the story, the flow of interaction was interrupted, indicating that technology can also become a barrier for engagement sometimes. Finding a way for automatically capturing stories as the are shared (i.e., through audio or video recording) remains a challenge to be addressed.

8.3.6.3 Enjoyment and volunteering

In general, everyone in the study reported high levels of satisfaction after each session. Some level of frustration was reported when the stories captured in the system did not reflect well enough the one shared verbally during conversation. Technical limitations acted as a barrier for the enjoyment in this case. Additionally, interesting examples of *ludic engagement* were seen in how participants challenged themselves into completing the whole timeline, racing to answer as many questions as possible or simply using question as an enjoyable activity to remember their past. For listeners, the enjoyment came mainly from learning interesting things about the past and the chance for helping others. For most of them, participating in the study became a valuable service to the community that they were offering. In fact, one of the most interesting outcomes of the study is that it sparkled the interest from the CSA in using IT-supported reminiscence as a way for motivating younger people into participating of volunteering activities within the CSA. In their view, IT is a realm were younger generations clearly have a leading role, and using IT as part of intergenerational activities gives them something where they can contribute and feel useful.

9

Conclusion and Future Work

In this dissertation we have addressed the problem domain of achieving a happy and *active ageing (AA)* from the information and communication technologies (IT) perspective. For doing so, we have leveraged upon an interdisciplinary approach to research and design that combined *participatory action research* and *computer science and engineering* in a single endeavour towards extending the state of the art of IT for AA in both knowledge and tools. In this section, we summarize the contributions of this dissertation by presenting the lessons we have learned, the limitations of our work and the future directions we envision for this line of research.

9.1 Lessons Learned

9.1.1 IT for Active Ageing and Socializing

In a first stage of our research, we have studied and characterized the *roles of IT in the support of AA*, with an emphasis in its social dimension (Chapters 2 and 3). AA is the "big picture" of this research project, and our work allowed us to answer the following general research questions:

- **GRQ1.1.** can IT play a role in enabling a more *active ageing*, i.e., the improvement of opportunities for health, security and participation as we age?

- **GRQ1.2.** how does IT play this role?.

- **GRQ2.1.** can IT enhance (i.e., increase, sustain, improve) social interactions for older adults?

- **GRQ2.2.** how does IT enhance (i.e., increase, sustain, improve) social interactions as we age?.

In our research and exploratory works during this stage, we have found that IT can certainly play an important and enabling role in AA **(GRQ1.1.)**, not only to mitigate some of the negative side effects of ageing (e.g., physical and cognitive decline) but to give raise to new opportunities (e.g., by enhancing capabilities and creating new opportunities of socializing). We proposed a conceptual framework that

brings together these two different perspectives. Our proposal also correlates the determinants that affect quality of life during the ageing process with the type of support IT can provide to modulate these determinants (**GRQ1.2.**). We used this framework to systematically review exemplary IT services and applications that explicitly provide support for AA, an exercise that allowed us both to appreciate the extraordinary value that IT may bring to older adults and, at the same time, to identify challenges and opportunities. This framework, fully represented in Figure 2.3, represents the summary of our contribution to the state of the art in this stage.

Furthermore, the merger of physical assistive technology with information and communication technologies does not only bring an increasingly wide range of innovative services to prevention, compensation and care, but it also connects people with older adults and keeps them engaged in community activities. *Social applications* are spreading among older adults and increasingly connect them with friends and family. There is also an emerging thread of emotions-oriented social applications, whose main purpose is to enhance people's subjective wellbeing. Noticing the importance of this space, our work was later focused in the social dimension of AA and the design and evaluation of enhancement IT for this space. Our initial exploration in this new focus resulted in the following realizations: (i) the need of a participatory action approach to research (as a better way for conducting research in the field), (ii) the importance of intergenerational engagement and company, and (iii) the high heterogeneity of "the elderly" as a target user group. These realizations led us to narrow our focus to one social experience (rather than "the elderly") as the core of the following stage for our project: *intergenerational engagement through the practice of social reminiscence.*

9.1.2 IT for social reminiscence

In the second stage of the project, literature (Chapter 4) and a series of participatory action research experiences (Chapter 6) informed our understanding about the social reminiscence phenomena, driving the design (Chapter 7) and evaluation (Chapter 8) of an interactive IT solution for stimulating intergenerational engagement through social reminiscence. *Reminiscens*, the resulting interactive system, brought together older adults as narrators and young volunteers as listeners in storytelling sessions where a tablet application was used to facilitate the preservation of narrators' memories while stimulating interaction and reminiscence with contextual multimedia and questions. This work allowed us to answer the following research questions:

- **RQ1.1** can IT stimulate the practice of reminiscence in a social and intergenerational context?

- **RQ1.2** how can IT (which technology, which designs, which interactions, what content) stimulate the practice of reminiscence in a social and intergenerational context?

- **RQ2.1.** can IT-supported reminiscence systems facilitate increased and sustained intergenerational social interactions?

- **RQ2.2.** how can IT-supported reminiscence systems facilitate increased and sustained intergenerational social interactions?

- **RQ2.3.** is IT-supported social reminiscence enjoyable?

In general terms, as we have seen in detail in our analysis of results from the field studies, the answers to the "can" and "is" questions are affirmative. IT-supported social reminiscence motivated a wide and interesting range of intergenerational engagement, particularly in the form of collaboration and storytelling (**RQ1.1 and RQ2.1**). It has also been an enjoyable experience for both young listeners and older

adults narrators (**RQ2.3**). In the following, we extend our discussion (started in chapter 8) to summarize the most important lessons we have learned from this space and that serve as answers for the "how" questions (**RQ1.2 and RQ2.3**).

9.1.2.1 Stimulation of reminiscence and storytelling

As we have seen in our results, contextual triggers within *Reminiscens* were no more effective than other stimuli in activating participants' memories. This does not mean they did not work as both questions and multimedia content like songs were praised by participants as a nice way of stimulating their memory. Moreover, free exploration of contextual content that was not provided by *Reminiscens* but was actively searched by participants can be seen as a confirmation of the potential of contextual triggers for stimulating reminiscence.

Interestingly, contextual questions were useful for both listeners and narrators. Listeners used questions to find topics of conversation. Narrators used questions especially from home. For some of the participants, questions were a game (or a "race" as someone put it) where the goal was to answer as many questions as possible and complete their life stories. For other participants, questions where a simple and nice way of guiding their storytelling and self-reflection practices.

As noted by both listeners and narrators in the questionnaires, the most important stimulation came actually from meeting, sharing and preserving stories for posterity. Much of the stimulation depended on how listeners and narrators interacted while sharing narrators' life stories. Different patterns of engagement were observed, which are discussed in the next section.

The timeline was also a stimulation feature that guided the process, as some participants would start each session by asking up to what point in the timeline they arrived in the last session. While it was a good way for organizing the storytelling process, the timeline was somewhat limited in supporting navigation of stories. In the design of *Reminiscens* the main screen would only display a limited number of stories (2) that belonged to the highlighted decade in the timeline. This meant that for searching stories by decade, users needed to remember the decade of the story first, select that decade and then iterate the modal panel of stories until finding the requested story. Of course, this required too much interaction. Search and other ways of categorizing the content are potential solutions for improving navigation. Adding something like a "table of contents" based on life stages or even a simple list of all the stories can improve navigation substantially.

The focus on building the timeline shows also how storytelling itself was already powerful in stimulating people to remember their past. Exploring narrators' stories without any context resulted in the same number of memories being recalled with respect to the version of *Reminiscens* with the context enabled. Nevertheless, this storytelling was mostly guided and focused on important life events. Questions and contextual multimedia, on the other hand, resulted in people remembering things that they did not expect to, giving some diversity to stories.

The final book was another element of stimulation, specially towards the end of the study. Narrators became very fond of the idea of having a book about their lives and some of them became interested in making sure that it had every single story in them, especially focusing on the addition of more pictures. In some cases, they edited some stories or added new ones just to make sure everyone who is or was part of their lives were mentioned at least once, making sure that nobody was left without mention (also because they though that might make people angry). Extending Reminiscens with a feature for automatically creating a book from stories in the timeline is an interesting future research project.

Finally, an interesting pattern of storytelling we have observed is the use of public content for anchoring personal stories. In several occasions, life stories had a picture found online instead of personal photo to represent the story. This happened in both the long and the short study, and it was also a common storytelling strategy for the blog posts that the CSA community has written during (and after) the first installment of the Laboratory of Technologies (see chapter 6). It would be interesting to explore further this aspect, but it also raises some challenges about how to manage copyright issues that are not clear for most of the participants. For them, it would seem that everything that is available online is freely shareable.

9.1.2.2 Intergenerational engagement and collaboration

In general *Reminiscens* worked well as a "ticket to talk" [304] or an excuse for the engagement. Furthermore it sparkled a high level of collaboration between narrators and listeners; who worked actively together in the quest for preserving the stories that were shared during sessions. Even when the preservation of stories was entirely done by the listener, either because the listener preferred it that way or because the narrator did not feel confident enough to use the tablet, both constructed the final version of the story together. In the few exceptions to this rule, the result was clearly a reduced satisfaction.

From our observations, there were broadly three styles of engagement by listeners: the *scribe*, who focused his interaction in capturing as much as possible of the story being told and already writing it into the system in parallel; the *trainer*, who focused on helping the narrator in learning how to use the technology; and the *pure listener*, who focused on listening and enjoying of the stories, occasionally adding stories or reflections of his own. The engagement by narrators was more homogeneous: they were all truly inserted in their roles of being *storytellers*. The differences were instead on the types of stories they enjoyed to share the most: some were very much *travel-driven*, providing a full account of all the places in the world that they have visited; others were *anecdote-driven*, focusing on those little old memories of adventures and moments full of laugh, boldness and lessons to learn; and others were *pride-oriented*, focusing in the milestones or achievements of their lives. *Trainer* listeners in combination with *anecdote-driven* narrators were generally the most collaborative ones, and they also made the sessions more enjoyable. Moreover, some listeners would sometimes act as *curators* in the sense that they would actively influence what story or content should the narrator tell. Similarly, trainer listeners were often using one of two strategies: they were *teachers*, showing how to do everything step by step; or they were *let-do* trainers, stimulating narrators to learn by doing and just assisting in the process.

In the original design we thought of a collaboration and sharing that happened off-line, outside of the sessions (e.g., by allowing people to collaboratively edit shared stories), but as we have seen in the sessions, the most enjoyable collaboration happened right there at the time of sharing the story face-to-face. That is the moment where the technology should try to add something new and engaging to the collaboration. In fact, some people brought other members of the family to participate, causing the timeline to go from being a "personal" story to a story shared by many. This forced us to quickly patch our user management system to allow more than one user to share the same "Person" in order to have them both completing the same timeline.

Another interesting aspect of the interactions we have seen in this study has to do with what one of the coordinators of the CSA mentioned during an interview: *Reminiscens* put narrators and listeners at the same level by giving both a somewhat equal *role*. Narrators contributed with their stories and listeners helped in preserving these stories digitally. According to the one of the CSA coordinators, older adults

are usually interested in participating of intergenerational activities, but his is not so much true with younger people. In the study, younger listeners brought to the table their, a priori, greater expertise with technologies and felt like they were actually giving something important. This resulted in satisfaction for both sides and facilitated the involvement of younger listeners. Collaboration was also enabled between narrators themselves, outside the sessions. Some of them would casually meet at the CSA and work together to curate their stories.

Sometimes, technology acted as a barrier for engagement. In particular, when listeners tried to rapidly write the stories while the narrators were telling them resulted in the flow of interaction being broken. Finding a way for automatically capturing stories as they are shared (i.e., through audio and video recording, speech-to-text) remains a challenge to be addressed in future works.

9.1.2.3 Enjoyment and volunteering

In general, everyone in the study always reported high levels of satisfaction after the sessions. The only time in which some level of frustration was reported was when the stories captured in the system were not as rich as the ones shared verbally during sessions. This is a critical aspect that is related to the technology and not so much to the experience facilitated by the technology. In this case, the limitations of the system acted as a barrier for the enjoyment of the experience.

The challenge of completing the timeline, racing to answer as many questions as possible or simply using questions as an enjoyable activity to occasionally remember the past are examples of what Blythe et al. [66] called a *ludic engagement*. Similarly to their work, we have seen how this ludic engagement can be a powerful and enjoyable driver of intergenerational engagement. Challenging older adults in these game-like activities seems promising as an enjoyable way for increasing their engagement with others. In our study, we had few family groups, but it was noticeable how easy it was for them to engage more people and transform the session in ludic engagement for the whole family. This is an interesting line of research for the future.

For listeners, the enjoyment came mainly from two sources: learning interesting things about the past and the chance of helping others. For most of them, participating in the study became a valuable service that they were offering to the community. This is an indication that this type of IT-driven engagement might be useful to motivate volunteering in the young. This is, in fact, one of the most interesting outcomes of the study, as it sparkled the interest from the CSA in using IT-supported reminiscence as a way for motivating younger people into participating of volunteering activities within the CSA. In their view, IT is a realm were younger generations clearly have a leading role, and using IT as part of intergenerational activities give them something where they can contribute and feel useful.

9.1.2.4 Design Spaces for Intergenerational Engagement

Building upon the stages of IT-supported reminiscence that we have observed in this study, we argue that each of these stages represent a design space on its own that can benefit from the support of IT. Figure 9.1 further generalizes the model into three main design spaces that are common, not only for social reminiscence, but for the more general challenge of intergenerational engagement. Interactive systems can be crafted to support the **preparation** of the engagement activities, both for people who participate (narrators and listeners) and institutions that organize them (the CSA). For example, *digital diaries* to organize draft notes of the stories to share can be an improvement for *Reminiscens*, but we can also

explore other interactive systems designed only for the purpose of helping people as they prepare for this type of engagement activities. *Reminiscens' contextual life questions* would also be an interesting method for people to prepare what stories they would like to share in reminiscence sessions, or what resources they would like to bring along in other types of intergenerational engagement activities. However, there needs to be a way of finding these questions and their answers easily during the actual engagement (this was not possible in Reminiscens).

The second space with a potential for design, particularly for mobile IT, has to do with the stimulation and support of **conversation** during intergenerational engagement activities. With reminiscence sessions this was achieved through stimulation of memories that can lead to storytelling and self-reflection. *Reminiscens* can improve in this space by adding the possibility of searching the web already within the app, in order to facilitate the free exploration of the context of the stories. *Reminiscens*, and any other system, can also improve by actively supporting the kind of *ludic engagement* we have seen with the questions during the study. *Audio-recording*, automatic systems for transforming *speech-to-text* and *digital diaries* for personal reflections are other ways in which *Reminiscens* can improve. Audio-recording has also to do with the passive preservation of memories for posterity. IT systems need only to be careful in making people aware of what is recorded and why, giving them also a full control for stop or pause the recording whenever they want.

The third space we would like to emphasize is that of **collaboration**. This space holds a big promise and it has been here where the most engaging interactions of our study occurred. Narrators and listeners enjoyed collaborating in the preservation and curation of the stories, and it is possible that this type of collaboration will also enable much satisfaction in other types of intergenerational activities. *Reminiscens* can improve in this space by allowing users to *edit and enhance* the pictures they add to stories. The lack of *searching* features to navigate through stories was pointed out as a limitation during the study and other features that might be interesting to explore for preservation and curation are the ability to *insert public content found online* and to *share individual stories* with other people via email or social networks. Some participants for example, used publicly available pictures as a way of representing their stories visually, which has an implied challenge regarding how to deal with copyrighted content without limiting the creativity nor the enjoyment of narrators.

As it happened with some of the participants of the study, the stories they shared were not only about them, but involved other members in their close circle (family and friends). Since *Reminiscens* had no way to support shared timelines, we were forced to hack our own system during the study in order to associate more than one person to the same timeline. Facilitating shared timelines and stories is another potential improvement for *Reminiscens*.

9.1.3 Contributions

Finally, taking into account everything we have previously discussed, the contributions of this dissertation can be summarized as follows:

- **Knowledge:** an understanding of what role IT can play in supporting, stimulating and accompanying active ageing and social interactions through the practice of reminiscence. This understanding is summarized in our proposed conceptual framework for the analysis of IT for AA.

- **Model:** a conceptual model of the different stages of IT-supported social reminiscence sessions, and an extended model of the design spaces for intergenerational engagement.
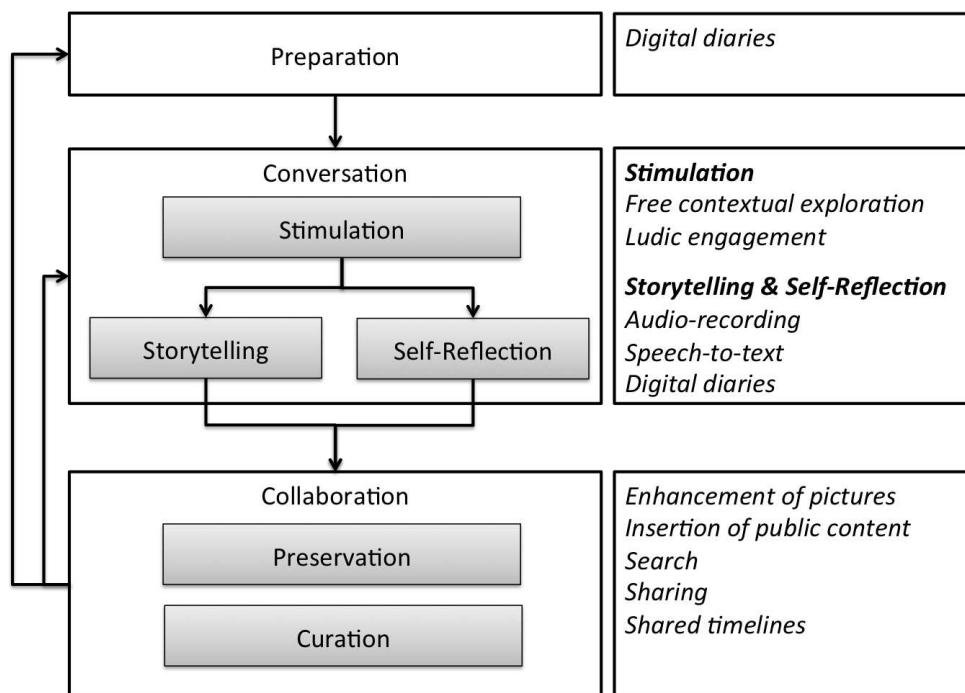
Figure 9.1: **Reminiscence longitudinal study.** IT Design spaces for intergenerational engagement. On the left, some of the proposed improvements for *Reminiscens* based on observations from the long study.

- **System:** an exemplary socio-technical system that fits the aforementioned roles, including a knowledge base and algorithms to support contextual stimulation of reminiscence, using multimedia resources that are publicly available on the web.

- **Evaluation:** quantitative and qualitative results obtained from observing the use of our system in a real intergenerational context.

9.2 Limitations

One of the main limitations of this dissertation is that it started with an overly broad scope and narrowed down a bit late in the research plan. Given that the first focus was set on AA, and the goal was to enable AA through socializing, we naturally focus all of our participatory research activities around older adults. The **PD workshops**, for example, lacked the participation of young people as stakeholders (acting as listeners). Instead, young people did participate but as volunteers to act as "facilitators" of the workshops. It is highly possible that the resulting design would have been substantially different had the volunteers known more explicitly what their future role in the experience of *Reminiscens* would be. The system was thought for "intergenerational" engagement, but the **PD workshops** officially involved only one of the generations. The **PD Workshops** had the additional limitation that they were focused on co-designing a system that was proposed by the researchers without participation of the community in generating the seminal idea.

A second important limitation has to do with an unbalance between the effort devoted to the design, preparation and execution of the field studies; and the effort devoted to the analysis of its outcomes. The

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latter was substantially more limited than the former. For this reason, and given the substantial amount of qualitative observations we have gathered, it is highly possible that there is still much more to learn from our results, which would surely benefit from more analysis in the future. Also related to the studies, the limited number of participants and the unbalanced nature of the data we have collected has resulted in a little level of statistical significance for our quantitative results. The complexity of the phenomena we were investigating (IT-supported intergenerational social reminiscence) made it difficult to isolate all the potential variables of the experience without fundamentally changing the nature of the experience itself (e.g., we could not isolate the impact of storytelling because it was a central part of the reminiscence sessions, which we could not take out).

A third limitation has to do with the non-implemented features of *Reminiscens* that we believe would have had an important impact in the development of the sessions. *Audio-recording*, the support for *networks* and *sharing* could have transformed the tool in a much more effective instrument for supporting the sessions.

9.3   Future Work

Experiences of face-to-face intergenerational engagement, such as the one we supported with Reminiscens, are still an open and promising space for research and innovation. We have thoroughly explored one of such experiences, but there still room for other contributions, such us the potential use of games for stimulating interactions that create the kind of *ludic engagement* we have observed during this study. We envision a future were many more of *Reminiscens-like* applications will exist, with the goal of supporting *preparation*, *conversation* and *collaboration* of intergenerational engagement activities. In this line, additional benefits and application of these technologies could emerge from the exploration of how well IT-supported engagement motivates *intergenerational volunteering* by using IT as the excuse that bring younger generations closer to older adults, in the context of senior centers like the CSA.

Moreover, another future work would involve the study of ludic engagement in family settings, through IT-supported social reminiscence. The high engagement in the few families that participated of our study indicate that this an interesting thread of work to follow.

There is also room for improving *Reminiscens*. Much more can be improved by analyzing better the types of stimuli that are more effective in stimulating reminiscence. Adding the support for user interests and allowing family or friends to curate the context are two ways in which the knowledge base could be improved in the future. The knowledge base needs also to be extended in terms of indexed content. New content can be collected and indexed, and current content should be cleaned and further categorized. A new algorithm of contextual stimulation could also leverage real time suggestions based on the Web. Crowdsourcing could be applied to help in the cleaning of data and adding content which is not in digital forms. In terms of user experience, future work include exploring how to use effectively audio and video recording, and speech-to-text technologies to capture stories as they are told, without breaking the flow of the storytelling. Moreover, giving the potential of the book to drive the whole experience, it might be interesting to implement a feature for allowing users to export all of their content in a simple book of their lives, already available for printing (or improvement).

There is also room for analysis of the outcomes of our long study, which we would like to explore further. Namely, conversation analysis on field notes has the potential of producing a more detailed categorization of the patterns of social interactions we have observed during the study. This will provide

excellent insights to drive research and design of IT for intergenerational engagement in conversation and collaboration. Moreover, we are also interested in analyzing the differences between the family groups with respect to the unrelated groups. The quantitative analysis might improve also if we further refined the qualitative scores of each session based on a a more detailed content analysis of the notes. And finally, new experiments can be designed to investigate in detail other research questions like what type of content stimulates more memories, what type of memories are stimulated by different categories of content or what emotions are produced by this stimulation.

<div style="text-align: right; font-size: 3em; font-weight: bold; color: #999;">A</div>

Preliminary Research Experiences

Preliminary to the research project described in this dissertation, additional work was realized as part of the Ph.D. program. In this appendix, a short summary of these works is presented, along with the list of publications that resulted from them.

A.1   Reputation in academia

The initial focus of research in this Ph.D. was about exploring the intersection between citation-based metrics and subjective reputation based on peer opinions in academia. The goal was to find a better model for assessing scientific impact. Under this scope, we have experimented on comparing citation-based metrics with opinion-based reputation, finding little to no correlation. Similarly, we collaborated with other researchers in the genesis of a web platform that aggregates the impact of a person's research products, including both traditional outputs (e.g., journal and conference articles) and non-traditional ones such as blog posts, datasets and software[1]. This thread of research work resulted in the following publications [210, 287, 269, 268, 52, 271, 270, 288, 267, 63, 209]

A.2   Collaboration in academia

While transitioning to the field of social informatics, a brief exploration was focused on how the social network of a researcher influences his research. We have explored this question by looking at how much of what a researcher cites in his/her publications was original found thanks to his/her network of collaborators. Our approach consisted in first, interviewing researchers about what was the origin of citations in their last publication, and second, conducting an online survey where we further asked the source of citations to an wider audience based on a predefined list of categories that emerged from the interviews. Based on those results, we experimented with recommending citations based on what is cited

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[1]The platform is called ImpactStory and is available at: `http://impactstory.org/`

within the coauthorship network of a researcher. In the same scope, another thread of research consisted in the creation of a collaborative platform for professors in academia to share their coursework material in order to create a dynamic and evolving *LiquidBook* upon the aggregation of those materials. This threads of research resulted in the following publications [51, 88].

List of preliminary research experiences publications

[12] M. Baez, D. Mirylenka, and C. Parra. Understanding and supporting search for scholarly knowledge. In *7th European Computer Science Summit*, Milano, Italy, 2011.

[13] Báez, Marcos and Parra, Cristhian and Casati, Fabio and Marchese, Maurizio and Daniel, Florian and Di Meo, Kasia and Zobele, Silvia and Menapace, Carlo and Valeri, Beatrice. Gelee: Cooperative Lifecycle Management for (Composite) Artifacts. In L. Baresi, C.-H. Chi, and J. Suzuki, editors, *Service-Oriented Computing*, pages 645–646. Springer Berlin / Heidelberg, 2009.

[14] A. Birukou, M. Baez, F. Casati, R. Chenu-Abente, M. Imran, M. Marchese, M. Medo, D. Mirylenka, N. Osman, and C. Parra. Design of the Liquid Publications Integrated Platform. Technical report, University of Trento, 2011.

[15] F. Casati, M. Marchese, C. Parra, L. Cernuzzi, and R. Gerstner. Liquid Book : collaborative reuse and sharing of multifaceted content. In *7th European Computer Science Summit*, Milano, Italy, 2011.

[16] P. Kungas, L. García-ba nuelos, and C. Parra. Measurement of impact , voting-based reputation and relatedness. Technical report, University of Trento, 2011.

[17] P. Küngas, S. Karus, S. Vakulenko, M. Dumas, C. Parra, and F. Casati. Reverse-engineering conference rankings: what does it take to make a reputable conference? *Scientometrics*, 2013.

[18] C. Parra, M. Baez, F. Casati, M. Marchese, F. Daniel, V. Sommarive, and L. Cernuzzi. A Scientific Resource Management System. In *CLEI 2010*, 2010.

[19] C. Parra, M. Baez, F. Daniel, F. Casati, and M. Marchese. A SCIENTIFIC RESOURCE SPACE MANAGEMENT. Technical Report February, University of Trento, Trento, 2010.

[20] C. Parra, A. Birukou, F. Casati, R. Saint-paul, and J. Rushton. UCount : a Community-Driven Approach for Measuring Scientific Reputation. In *altmetrics workshop 2011*, Trento, Italy, 2011. University of Trento.

[21] C. Parra, F. Casati, F. Daniel, M. Marchese, L. Cernuzzi, P. Kungas, L. García-ba nuelos, and K. Kisselite. Investigating the nature of scientific reputation. In *13th International Society for Scientometrics and Informetrics Conference*, Durban, South Africa, 2011.

[22] C. Parra, M. Imran, D. Mirylenka, F. Daniel, F. Casati, and M. Marchese. A Scientific Resource Space for Advanced Research Evaluation Scenarios. In *19th Italian Symposium on Advanced Database Systems*, 2011.

[23] J. Priem, C. Parra, H. Piwowar, P. Groth, and A. Waagmeester. Uncovering impacts: a case study in using altmetrics tools. In *Workshop on the Semantic Publishing SePublica 2012 at the 9th Extended Semantic Web Conference*, 2012.

[24] J. Priem, C. Parra, H. Piwowar, and A. Waagmeester. Uncovering impacts : CitedIn and total-impact , two new tools for gathering altmetrics . Technical report, CEUR, 2012.

B

Related/Co-supervised Bachelor/Master projects

In the course of this dissertation, several prototypes and sub-projects were realized as part of either the exploratory works or the core parts of the dissertation. All these would not have been possible without the help of undergraduate students who collaborated with the project by developing their own bachelor's or masters' thesis around the different topics addressed in this dissertation. These collaborations resulted in the following list of related masters' and bachelor project developed under this dissertation scope.

- Bachelor and master projects related to the exploratory work discussed in section 3.3 (What's Up) include the implementation and evaluation of the platform and mobile/web applications [236] [326] [239] including some potential extensions to make the system work for real-time interaction [240] [327]

- Bachelor and master projects related to the exploratory work discussed in section 2.5 (AllenaVita) include the implementation of a mobile lifecoach application [40] and a web monitoring dashboard for professional doctors and nurses [110] .

- Finally, bachelor and master projects related to the core work of this dissertation (Reminiscens), include part of collecting metadata about historical resources from the web and implementing a service API for contextual queries of this metadata [260], part of the the implementation of tablet/web application for reminiscens [44] and a final brief exploration of other storytelling tools from an usability perspective [41]. Also related to reminiscens, the Participatory Design Workshops have been extensively discussed in a thesis for the department of *Sociology and Social Research of the University of Trento* [237].

List of related/co-supervised bachelor and master theses

[25] Aleksey Kashytsa. *Allena Vita: studio di un sistema di allenamento per lo stile di vita del paziente a distanza*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2014.

[26] Alessandro Pezzin. *Tecnologia per la reminiscenza: il caso di studio di Reminiscens e Placebook*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2014.

[27] Andrea Biasioli. *Reminiscens: stimolare i ricordi e l'interazione intergenerazionale*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2014.

[28] Davide Martintoni. *Implementation of the AllenaVita Dashboard [Project in progress at the time of this dissertation]*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2014.

[29] Marco Dianti. *What's up: dynamically adapting features for a better experience for elder users*. Master's Thesis, Faculty of Science, University of Trento, 2012.

[30] Maria Garbari. *La progettazione partecipata nel rapporto tra anziani di oggi e tecnologia: uno studio di caso*. Undergraduate Honors Thesis, Department of Sociology and Social Research, University of Trento, 2013.

[31] Massimiliano Battan. *What's up web: enabling intergenerational sharing through the web*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2012.

[32] Maurizio Cainelli. *Sincronizzazione di database centralizzati tramite dispositivi mobili Android: il caso di studio dellapplicazione Whats Up?* Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2012.

[33] Nicola Parrello. *Reminiscens, una knowledge base di risorse storiche per supportare la reminiscenza*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2013.

[34] Simone Casagranda. *WhatsUp: supporto per sistemi Android della piattaforma di emotion-sharing*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2012.

[35] Simone Melchiori. *WhatsUp Sync: module per l'esposizione sincronizzata di test e immagini su dispositivi mobili*. Undergraduate Honors Thesis, Faculty of Science, University of Trento, 2012.

C

What's Up think aloud study evaluation questionnaire

The following is a translated version of the questionnaire used in the What's Up think aloud study[119].

What's Up? Keep in touch!

Mark the correct answer: Age: (64-70) (71-75) (76-80) (81-85) (86+)

Gender: (M) (F)

Select the answer that best represents your feelings:

1. *The application is easy to use:*
   - Definitely not
   - No
   - I don't know
   - Yes
   - Definitely yes

2. *It is easy to read the texts:*
   - Definitely not
   - No
   - I don't know
   - Yes
   - Definitely yes

3. *The meaning of the buttons is clear:*

- Definitely not
- No
- I don't know
- Yes
- Definitely yes

4. *The messages are presented in an aesthetically likeable way:*
    - Definitely not
    - No
    - I don't know
    - Yes
    - Definitely yes

5. *I felt comfortable while using the application:*
    - Definitely not
    - No
    - I don't know
    - Yes
    - Definitely yes

Would you be able to rank the distinct user interfaces from the one you like the best to the one you liked the least

- Yes
- No
- I don't know

How do you usually communicate with your friends and relatives?

1. *With the phone*
    - Always
    - Often
    - Sometimes
    - Rarely
    - Never

2. *Via SMS*
    - Always
    - Often
    - Sometimes
    - Rarely

- Never

3. *In person*
    - Always
    - Often
    - Sometimes
    - Rarely
    - Never

4. *Via internet*
    - Always
    - Often
    - Sometimes
    - Rarely
    - Never

Would you use this application in the future?

- Always
- Often
- Sometimes
- Rarely
- Never

Why?

Would you be able to use it on your own?

- Yes
- No
- I don't know

Would you like to receive also video?

- Yes
- No
- I don't know

What else would you like to have in the applicaiton?

D

PD Workshop Observation guides and materials

D.1 First PD Workshop (June 12th, 2012)

Material in this appendix was used as guide for volunteers and observers of the first PD workshop detailed in chapter 6.

D.1.1 Activity 1: What's Up Focus Group

- Explain Elders simply what is the app for. Motivate them to use the tool. Make sure everyone use it at least once.

- When the elders are using the app, try to ask them to describe what they do and why they do it.

Interface	Notes
Whats Up, No Buttons	
Whats Up, Navigation	
Whats Up, Feedback	
Whats Up, Feedback and Comment	

D.1.2 Activity 2: Active Lifestyle Focus Group

- Explain simply all the features of the app. Explain why are strength and balance exercises important.

- When the elders are using the app, try to ask them to describe what they do and why they do it.

- Depending on group, mention as a motivation strategy just the one assigned. Show the others as features of the app, but dont say they are for motivating them. Try to find out if they find these things motivating or not.

Interface	Notes
Active Lifestyle, Flower Motivation	
Active Lifestyle, Mountain Motivation	
Active Lifestyle, Friends and Inbox	
Active Lifestyle, Bulletin Board	

D.1.3 Activity 3: Brainstorming Session

D.1.4 First Part (15min)

- Motivate the participants to list the actions they usually take in order to perform the following activities. Ask them What they share, when, where and with whom? as part of the discussions so that the observer can take notes about this.
- Ask them to put the steps in post-its and order them.

Activity	Actions they usually do (what, when, where and with whom they share?)
Communicating with Family and friends, in particular those younger than us.	
Exercising or playing for keeping fit both in mind and body, particularly, to maintain the motivation	
Sharing current life experiences or stories and memories	
Sharing current life experiences or stories and memories	

D.1.4.1 Second Part (15min)

- Based on one tool they have seen Today and imagining they have it home, ask them to describe what they did Yesterday with it?. For what they used it? whe? where? with whom?. Try to make them put one word for some of these questions in post-its.

This is a future tool. For this group, the facilitators will do an step by step demo of a paper prototype to motivate the discussion

Group	Imagine you have this tool. Tell us what you have done yesterday with it (what you did? when you did? where you did it? with whom were you when you used it?)
Whats Up (relate the tool with communication)	Active Lifestyle and Active Brain (relate the tools with keeping fit physically and mentally)
Life Albums* (related the tool with sharing their lives experiences)	
Life Albums* (relate the tool with finding old friends)	
Sharing current life experiences or stories and memories	

D.1.4.2 Third Part (15min)

- Ask them to think about 4 ideas to improve the tools based on what you usually do and what you have seen is possible with the apps.
- Categorize ideas (for observers) with these categories = Missing Feature (Mark with MF), Change Request on the UI (C-UI), Change Request on Functions (C-F). What they share? (U-1). Where they use the tool? (U-2). When they use it? (U-3). How they use it? (U-4). With who they use it? (U-5)

Activity	Ideas
Whats Up (reasoning about communication with youngs)	
Active Lifestyle and Active Brain (reasoning about what motivates them to keep fit)	
Life Albums* (reasoning about how can they share their lives)	
Life Albums* (reasoning about how can they share their lives)	

This is a future tool. An starting set of screen will be shown to motivate the discussion.

D.1.5 Guide for pure observers

The following, are guides given to volunteers who participated of this workshop in the quality of pure observers.

D.1.5.1 Guide 1: Mental Models Evaluation

Take note of each slip and mistake by elders when using the apps (WU=Whats Up, AL=Active Lifestyle, AB=Active Brain).

Is a Slip?	Is a Mistake?	Application	Description of the problem

- **Slip and Mistakes:** The division occurs at the level of the intention: A Person establishes an intention to act. If the intention is not appropriate, this is a mistake. If the action is not what was intended, this is a slip.

- A slip implies that the user **has the correct mental model** about the function of a feature in the app, but uses incorrectly (e.g. knowing what the "Like" button it is for but pressing the "Unlike" because is too close). A mistake implies that the **users mental model of the function of a feature in the app is wrong** (e.g. swiping a button on the ipad expecting to go to the next image.

D.1.5.2   Guide 2: Flanders Interaction Analysis FIAC

As proposed by Robson [300]. Check Below for an overview of the analysis and explanations*.

For each interaction, put a number in the row corresponding to the category of that interaction. Teachers are groups Demonstrator/Facilitator and pupils are participant older adults. For every new interaction, increase the number in one.

Explanation of FIAC and each category.   The interaction analysis system developed by Flanders (1970) was a result of his drive to develop more objective techniques for analysing interaction and has been widely used in educational research. It comprises ten categories that are non-judgemental and allow the researcher to determine the level of student involvement as well as the lecturers questioning and feedback strategies. Flanders Interaction Analysis Categories (FIAC) and codes are well defined and include seven categories that indicate whether the lecturer was responding or initiating interaction,two categories that indicate whether the students were responding or initiating interaction and a tenth category to indicate silence or confusion

1. Accepts feeling: Accepts and clarifies an attitude or the feeling tone of a pupil a nonthreatening manner. Feelings may be positive or negative. Predicting and recalling feelings are included.

2. Praises or encourages: Praises or encourages pupil action or behaviour. Jokes that release tension, but not at the expense of another individual; nodding head,or saying Um hm? or go on are included.

3. Accepts or uses ideas of pupils: Clarifying, building, or developing ideas suggested by a pupil. Teacher extensions of pupil ideas are included but as the teacher brings more of his own ideas into play, shift to category five.

4. Asks questions: Asking a question about content or procedure, based on teacher ideas, with the intent that a pupil will answer.

5. Lecturing: Giving facts or opinion about content or procedures; expressing his own ideas, giving his own explanation, or citing an authority other than a pupil.

6. Giving directions: Directions, commands, or orders to which a pupil is expected to comply.

Who?	Category	Counter
Teacher	**Accepts feeling:** Accepts and clarifies an attitude or the feeling tone of a pupil a nonthreatening manner. Feelings may be positive or negative. Predicting and recalling feelings are included.	
Teacher	**Praises or encourages:** Praises or encourages pupil action or behaviour. Jokes that release tension, but not at the expense of another individual; nodding head,or saying "Um hm?" or "go on" are included.	
Teacher	**Accepts or uses ideas of pupils:** Clarifying, building, or developing ideas suggested by a pupil. Teacher extensions of pupil ideas are included but as the teacher brings more of his own ideas into play, shift to category five.	
Teacher	**Asks questions:** Asking a question about content or procedure, based on teacher ideas, with the intent that a pupil will answer.	
Teacher	**Lecturing:** Giving facts or opinion about content or procedures; expressing his own ideas, giving his own explanation, or citing an authority other than a pupil.	
Teacher	**Giving directions:** Directions, commands, or orders to which a pupil is expected to comply.	
Teacher	**Criticizing or justifying authority:** Statements intended to change pupil behaviour from non acceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing; extreme self-reference.	
Pupil	**Pupil-talk - response:** Talk by pupils in response to teacher. Teach initiates the contact or solicits pupil statement or structures the situation. Freedom to express own ideas is limited.	
Pupil	**Pupil-talk - initiation:** Talk by pupils which they initiate. Expressing own ideas; initiating a new topic; freedom to develop opinions and a line of thought,like asking thoughtful questions; going beyond the existing structure.	
Silence	**Silence or confusion:** Pauses, short periods of silence and periods of confusion in which communication cannot be understood by the observer	

7. Criticizing or justifying authority: Statements intended to change pupil behaviour from non acceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing; extreme self-reference.

8. Pupil-talk - response: Talk by pupils in response to teacher. Teach initiates the contact or solicits pupil statement or structures the situation. Freedom to express own ideas is limited.

9. Pupil-talk - Initiation: Talk by pupils which they initiate. Expressing own ideas; initiating a new topic; freedom to develop opinions and a line of thought,like asking thoughtful questions; going beyond the existing structure.

10. Silence or confusion: Pauses, short periods of silence and periods of confusion in which communication cannot be understood by the observer

D.1.5.3   Guide 3: General Observer

General notes on the activity. Use the same guides as the Participant Observers.

D.1.5.4   Guide 4: Brainstorming Observer

Notes related to the last session of the workshop. Observe the type of ideas that they generate and mark them using the coding scheme proposed below and use the same guides as the Participant Observers.

Categories:

- Missing Feature = MF
- Change Request UI = C-UI
- Change Request Functional = C-F
- Usage Scenario: What? = U-1
- Usage Scenario: Where? = U-2
- Usage Scenario: When? = U-3
- Usage Scenario: How? = U-4
- Usage Scenario: With who? = U-5

D.2   Second PD Workshop (November 20th, 2012)

The following are the forms used by volunteers in order to gather observations and guide the activities of the second PD workshop.

Domande per l'intervista (stampare minimo 20)

1. Qual è il tuo nome?	2. Quando sei nata/o?
3. Dove sei nata/o?	4. Dove vivi adesso?

5. Che scuole hai frequentato? Quando?
6. Ti ricordi di qualche professore o compagna/compagno di scuola?
7. Ci sono degli episodi particolari che ti fa piacere ricordare? (non raccontarli ora, fai solo un breve elenco)

8. Che lavori hai fatto finora? Dove? Quando?

9. Ti ricordi di qualche collega di lavoro?

10. Ci sono degli episodi particolari che ti fa piacere ricordare? (non raccontarli ora, fai solo un breve elenco)

11. Sei mai stata/o all'estero? Quando e dove?

12. Di quali vacanza ti ricordi?

13. Ci sono amici o amiche del passato che ricordi con piacere ma con cui hai perso contatto perche' abitano lontano?

14. Di quali canzoni o cantanti ti fa piacere ricordare?

15. Sono legati a qualche episodio particolare?

16. Di quali film o attori/attrici ti fa piacere ricordare?

17. Di quali scrittori o libri ti fa piacere ricordare?

18. Ci sono ricordi della tua vita affettiva e sentimentale che ti fa piacere raccontare? (per esempio, l'incontro con all'amore della tua vita oppure il tuo primo bacio)

19. Ci sono altre cose che ti piace ricordare?

Foglio per l'osservazioni (scrivi, scrivi, scrivi... e se in dubbio, scrivi :-)) (Stampare 12)

Argomenti dell'intervista che mettono in difficoltà le persone (intervistato o intervistatore?)

Argomenti dell'intervista che gli piacciono di più (intervistato o intervistatore?)

La storia raccontata è legata all'oggetto portato da casa?

A chi vogliono raccontare la storia?

Che tipo di oggetto ha portato (foto, souvenir, ecc.)?

Che emozioni le/gli vengono nel raccontare questa storia?

Chi partecipa alla storia raccontata? (famiglia, amici, colleghi, ecc.)

DR1. Cosa ti aiuterebbe a raccontare la tua storia?

Altre Domande da esplorare durante tutto il workshop come osservatori

DR2. Come la gente visita il proprio passato?	DR3. Come lo raccontano o lo rivivono?

DR4. A chi lo raccontano?	DR5. Quando, in quali situazioni lo raccontano?
DR6. Se ne hanno voglia, come fanno a trovare informazioni dal passato legate alle loro storie?	DR7. Come si sentono nel ricordare le loro storie del loro passato?
DR8. Quanto spesso rivivono il loro passato e quanto gli piace?	DR9. Come si organizzano i ricordi? (Album, foto in casa, ecc). Chi aiuta a organizzarli?

Altre note

D.3 Third PD Workshop (December 11th, 2012)

The following are the forms used by volunteers in order to gather observations and guide the activities of the third PD workshop. A video highlighting the activities of this and the previous workshop is also available in youtube[1].

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[1] `https://www.youtube.com/watch?feature=player_embedded&v=SjMVunjVTes`

Guida per l'Osservazione delle Confusione

Osserva il lavoro in gruppi e prendi Nota di tutto quello che risponde alla domanda: ***"Quali componenti della esperienza e contenuti fanno confusione?"***

Osservazioni durante l'uso generale dell'Ipad
Osservazioni durante la esplorazione di Reminiscens

Guida per l'Osservazione di Interessi

Osserva il lavoro in gruppi e prendi Nota di tutto quello che risponde alla domanda: ***"Quali contenuti sono i più interessanti per motivare la conversazione?"***

Osservazioni durante l'uso generale dell'Ipad

Osservazioni durante la esplorazione di Reminiscens

Guida per l'Osservazione dei Modeli Mentalli

Take note of each slip and mistake by elders when using the apps (in *parte*, put during what part of the worshop you obbserved this)

Slip	Mistake	Parte	Description

- **Slip and Mistakes:** "The division occurs at the level of the intention: A Person establishes an intention to act. If the intention is not appropriate, this is a mistake. If the action is not what was intended, this is a slip."
- A **slip** implies that the user has **the correct mental model** about the function of a feature in the app, but uses incorrectly (e.g. knowing what the "Like" button it is for but pressing the "Unlike" because is too close).

- A **mistake** implies that the user's mental model of the function of a feature in the app is wrong (e.g. swiping a button on the ipad expecting to go to the next image)

Osservazioni Generali

Domande che teniamo in conto per questa esperienza

DR1. Quali componenti dell'esperienza e contenuti sono i più **interessanti** pero motivare la conversazione?

DR2. Quali componenti della esperienza e contenuti fanno **confusione**?

DR3. Che difficoltà si trova per capire l'obbietivo dell'app?

DR4. Che difficoltà si trova nell'uso dell'iPad come mezzo per esplorare i ricordi?

D.4 Fourth PD Workshop (February 25th, 2012)

The following are the forms used by volunteers in order to gather observations and guide the activities of the fourth PD workshop. Additionally, the comeback video displayed in this workshop is available on youtube [2].

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[2] https://www.youtube.com/watch?feature=player_embedded&v=8DhnAetLrG0

Osservazioni dell'utilizzo di Reminiscens

Parte del prototipo schiacciato	Cosa intendevano fare

Secondo loro, per cosa serve Reminiscens? Mettere i pos-it nel reverso di questo foglio

Altre Osservazioni

Osservazioni dell'utilizzo di Glogster
Che elementi utilizzano

Quale sono i le characteristiche dello strumento che fanno più fatica a capire e usare

Valutazione di Glogster e discussione
Che difficoltà avete trovato nel fare un poster con questo strumento?

Che tipo de storie pensate sarebbero interessante rappresentare tramite posters di questo tipo?

Vi piacerebbe condividere questi posters? Con chi? Come?

Guida per Glogster

Inizio
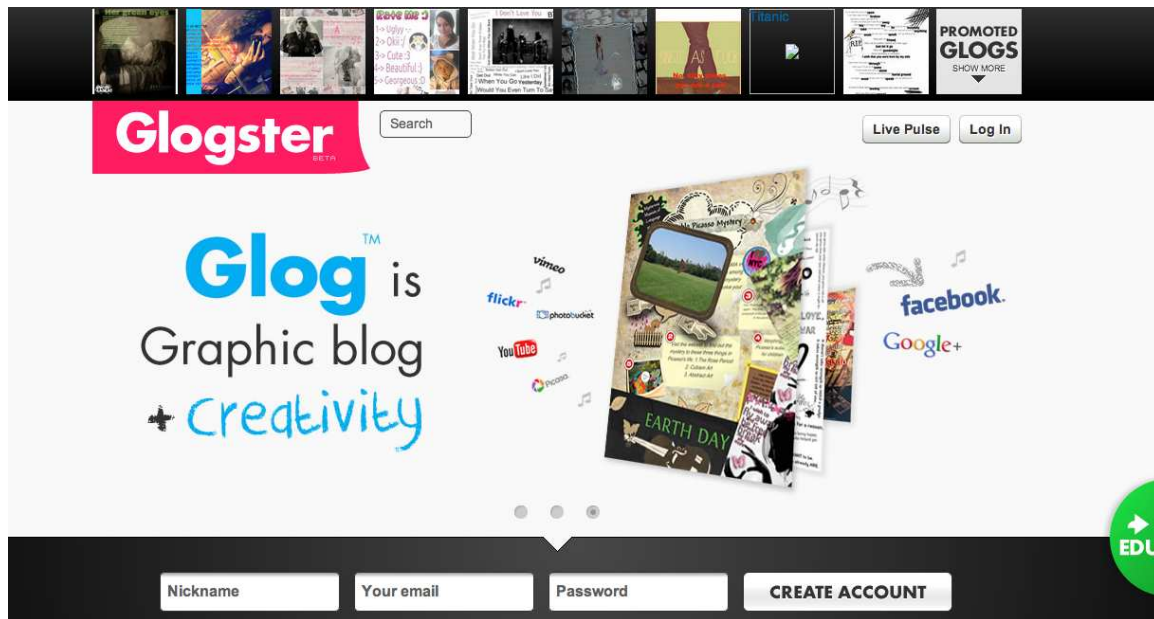
Scegliere "Wide Glog"
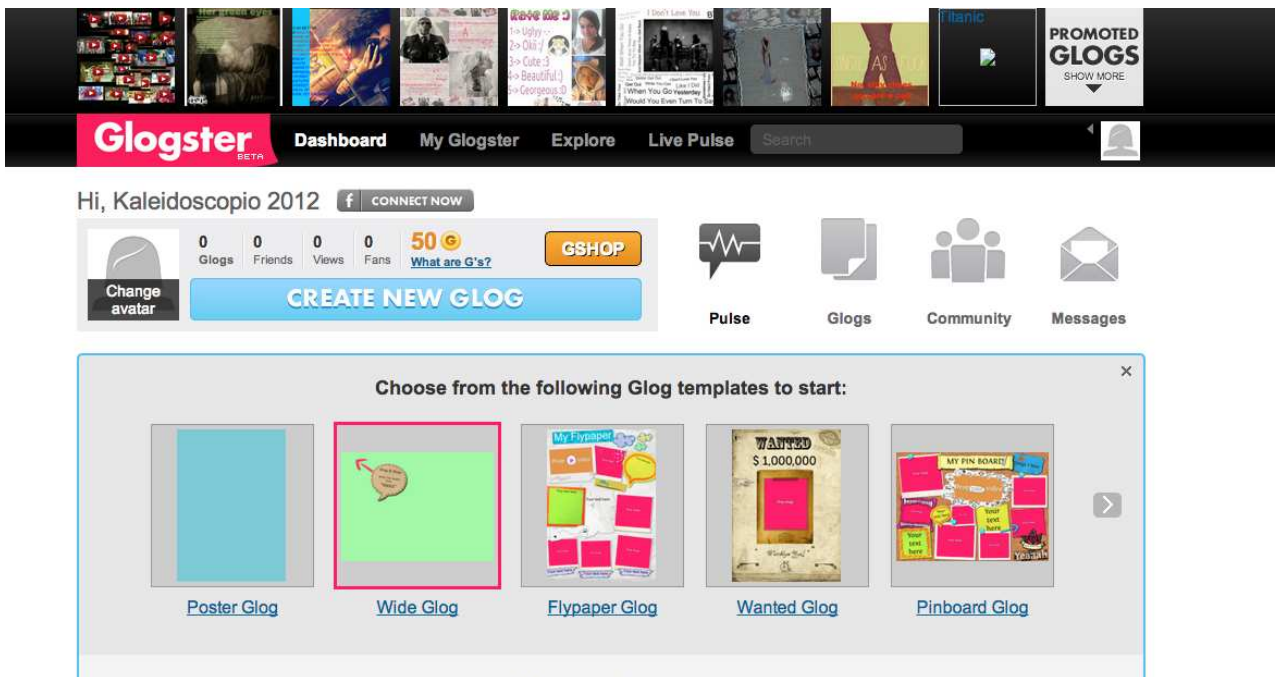
Per inserire qualcosa nel poster, si deve schiacciare su qualsiese delle seguenti opzioni:

- Text = testo
- Graphics = grafica o immagini prefabbricati
- Image = immagini da caricare da google o del vostro computer
- Wall = per modificare lo sfondo del poster
- Audio = per caricare suoni e audio del vostro computer
- Video = per inserire de i video del vostro computer o de youtube
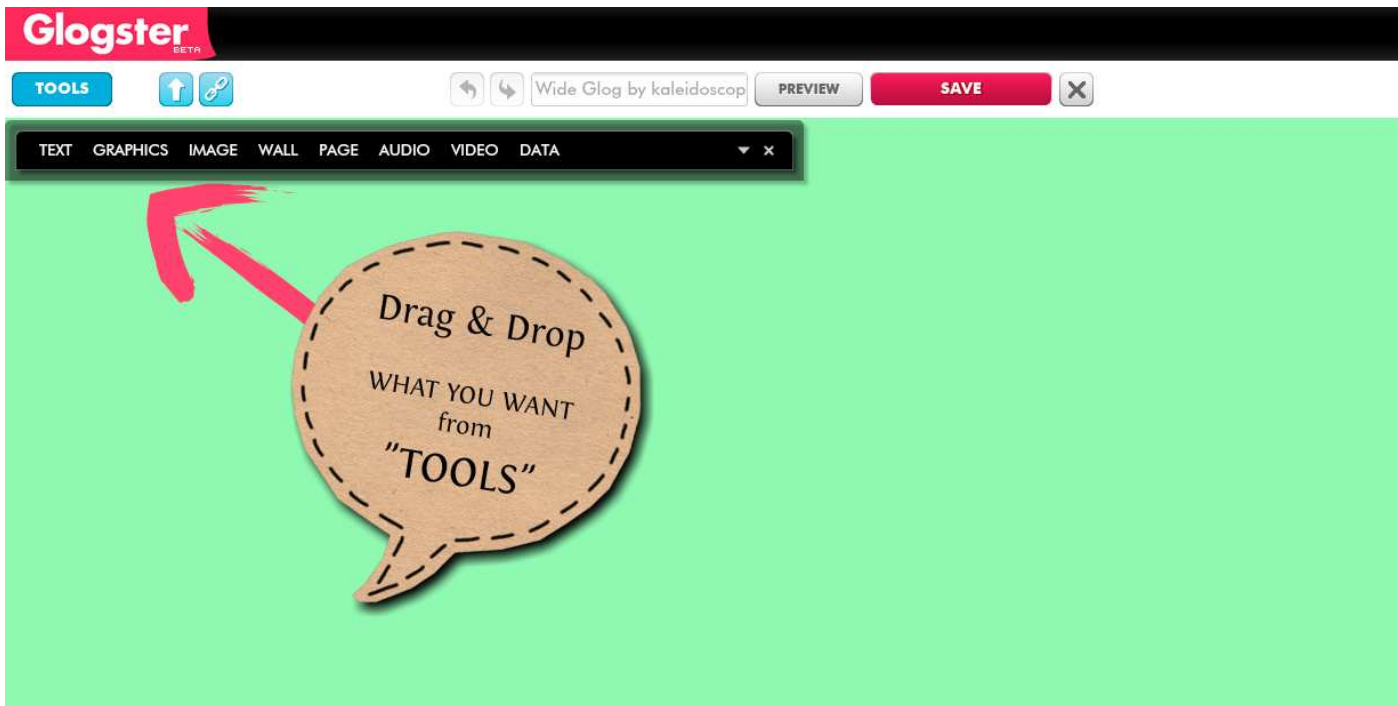
Una volta scelto quello da inserire (per esempio un testo) si deve scegliere lo stilo e dopo schiacciare "Use it"
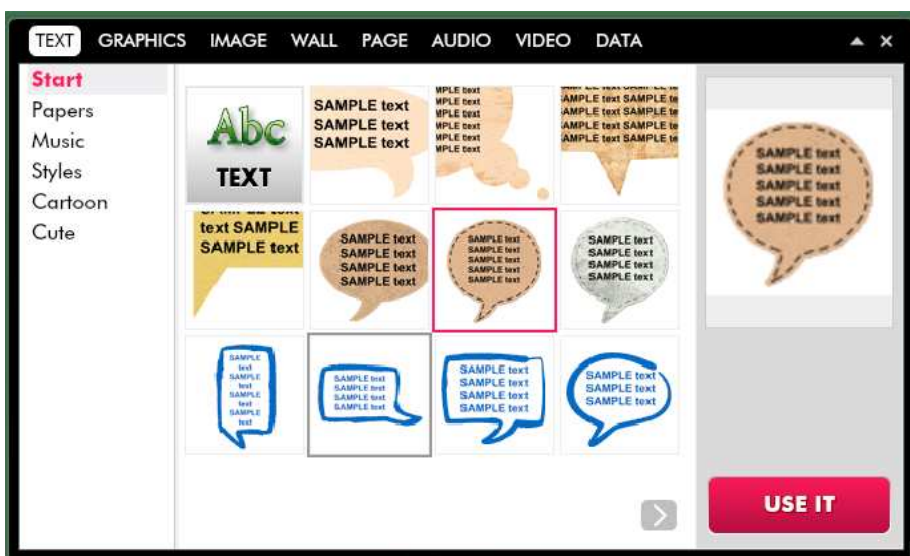
Il testo viene inserito con lo stilo scelto. Adesso si deve fare click su l'elemento inserito per

modificarlo. Si può ingrandire, rotare, muovere. Con due click, si può cambiare il contenuto del testo.
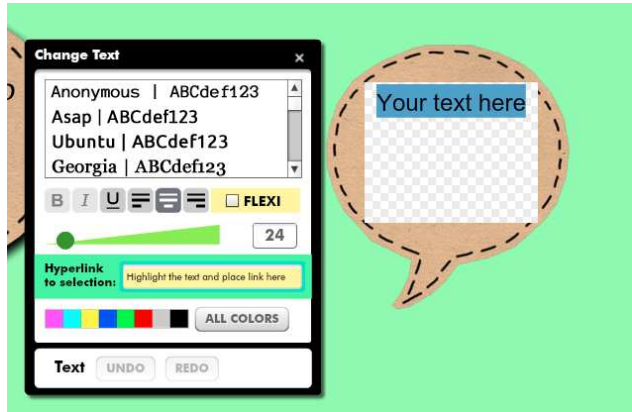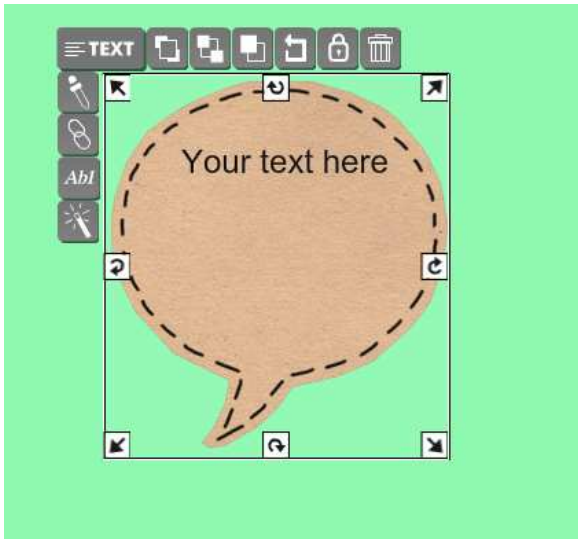
Social Disengagement Index Questionnaire and Procedure

Below, both questions and procedure to calculate the social disengagement index adapted from the original index proposed by Bassuk et al. [55]. In our calculation of the index, we have used a relaxed version of the score where we excluded CHURCH activities on the basis that some of our participant were non-religious and, even if non-religious, we believed that they could still have a high level of social engagement. Moreover, given the intergenerational nature of our participants, and the original index was prepared specifically for older adults, we excluded also question 14 and considered question 2 as if they were currently in a relationship.

I. Presence of spouse (SPOUSE SCORE) 1. Have you ever been married? *(Response codes: 1 yes, 2 no [skip Question 2])*

2. Are you now married, separated, divorced, or widowed? *(Response codes: 1 married, 2 separated, 3 divorced, 4 widowed)*

SPOUSE SCORE PROCEDURE: If the response to Question 1 1 and the response to Question 2 1, then code SPOUSE as 1; otherwise, code SPOUSE as 0.

II. Monthly visual contact with three or more relatives and close friends (VISUAL)

III. Yearly nonvisual contact with 10 or more relatives and close friends (NONVIS)

Children:

1. How many children, if any, have you had (including adopted children or children you have raised)? *(If none, code Questions 24 as 0.)*

2. How many are presently living?

3a. How many of your children do you see at least once a week?

3b. Of the others, how many do you see every month?

4a. How many of your children do you talk to on the phone or correspond with weekly?

4b. Of the others, how many do you talk to on the phone or correspond with monthly?

4c. Of the others, how many do you talk to on the phone or correspond with several times a year?

Other relatives:

5. In general, apart from your children, how many other relatives do you have that you feel close to? (People that you feel at ease with, can talk to about private matters, and can call on for help.)

6. How many of these relatives do you see at least once a month?

7. How many of these relatives do you correspond with, either by letter or telephone, a few times a year?

Close friends:

8. In general, how many close friends do you have? (Peo-ple that you feel at ease with, can talk to about private matters, and can call on for help.)

9. How many of these friends do you see at least once a month?

10. How many of these friends do you exchange letters or telephone calls with a few times a year?

VISUAL AND NOVIS SCORES PROCEDURE: If the response to Questions 3a + 3b + 6 + 9 ¿= 3, then code VISUAL as 1; otherwise, code VISUAL as 0. If the response to Questions 4a 4b 4c 7 10 10, then code NONVIS as 1; otherwise code NONVIS as 0.

IV. Frequent attendance at religious services (CHURCH)

1. About how often do you go to religious meetings or services? *(Response codes: 1 never or almost never; 2 once or twice a year; 3 every few months; 4 once or twice a month; 5 once a week; 6 more than once a week.)*

CHURCH SCORE PROCEDURE: If the response to Question 1 4, then code CHURCH as 1; otherwise, code CHURCH as 0. V. Membership in other groups (GROUPS)

1. Do you participate in any groups, such as a Senior center; social or work group; church-connected group; self-help group; or charity, public service, or community group? *(Response codes: 1 yes [specify]; 2 no)*

GROUPS PROCEDURE: If the response to Question 1 1, then code GROUPS as 1; otherwise, code GROUPS as 0.

VI. Regular participation in recreational social activities (SOCACT)

Here is a list of things people do in their free time. In the last month, how often have you done each of these things? (Response codes: 0 never; 1 sometimes; 2 often)

1. Active sports or swimming

2. Take walks

3. Work in the garden or yard

4. Do physical exercises

5. Prepare your meals

6. Work at a hobby

7. Go out and do some shopping

8. Go out to a movie, restaurant, or sporting event

9. Read books, magazines, newspapers

10. Watch television

11. Day trips, overnight trips

12. Unpaid community or volunteer work

13. Paid community work

14. Regularly play cards, games, or bingo

15. Any other activities (specify) Regular participation in recreational social activities:

SOCACT SCORE PROCEDURE: If the response to Questions 7 8 11 12 13 14 is 6 (that is, if the mean response 1), then code SOCACT as 1; otherwise, code SOCACT as 0. (Note: It is possible that activities were done alone. Items were chosen on the basis of the authors judgment that, more often than not, these activities are done with other people.)

PHYSACT SCORE PROCEDURE: Regular participation in physical activities (not part of the social disengagement index): If the response to Questions 1 2 3 4 is 4 (that is, if the mean response 1), then code PHYSACT as 1; otherwise, code PHYSACT as 0.

FINAL SCORE PROCEDURE:

A composite index of social disengagement was constructed from the six indicators (SPOUSE, VISUAL, NONVIS, CHURCH, GROUPS, and SOCACT). Scoring was as follows: 1 five to six ties, 2 three to four ties, 3 one to two ties, 4 no ties. Tie refers to the type of social contact. If more than two indicators were missing (questions that were not answered and "dont know" responses were scored as missing), the index was not scored.

F

Reminiscence Bootstrap Questionnaire

A mix of questions based on both the *Memory Grabber*, a life review template available online[1], and the autobiographic agenda proposed by De Beni et al. [112]

Life stories initialization questionnaire

This is the Life Story of (- first name) (- last name). I was born on ( ) in the town/city of ( ). My Current city is ( ) and my nationality is ( ). I was born number ( ) of ( ) children. I have ( ) brother(s) and ( ) sister(s).

Milestones of my life

Write small sentences about some of the following milestones of your life (the ones you prefer to share):

Started the first grade (including the name and city of your school)

Graduated from high school (including the name and city of your highschool)

A family move

Graduated college (including the name and city of your college)

Periods of employment

Childhood memories

My earliest memories as a child are...

My happiest moments, as a child, were...

The oldest relative that I can remember was...

When I "grew up" I wanted to be a ...

10 early memories that I have of my paternal grandparents are...

I had stitches as a kid YES or NO

---

[1]Memory Grabber: http://www.familyhistoryproducts.com/

My favorite toy was...

My most memorable babysitter was...

My first bike was ...

Life lists

List places that you have visited in your life

List things you enjoy talking, reading and learning about

List musicians and musical groups that you liked as a teenager

List musicians and musical groups that you like now

List the hardest decisions you've ever had to make

G

Final questionnaire after the study

This final questionnaire was compiled by participants of the longitudinal study of reminiscence supported by IT with the goal of gathering their opinion on general aspects of the experience, the *Reminiscens* system and how much did they share aspects of the study with people in their social networks. The questionnaire is in italian, as it was introduced to participants.

1. Quest'esperienza mi servita per...

2. Avere ricordato delle storie della mia vita...

3. Mi piacerebbe usare il risultato di quest'esperimento per...

4. Credo che quest'esperienza mi abbia fatto avvicinare e abbia intensificato il legame tra...

   - i vecchi amici
   - gli amici da meno di 3 anni
   - coniuge
   - i figli
   - i nipoti
   - i parenti
   - me stesso
   - nuove persone
   - *Le persone giovane
   - *L'ascoltatore/trice
   - **le persone anziane
   - **il narratore/la narratrice

5. Qui di seguito ci sono cinque affermazioni con le quali tu puoi essere d'accordo o in disaccordo.

Usando la scala qui sotto da 1 a 7 indica quanto sei daccordo con ogni frase scegliendo il valore corrispondente a fianco:

- stato divertente per me partecipare alle sessioni di reminiscenza.
- Mi sentivo frustrato durante lo studio.
- Mi sentivo ansioso durante lo studio.
- Mi sentivo ansioso quando si avvicinava il momento della sessione di ricordo.
- Mi mancheranno le sessioni di ricordo.
- Vorrei continuare ad utilizzare lapplicazione da casa mia.
- Mi piacciono i tre tipi di contenuti visualizzati durante lo studio (foto, canzoni, informazioni dei personaggi storici).

6. *Qui di seguito ci sono cinque affermazioni con le quali tu puoi essere d'accordo o in disaccordo. Usando la scala qui sotto da 1 a 7 indica quanto sei daccordo con ogni frase scegliendo il valore corrispondente a fianco:

- L'applicazione mi stimola a condividere i miei ricordi personali.
- Vorrei utilizzare nuovamente l'applicazione.
- Mi sento di raccomandare lapplicazione ai miei amici e famigliari.
- Io di solito non mi sento motivato a condividere i miei ricordi, ma Reminiscens mi ha aiutato ha farlo.
- stato divertente partecipare alle sessioni di ricordo con lapplicazione Reminiscens.
- Mi piacciono i tre tipi di contenuti visualizzati durante lo studio (foto, canzoni, informazioni dei personaggi storici).
- Mi sentivo motivato a raccontare le mie storie quando vedevo le domande nellapplicazione
- Mi sentivo motivato a raccontare le mie storie quando vedevo le foto dal passato nellapplicazione
- Mi sentivo motivato a raccontare le mie storie quando ascoltavo le canzoni del passato nellapplicazione
- Mi sentivo motivato a raccontare le mie storie quando leggevo le informazioni della vita dei personaggi storici nellapplicazione

7. Ti chiediamo di ordinare l'elenco sotto (a-h) usando una scala numerica di 1 a 8, dove 1 per la strategia pi motivante e 8 per la strategia meno motivante.

- Le foto di contesto alle proprie storie
- Le canzoni di contesto alle proprie storie
- Le informazioni di personaggi storici di contesto alle proprie storie
- Le domande suggerite
- Il fatto di condividere le mie storie faccia-a-faccia con il mio famigliare
- Il fatto di raccontare a voce la mia storia
- La possibilit di caricare le mie foto e scrivere la storia affianco

236

- Il fatto di sapere che alla fine del percorso, ci sarebbe un libro stampato di tutte le storie caricate nel sistema

8. Quante persone hai coinvolto nella costruzione dei ricordi e delle storie, parlando e confrontandoti direttamente con loro?

9. Quante di queste persone fanno parte del tuo nucleo famigliare?

10. Quante di queste persone fanno parte del tuo gruppo di amici da pi di 15 anni?

11. Quante di queste persone fanno parte del tuo gruppo di amici da pi di 3 anni e da meno di 15 anni?

12. Con quante persone hai parlato o commentato riguardo all'esperimento al quale hai partecipato?

13. Quante di queste persone fanno parte del tuo nucleo famigliare?

14. Quante persone, che non sentivi da pi di 3 anni, hai contattato riguardo all'esperimento?

15. Quante delle persone da te ricordate durante l'esperimento hai sentito il desiderio di contattare per sapere come stanno?

16. Con quante di queste persone hai provato a metterti in contatto?

17. Altri commenti che vuoi scrivere sullo studio (Suggerimenti, critiche, consigli, ecc...)

Only for narrators

**Only for listeners*

H

Participant Diaries and Mood Questionnaire

In this appendix, we include the guiding questions and mood questionnaire that were part of the diary given to each participant of the long study. These were placed every two pages within the diary.

Da compilare alla fine della giornata

Oggi hai usato l'applicazione?
Se lo hai fatto, scrivi qualche commento!

ti diamo qualche spunto...

Quando e dove l'hai usata?

Da sola/o o con qualcuno? Con chi?

Hai provato delle emozioni? Quali?

C'è qualcosa di particolare che ti è piaciuto fare?

O magari c'è qualcosa che non ti è piaciuto?

Hai imparato o scoperto qualcosa di nuovo?

Qualcosa che non ti saresti aspettata/o di scoprire?

Hai fatto dei paragoni tra il passato e il presente, tra quello che hai sentito raccontare e la tua personale esperienza.

Altro che ci vuoi raccontare...

Data:_____ Giorno: _____

In questo momento mi sento:

	1	2	3	4	5	
Triste	◯	◯	◯	◯	◯	Contento
Stanco	◯	◯	◯	◯	◯	Energico
Preoccupato	◯	◯	◯	◯	◯	Tranquillo
Teso	◯	◯	◯	◯	◯	Rilassato
Pessimista	◯	◯	◯	◯	◯	Ottimista
Sfiduciato	◯	◯	◯	◯	◯	Speranzoso
Isolato	◯	◯	◯	◯	◯	Connesso
Annoiato	◯	◯	◯	◯	◯	Interessato

Da compilare alla fine della giornata

Oggi hai usato l'applicazione?
Se si, scrivi qualche commento!

ti diamo qualche spunto...

Quando e dove l'hai usata?

Da sola/o o con qualcuno? Con chi?

Hai provato delle emozioni? Quali?

C'è qualcosa di particolare che ti è piaciuto fare?

O magari c'è qualcosa che non ti è piaciuto?

Altro che ci vuoi raccontare...

Data:_____ Giorno: _____

In questo momento mi sento:

	1	2	3	4	5	
Triste	◯	◯	◯	◯	◯	Contento
Stanco	◯	◯	◯	◯	◯	Energico
Preoccupato	◯	◯	◯	◯	◯	Tranquillo
Teso	◯	◯	◯	◯	◯	Rilassato
Pessimista	◯	◯	◯	◯	◯	Ottimista
Sfiduciato	◯	◯	◯	◯	◯	Speranzoso
Isolato	◯	◯	◯	◯	◯	Connesso
Annoiato	◯	◯	◯	◯	◯	Interessato

Long Study of Reminiscens: Ethical Committee Request

In this appendix, we include the original request submitted to the ethical committee of the University of Trento, along with the response we obtained from them. The documents in this appendix are in italian, as they were originally presented.

Modulo per la richiesta
di approvazione di un protocollo di ricerca

---

1. Presentazione del progetto

1.1 Titolo del progetto:
Studio sulla tecnologia per lo stimolo dei ricordi (STSR)

1.2 Responsabile del progetto (Allegare curriculum):
Cristhian Parra. Dottorando di ricerca in Tecnologie delle Communicazione e delll'Informazione preso al Dipartimento di Ingegneria e Scienza dell'Informazione (DISI) dell'Università degli Studi di Trento. Si veda allegato (A) il CV del responsabile

1.3 Altri ricercatori coinvolti, enti di appartenenza, loro recapito (Allegare i curricula sintetici e mirati)
- Vincenzo D'Andrea. DISI. Università degli Studi di Trento, supervisore di dottorato di Cristhian Parra e supervisore scientifico del progetto di ricerca
- Valeria Galdino. Laureanda del Dipartimento di Sociologia e Ricerca Sociale dell''Università degli studi di Trento

Si veda curricula sintetici in allegato (B)

1.4 Sede/i della ricerca
Centro Servizi Anziani gestito dalla Cooperativa Kaleidoscopio. Via Belenzani 49. Trento, Italia.

1.5 E' necessaria l'autorizzazione di altri Enti (ad es., ospedali, scuole, carceri) per l'accesso a dati o il coinvolgimento di partecipanti? Se sì, allegare copia della lettera di autorizzazione
Si. Si veda in allegato (I) l'Autorizzazione del Centro Servizio Anziani (CSA) della Cooperativa Kaleidoscopio.

1.6 Il responsabile e i componenti del gruppo di ricerca nonché i rispettivi familiari hanno interessi specifici in rapporto all'esito dello studio? (Allegare dichiarazione)
No. Dichiarazione in allegato (C).

1.7 Il responsabile della ricerca ha tempo sufficiente, attrezzature, strutture e personale idonei, per condurre la ricerca? (Allegare dichiarazione, controfirmata dal responsabile della struttura a cui afferisce)
Si. Dichiarazione in allegato (D).

1.8 Sono previsti interventi che richiedono specifiche professionalità (ad es. medico, psicologo, infermiere, ecc.) ai sensi della normativa vigente? Se sì, specificare.

No.

2. Dettagli relativi al progetto

2.1 Eventuali Enti finanziatori o Sponsor (indicare contributi)

- Gruppo di Ricerca Lifeparticipation. DISI, Università degli Studi di Trento. Contribuisce con tablets per le sessione di reminiscenza

2.2 Data prevista di inizio della ricerca: 01 / 09 / 2013

2.3 Durata prevista della ricerca (in mesi): 4 Mesi

2.4 Riassunto in italiano del programma di ricerca (eventuale rappresentazione schematica del protocollo)

Il progetto di studio *Reminiscens* è uno studio longitudinale sulla pratica della reminiscenza assistita dalla tecnologia. Lo studio coninvolge 8 coppie intergenerazionali, costituite da un adulto di età superiore a 65 anni (per comodità chiamato "adulto" nel seguito) e da un membro più giovane della sua famiglia (o altra persona scelta assieme all'adulto). Ciascuna coppia verrà coinvolta in 8 sessioni di reminiscenza con cadenza approssimativente settimanale (le date saranno concordate con ciascuna coppia). Nelle sessioni i partecipanti utilizzarano un'applicazione su tablet progettata con alcune caratteristiche specifiche per stimolare una conversazione centrata sui ricordi personali. I due partecipanti avranno inoltre accesso al sistema da casa, attraverso una interfaccia web per continuare (a loro scelta) a interagire con il sistema tra una sessione e l'altra. Durante la sessione, sarà selezionata una fase della vita dell'adulto intorno alla quale la coppia parlerà dei suoi ricordi, aiutata dai contenuti multimediali che appaiono sul tablet. Durante l'intervallo tra due sessioni l'adulto avrà un diario nel quale registrà il suo stato d'animo e il tipo di utilizzo (o meno) dell'interfaccia web da casa. Il sistema raccoglierà nei log di utilizzo solo l'identificativo dell'utente, orario e durata della sessione di lavoro, funzionalità utilizzata (non si tiene traccia delle attività di dettaglio). Alla fine delle 8 sessioni di reminiscenza (primi due mesi dello studio), i partecipanti avranno ancora la possibilità di utilizzare il sistema per altri 2 mesi dalle loro case. Prima dell'inizio e dopo la fine dello studio, i partecipanti avranno di compilare i seguenti questionari: 1) Familiarità con la Tecnologia, 2) Soddisfazione con la Vita, 3) Interazione Sociale, 4) Ricordi Personali e 5) Soddisfazzione e intenzione d'utilizzo dell'applicazione. Le bozze dei questionari sono allegate a questo documento. (Allegato E). Il nostro obiettivo è quello di esplorare se e quanto il nostro strumento (e i contenuti che abbiamo selezionato) sono in grado di stimolare efficacemente la reminiscenza. Oltre a questo, il nostro progetto è collegato alla iniziativa del Centro Servizi Anziani di Kaleidoscopio per promuovere l'interazione intergenerazionale, dove i giovani volontari aiutano agli anziani ad imparare e migliorare la loro conoscenza sulle tecnologie dell'informazione (si veda locandina in allegato E). La figura qui sotto rappresenta la sequenza temporale dello studio.
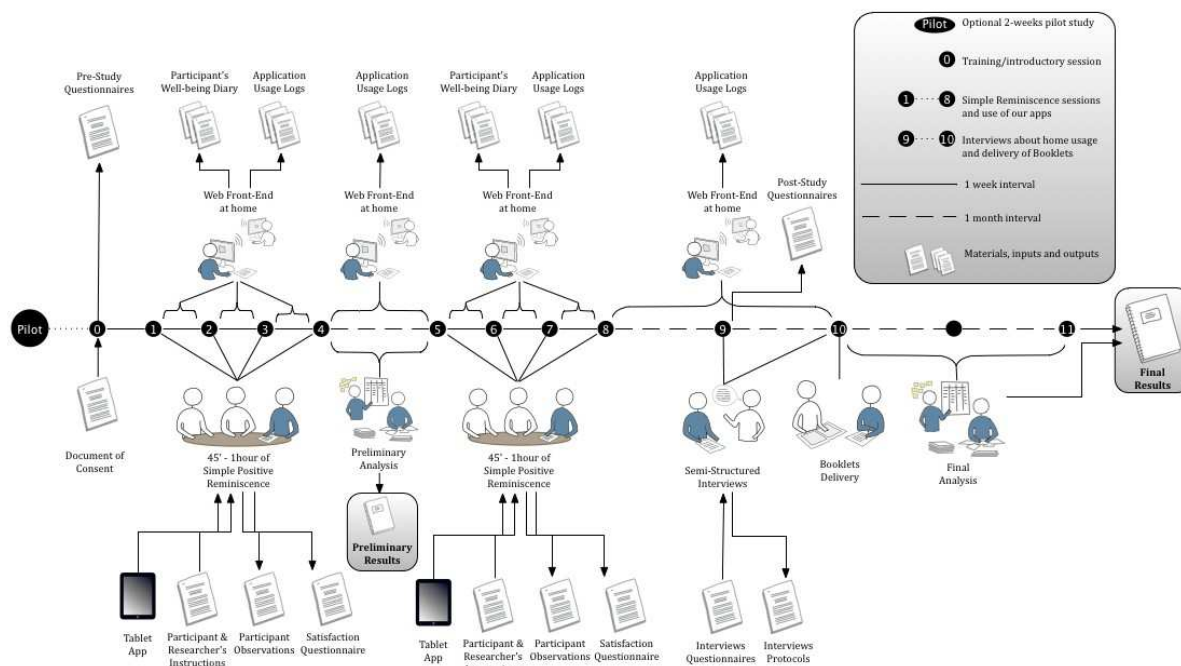
2.5 Descrizione del progetto:

2.5.1 Base di partenza e giustificazione teorica

La reminiscenza (cioè, ricordare e condividere i ricordi del passato [2]) è una pratica che esiste da sempre e che si verifica in tutte le età, anche se soprattutto in età avanzata, quando alcuni tipi di reminiscenza diventano più significativi [3] (ad esempio, la revisione di vita o "life review"). Gli studi su questo tema hanno trovato che rivisitare i ricordi del passato possono aumentare la soddisfazione di vita e ridurre o prevenire la depressione [4]. In misura minore, altri studi hanno trovato che la pratica della reminiscenza può anche migliorare le interazioni sociali negli anziani [5] [6]. Questi risultati, insieme con l'idea che si tratta di una pratica comunemente piacevole per gli anziani, hanno anche portato alla sua applicazione a scopo terapeutico nella cosiddetta terapia dei ricordi (reminiscence therapy) [7] [8]. I benefici di questa pratica e il suo impatto su tutte le età ci fanno pensare che possiamo utilizzarla come un ponte tra le generazioni per stimolare l'interazione sociale tra gli anziani e il loro cerchio sociale. In particolare, alcuni studi hanno trovato che la reminiscenza sociale e preferita in un contesto faccia-a-faccia invece che mediata dalla tecnologia [9], per cui il nostro obiettivo e quello di stimolare (invece che mediare) la reminiscenza quando le persone si trovano assieme.

2.5.2 Obiettivi

Il progetto di studio ha come obiettivo principale valutare l'utilizzo di un strumento digitale per stimolare la reminiscenza ed esplorare come viene avviata l'interazione sociale intorno a questa pratica. In particolare, si cerca di:

- Capire come possiamo stimolare la reminiscenza con l'aiuto della tecnologia dell'Informazione
- Valutare la nostra applicazione come mezzo per lo stimolo della reminiscenza
- Esplorare le interazioni sociali intorno alla pratica della reminiscenza

2.5.3 Metodo di indagine proposto

Sperimentazione longitudinale controllata con un disegno "within groups" dove ogni coppia partecipante avrà l'opportunità di provare diverse versioni del nostro sistema, con l'obbiettivo di valutare l'impatto delle diverse caratteristiche del nostro progetto.

2.5.4 Descrizione della procedura (allegare protocollo e copia del materiale utilizzato)

Si veda allegato (F), con la descrizione completa dello studio in inglese.

2.5.5 Riferimenti bibliografici

[1] M. Dianti, C. Parra, F. Casati, and A. De Angelli, "What's Up : Fostering Intergenerational Social Interactions What's Up Intergenerational Communication," International Reports on Socio-Informatics (IRSI). Special Issue on Designing for Inter/Generational Communities, vol. 9, no. 1, pp. 22–27, 2012.

[2] R. Butler, "The Life Review: An Interpretation of Reminiscence in the Aged," Psychiatry, 1963.

[3] G. Cohen and S. Taylor, "Reminiscence and ageing," Ageing and Society, vol. 18, no. 5, pp. 601–610, 1998.

[4] B. K. Haight and J. D. Webster, Critical advances in reminiscence work. Springer Publishing Company, 2007.

[5] M. Pinquart and S. Forstmeier, "Effects of reminiscence interventions on psychosocial outcomes: a meta-analysis.," Aging & mental health, vol. 16, no. 5, pp. 541–58, Jan. 2012.

[6] D. M. Head, S. Portnoy, and R. T. Woods, "The impact of reminiscence groups in two different settings," International Journal of Geriatric Psychiatry, vol. 5, no. 5, pp. 295–302, Sep. 1990.

[7] L. M. Watt and P. Cappeliez, "Integrative and instrumental reminiscence therapies for depression in older adults: Intervention strategies and treatment effectiveness," Aging & Mental Health, vol. 4, no. 2, pp. 166–177, May 2000.

[8] B. Woods, A. Spector, and C. Jones, "Terapia de recuerdo para la demencia," 2005.

[9] Cosley, Dan et al. "Experiences with designing tools for everyday reminiscing." *Human–Computer Interaction* 27.1-2 (2012): 175-198.

3. Dettagli relativi ai partecipanti

3.1 Quali tipologie di soggetti prenderanno parte allo studio?

[ ] Studenti

[X] Adulti (età superiore a 18 anni e in grado di esprimere il loro consenso)

[X] Bambini e ragazzi di età inferiore a 18 anni (adolescenti)

[X] Anziani (età superiore ai 65 anni e in grado di esprimere il loro consenso)

[ ] Soggetti di madrelingua non italiana

[ ] Soggetti con deficit cognitivo/mentale, NON in grado di esprimere il proprio consenso

[ ] Altre persone la cui capacità di esprimere consenso possa essere compromessa (indicare per quale motivo)

[ ] Soggetti con disabilità fisica (specificare di quale tipo)

[ ]   Soggetti istituzionalizzati (ad es., carcerati, pazienti ospedalizzati ecc.)

[ ]   Pazienti e/o clienti segnalati da medici, psicologi o altre categorie di professionisti

[ ]   Altre persone la cui capacità di esprimere consenso possa essere compromessa (indicare per quale motivo)

[ ]   Non è possibile determinare la tipologia di soggetti (ad es., somministrazione via internet)

3.2 E' possibile che alcuni dei soggetti si trovino in una posizione di dipendenza nei confronti del ricercatore o di uno dei suoi collaboratori, tale per cui si possa supporre che l'espressione del consenso a partecipare allo studio non sia del tutto libera e priva da ogni tipo di pressione (ad es., studente/professore, paziente/medico, dipendente/datore di lavoro)? Se sì, indicare come si intende provvedere per minimizzare la possibilità che il soggetto si senta obbligato a prendere parte alla ricerca

No

3.3 Caratteristiche dei partecipanti per la ricerca (specificare eventuali criteri di inclusione/esclusione).

i partecipanti saranno a coppie. In ciascuna copppia sarà presente una persona di età superiore a 65 anni e una persona più giovane (volontari o famigliari). La persona più giovane potrà essere anche un adolescente di età superiore a 14 anni.

Il criterio di inclusione per le persone di età superiore a 65 anni è essere in grado di ricordare e raccontare le loro storie di vita. Il criterio di inclusione per le persone di età compresa tra 14 e 65 anni è essere in grado di ascoltare e interagire durante il racconto delle storie.

3.4 Come verranno diffusi le informazioni e l'invito a partecipare alla ricerca? Allegare copia di eventuali locandine o lettere da inviare

Attraverso avvisi nel Centro Servizi Anziani preparati dallo staff del Centro

.

3.5 E' prevista qualche forma di incentivo per i partecipanti allo studio?

Alla fine dello studio, ogni partecipante riceverà una copia stampata di un libro contenente le storie da lui/lei raccontate.

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4. Rischio e gestione del rischio

4.1 La ricerca prevede

[X]   utilizzo di questionari (si veda allegato G)

[X]   interviste strutturate o semi-strutturate (si veda allegato G con le domande che verranno poste; ove questo non sia possibile, indicare gli argomenti che verranno trattati)

[ ]   interviste in profondità

[ ]   focus group

[X]   narrazioni autobiografiche

[X]   raccolta di diari (diary keeping)

[ ]   osservazione del comportamento dei soggetti a loro insaputa

[X]   osservazione del comportamento dei soggetti

[ ]   registrazioni audio o video dei soggetti

[ ]   somministrazione di stimoli, compiti o procedure e registrazione di risposte comportamentali, opinioni

    o giudizi

[ ]   somministrazione di stimoli, compiti o procedure che il soggetto potrebbe trovare fastidiosi, stressanti,

    fisicamente o psicologicamente dolorosi, sia durante sia successivamente la conduzione dello studio

[ ]   registrazione di movimenti oculari

[ ]   utilizzo di TMS (Transcranial Magnetic Stimulation, o stimolazione magnetica transcranica)

[ ]   immersione in ambienti di realtà virtuale

[ ]   registrazione di potenziali evocati

[ ]   somministrazione di test, questionari o protocolli sperimentali attraverso internet (web, posta

    elettronica)

[ ]   utilizzo di test neuropsicologici

[ ]   tecniche di neuroimmagine (ad es., fMRI)

[ ]   la messa in atto di comportamenti che potrebbero diminuire l'autostima dei soggetti, o indurre

    imbarazzo, dispiacere o depressione

[ ]   procedure di inganno dei soggetti

[ ]   la somministrazione di sostanze o agenti (ad es., farmaci, alcol)

[ ]   raccolta di campioni di tessuto o fluidi umani (ad es., esami del sangue)

[ ]   la partecipazione ad un trial clinico

[ ]   altro (specificare)

4.2 Nel caso in cui la ricerca preveda l'uso di procedure che potrebbero risultare stressanti o pericolose per i partecipanti, descrivere la natura dei rischi e le conseguenze ragionevolmente attese delle procedure utilizzate.
N.A.

4.3 E' prevista una specifica polizza di assicurazione per responsabilità civile aggiuntiva a quella di Ateneo? Se sì, allegare il contratto di assicurazione in copia integrale.
N.A.

4.4 Come si prevede di affrontare eventuali complicanze o reazioni avverse?
N.A.

4.5 Si prevede che vi possano essere benefici per chi prende parte alla ricerca? Quali?

Si prevede che i partecipanti potranno aumentare la loro soddisfazione soggettiva della vita.

5. Informazione e consenso

5.1 Allegare una copia del Modulo Informativo e della Dichiarazione di Consenso.

Si veda allegato (H)

5.2 Tenuto conto che l'informazione va data a tutti i potenziali partecipanti, nel caso di soggetti non in grado di esprimere il consenso, indicare a chi si chiederà di acconsentire alla partecipazione precisandone il ruolo e i motivi

N.A.

5.3 Qualora, per la realizzazione dello studio, non fosse possibile informare i partecipanti prima dell'inizio della sperimentazione sull'obiettivo della stessa, specificare quali saranno le modalità del successivo colloquio di chiarificazione.

N.A.

5.4 Quali modalità saranno adottate per ricevere espressioni di dubbi e rispondere a richieste di precisazioni da parte dei soggetti nel corso dello studio?

Email e telefono.

5.5 In che modo i partecipanti saranno informati della possibilità di ricevere, direttamente o indirettamente, ogni altro dato relativo alle loro condizioni psico-fisiche che diventasse disponibile durante la ricerca?

Email e telefono

6. Anonimato e riservatezza dei dati personali

6.1 Allegare l'informativa relativa al trattamento dei dati personali ai sensi del D.Lgs. del 30 giugno 2003, n. 196 (Codice in materia di protezione dei dati personali).

Si veda come parte del consenso

6.2 Come verrà garantito ai partecipanti l'anonimato (ad es., utilizzo di codici di identificazione)?

Attraverso l'utilizzo di codici di identificazione.

6.3 Nel caso fosse necessario conservare i dati identificativi dei partecipanti, specificarne i motivi e le modalità con cui i soggetti ne sono informati.

Tutti i dati identificativi verrano cancellati una volta finito lo studio, eccetto il caso in cui il partecipante chieda espressamente di mantenere i dati per continuare con l'utilizzo del sistema.

6.4 Quali sono le misure di sicurezza che vengono comunque adottate per assicurarsi che venga rispettata la riservatezza dei dati?

Tutti i dati saranno disponibile soltanto attraverso una API che richiede autenticazione dell'utente. La comunicazione verrà fatta attraverso il protocollo HTTPS.

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7. Conservazione e sicurezza dei dati raccolti e dei risultati della ricerca

7.1 Chi avrà accesso ai dati raccolti e ai risultati (ancorché intermedi) della ricerca?

Soltanto i ricercatori coinvolti avranno accesso ai dati. I risultati potranno essere oggetto di pubblicazione scientifica, ma senza riferimenti personali ai partecipanti e senza l'utilizzo di materiali che permettano l'identificazione dei partecipanti.

7.2 Per quanti anni i dati raccolti verranno conservati dalla conclusione della ricerca?

Non più di un anno.

7.3 Indicare le modalità di conservazione dei dati sensibili (responsabile della corretta conservazione e luogo dove verranno conservati).

I dati verrano conservati su server protetti da password.

Io sottoscritto _____CRISTHIAN PARRA_____ .

dichiaro

che le informazioni contenute nel presente documento sono accurate, e mi impegno a

:

    a. comunicare per iscritto la data di inizio e di conclusione della sperimentazione, come pure della sua eventuale sospensione anticipata con l'indicazione dei motivi;
    b. condurre la sperimentazione secondo le modalità indicate;
    c. informare per iscritto degli eventi avversi, insorti nel corso dello studio, come di ogni elemento che potrebbe influire sulla sicurezza dei partecipanti o sul proseguimento dello studio;
    d. non introdurre variazioni al protocollo senza che il CESP abbia espresso parere favorevole;
    e. inviare, alla fine della ricerca, un rapporto sullo studio completato;
    f. conservare la documentazione per almeno 5 anni, salvo diverse indicazioni dal CESP, dalla conclusione della ricerca garantendo condizioni di riservatezza adeguate;
    g. ottemperare alle eventuali raccomandazioni richieste dal CESP e a darne comunicazione per iscritto.

Data_____24/06/2013_____ .

Firma del Responsabile del Progetto _____ .

UNIVERSITÀ DEGLI STUDI
DI TRENTO

PARERE del COMITATO ETICO
PER LA SPERIMENTAZIONE CON L'ESSERE VIVENTE

DATA   **03 luglio 2013**
SEDE   **Sala Riunioni - I piano - Via Belenzani, 12 – Trento**
N. ordine del giorno   **4 (odg composizione ordinaria)**

PROTOCOLLO N°   **2013-016**

Sono presenti alla deliberazione:

BRANZ Fabio	Componente	P
CASONATO Carlo	Vice-presidente che presiede	P
CORRADINI Flavio	Componente	P
CUBELLI Roberto	Componente	AG
DENTI Michela Alessandra	Componente	P
MALHERBE Jean François	Componente	AG
MARSICO Gaia	Componente	P
ROCCHETTI Loreta	Presidente	AG
ZAPPATERRA Fabrizio	Componente	P

Protocollo 2013-016
Titolo: **"Studio longitudinale sulla reminiscenza assistita dalla Tecnologia dell'Informazione (IT)"**
Responsabile: **dott. Cristhian Parra**

Il Comitato Etico per la sperimentazione con l'essere vivente, dopo aver esaminato la documentazione relativa allo studio in oggetto, esprime all'unanimità, il seguente parere:
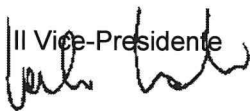
parere di approvazione, con la richiesta di apportare le modifiche e integrazioni come di seguito indicato:

Considerazioni generali: verificare l'opportunità della presenza/affiancamento di uno psicologo per gestire l'effetto della reminiscenza sui partecipanti, l'aumento/diminuzione del loro benessere e l'eventuale insorgere di reazioni negative e/o drammatiche.
Poiché allo studio partecipano sia gli anziani sia i giovani di conseguenza anche il foglio informativo deve tenerne conto.
- punti 3.1 e 3.3 aggiungere gli adulti (i giovani)
- foglio informativo (Modulo di consenso informato): precisare meglio in che cosa consiste la partecipazione per gli anziani e per i giovani; utilizzare termini comprensibili; prevedere che potrebbero esserci reazioni di disagio.

Il Vice-Presidente

Il Segretario

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