The Connective Power of Reminiscence

Designing a Reminiscence-based Tool to Increase Social Interactions in Residential Care

Francisco José Ibarra Cáceres

Advisor: Prof. Fabio Casati

Co-Advisor: Prof. Luca Cernuzzi

Department of Information Engineering and Computer Science
University of Trento

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To my mother

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Abstract

Reminiscence powers therapeutic interventions such as Life review and Reminiscence therapy, with well known positive outcomes on the wellbeing of older adults. In particular, reminiscence therapy supported by technology can increase self-esteem, facilitate social interactions and increase opportunities for conversation. Much research on reminiscence technology has in fact focused on improving interactions and conversation, mainly for people with dementia. Nonetheless, the potential for reminiscence to discover common life points among residents in residential care facilities and especially to use this information to foster bonding between residents has been little explored. The focus of this thesis is to design a reminiscence-based tool, to be used in nursing homes to stimulate interactions among older adults, family members, and nursing home staff.

We start by describing early work that reinforces the potential of ICT interventions on improving the wellbeing of older adults. These studies highlight the importance of social interactions on social wellbeing and of doing activities together in engagement and motivation. Through review works and exploratory studies we confirm the positive effects of social interaction on the wellbeing of older adults, the benefits associated to contributing, and the opportunities to improve social interactions, not only from distance but also in co-located settings.

In nursing homes we find a context that requires improving social interactions, and in reminiscence we find an ideal activity to make contributors out of older adults, stimulate conversation, and possibly increase connectedness between older adults and their networks. A series of studies were conducted with nursing homes stakeholders to define and design a tool suitable to their current practices, that could be used and adopted in nursing homes to stimulate co-located interactions.

In this thesis, we present the work carried out to define and validate and concept of a reminiscence-based tool, and describe how input from nursing home stakeholders has been integrated into the design of a tool to improve social interactions in residential care facilities.

Keywords: Older adults, Reminiscence, Loneliness, Social isolation, Social interactions, Co-located interactions

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Chapter 1

Introduction

Reminiscence is "the act or process of recalling or recounting a past experience; the event recalled or recounted, or something that reminds one of a past experience" [42]. We can all relate to this small, sometimes involuntary act, in some way: through the anecdotes shared with friends, the nostalgia produced when listening to a song, the memories that emerge by looking at a picture. Reminiscence is, indeed, common at all ages [172]. Nonetheless, it was Butler, in his seminal work on *Life review* [28], who indicated the particular importance of reminiscence in later life. Butler conceived Life review as "a naturally-occurring universal mental process", a process that could explain the tendency of older adults to reminisce more often, due to the proximity of the end of life and the time allowed for self-reflection after retirement. The work of Butler opened the doors for life review as a therapeutic intervention [1] and inspired research on reminiscence for the years to come [175].

Webster identified eight functions of reminiscence, based on the input from over 150 participants in two pilot studies for generation and validation of reasons why participants themselves and other people reminisce, as well as previous work in the field. These functions are: death preparation, identity, problem solving, teach and inform, conversation, boredom reduction, bitterness revival and intimacy maintenance [171]. Evidence of such functions have been later supported by years of research. Reminiscence therapy has been used for older adults with dementia [44, 154] and depression [21, 75], showing positive outcomes on mood, wellbeing and cognitive function, as well as a decrease in depression. Further benefits of reminiscence include creating connections between people and giving meaning to one's own life [175]. In particular, reminiscence therapy supported by technology has been used to increase self-esteem and facilitate social interactions, leading to more opportunities for conversation and less barriers due to motor impairments in the use of technology facilitated media [101].

The aforementioned benefits of reminiscence are the foundations of this work, and specifically that of stimulating social interactions through technology, our goal and focus.

1.1 Motivation

The first steps of this work were inspired by the widely spread initiative of the World Health organization named Active Ageing [182], which calls for "optimizing opportunities for health, participation and security in order to enhance the quality of life as people age". The Active Ageing framework defines seven factors or *determinants* that influence the process of ageing: culture and gender, health and social service systems, physical environment, as well as social (e.g. education), personal (e.g. genetics), economical (e.g income) and behavioral determinants (e.g. physical activity). Since the Active Ageing framework was issued in 2002, there has been extensive work leveraging on technologies for the improvement of the determinants mentioned above. For instance, pervasive computing and ambient assisted living are examples of ICTs used to support independent living, mobility and social participation [150]. Work by Parra et al. [132] further evidences the amount of ICT applications focused on Active Ageing, more specifically within the four goals of gerontechnology (prevention, compensation, care and enhancement) [67]. Parra et al. found alerting and monitoring applications, assistive technology, serious games, and communication and social applications to be the most popular type of applications. These are just examples of how technology has been and is leveraged to improve the quality of life of older adults.

Our early work was motivated by the potential that technology showed on improving the quality of life of older adults and by the well known benefits of physical activity. In particular, structured exercises, which have been linked to improvements on the physical, social and mental wellbeing of older adults [151]. Despite this fact, physical inactivity is common in older adults [68]. This is many times explained by the difficulty in accessing facilities, and the reduced functional abilities or low motivation exhibited by older adults [10, 145].

In response to these challenges, we devised and developed a tablet-based web application, called Gymcentral, which allowed older adults to train remotely from home by following video instructions of exercises. The application consisted on a virtual environment representing a fitness club, where older adults could meet, train and interact sharing the same virtual space. The Gymcentral application and the studies conducted are presented in detail in Chapter 2.

In short, two groups of older adult participants completed an eight-week training program entirely from home. Two versions of the application were tested, one on each group. One version, assigned to the social condition, included social and individual persuasion features

(e.g. simulated co-presence, messaging features), while the other version for the control condition, allowed for remote training but did not include the social or individual persuasion features.

A clear message emerging from the Gymcentral studies is that creating the opportunity and context to perform activities *together*, even remotely and in a virtual environment, can increase the engagement of older adult participants. This is reflected by the higher participation in the social condition, and the appreciation of social features such as simulated co-presence and inviting others to train.

Another important finding was the positive effect of social interactions over loneliness, even in a period as short as eight weeks [12]. However, considering the low number of private messages between participants, we must note that merely sharing context and activities is not enough to make participants connect. We observed some evidence of efforts towards community building in the form of public messages, but these did not suffice to create bonding or friendship, at least during the period of the study.

In light of these findings, we set out to explore different research directions by reviewing the related literature and current solutions. First, on the possibility to expand online activities to include others (although less physically demanding) that allow older adults to contribute. We believe this kind of activities might increase engagement and create more opportunities for social interactions. Second, on the current evidence on the effects of online interactions over loneliness and social isolation for older adults.

A third study was motivated by the fact that participants from the Gymcentral studies did not connect, as well as by early findings from the loneliness review (namely, the interest shown by older adults on intergenerational communications; see section 4.3.4). In this study we analyze the relationship between social interactions, connectedness and common life points. We include participants from age 18, to explore intergenerational interactions.

As we will show in Chapters 3 and 4, this led us to identify reminiscence as a potential activity. Our review on the literature and solutions tells us that despite the positive outlook for online activities and interactions by older adults, the evidence on true impact on wellbeing deriving from the use of these two is still scant. As a result, we looked for a problem space where technology would have a more supporting role and where it could help to enhance activities and interactions, even if the context of use was not fully online.

1.2 Refining the problem space

One of the main motivations to develop a home-based training application was to enable physical training for older adults who have mobility issues and therefore cannot leave home.

Old age has been in fact identified as a common risk factor for mobility impairment [38], which increases the relevance of home-based solutions for older adults. For this reason, along with the beneficial effects of social interaction [60], we considered that leveraging on technologies enabling remote contribution (online activities) and communication (online interactions) would have greater impact on the wellbeing of older adults.

However, our research on related work has shown that there have been very few studies on technologies that support remote contribution by older adults (see Chapter 3) and on the effect of interventions enabling remote communication to reduce loneliness and social isolation in old age (see Chapter 4). Therefore, there is not enough evidence to support a potential solution that relies solely on enabling remote contributions and communications.

Nonetheless, we have learned some important lessons from the related work. On solutions enabling remote contribution, we have found that:

- Social interactions occurring during contribution activities (i.e. volunteering) are a strong motivational element, the positive effects on wellbeing that such activities produce are in part due to these same social interactions [126].
- For older adults, having a sense of purpose and feeling that their contribution is important are main motivators [39, 94, 125].
- A lack of ICT skills and usability issues prevent older adults to use online contribution sites by themselves, sometimes requiring the help of others [95].

On interventions enabling remote communication, we have learned that:

- Intergenerational communication, especially with grandchildren, is an important source of motivation and enjoyment for older adults [20, 156, 176].
- Few studies have designed solutions specifically for older adults. Studies have focused on training older adults to use technology, rather than on developing solutions that directly address the barriers for social interaction.
- There is little work on designing technologies that help to initiate and sustain social interactions (e.g. by providing contextual information, suggesting conversation topics, revealing shared interests).

We also gained some interesting insights from our study on social interactions, connectedness and common life points (see Chapter 5), suggesting that:

- People interacting more frequently have higher levels of connectedness among each other. The same applies to those who have more common life points.

- The more aspects one shares, the more frequent the online interactions are – especially when there are common interests and when people engage in joint activities.

This tells us is that common life points could be used to increase social interactions, and consequently connectedness among people. Our review studies indicate that activities for contribution can bring opportunities for social interaction as well. However, it is important to keep in mind that older adults should be at the center of such activities, making clear that their help and participation is important and necessary. Our research tells us that in doing so, we could increase the engagement of older adults. We also found interactions with young people to be a source of motivation. Therefore, activities that allow for collaboration with or contribution from younger people could work better to encourage and sustain participation from older adults.

With respect to technology, we found that there is an opportunity to design solutions that not only facilitate interactions, but that help to improve them. In addition, few solutions are designed considering the skills and needs of older adults. This, combined with the need for assistance in the use of ICTs indicates that a context that allows for co-located activities could increase the feasibility and adoption of such solution.

While originally our intent was to design a tool to be used independently at home, our research on the state of the art made us reconsider this initial setting. Mainly, the lack of strong evidence to support the effect of remote interactions over loneliness and social isolation. Considering the opportunities identified to help initiate and sustain social interactions, a solution aiming to improve (not necessarily remote) social interactions in a context where peers can be reached more easily, might achieve a bigger impact on the social wellbeing of older adults. We found a similar context in nursing homes, since for older adults living in residential care facilities this place can effectively become home [24], and for many of them functional decline, disability, and frailty are common [162]. Moreover, loneliness is still common in nursing homes [159, 161], despite older adults living in the company of others.

To design a solution aiming to improve social interactions, nursing homes appear to be a more suitable context. The presence of peers and staff can be leveraged to improve social interactions in place, staff could assist older adults in the use of technology and we could analyse whether some of the findings from our previous studies, such as the increase of connectedness among people due to having more interactions and more common life points, apply in this context. However, this new context brings additional challenges which require further understanding and consideration.

1.3 Nursing homes as a setting

Acceptance and adaptation to nursing home life, as well as connectedness are among the key factors affecting the quality of life of older adults in residential care. While having peers among residents can improve acceptance and lead to friendship, the lack of peers can increase loneliness, boredom and deteriorate self-identity [24]. In fact, loneliness, boredom and helplessness are considered the "three plagues" of nursing home life [161]. Loneliness and depression continue to be an issue in residential care facilities, despite efforts such as entertainment and social activities [159], with residents themselves reporting about the "difficulty to form appropriate relationships with others" [24].

Exploratory studies from our research group [11] reinforce the reports found in the literature. From a series of visits to nursing homes in northern Italy as well as focus groups with the relatives of residents and members of the nursing home staff, we take that:

- It is hard for residents to establish friendship relationships in the nursing home. This difficulty is aggravated by the fact that many residents are not there by their own choice and their points of view differ from those of other nursing home residents with whom they now have to live.
- Visits from grandchildren are rare. This, despite efforts by other family members to involve the younger members of their family.

On the other hand, we have also found some positive aspects:

- There is usually a primary caregiver (children of the residents mostly) who often visits and spends time with his/her older adult relative in the nursing home. Such visits have a positive effect on connectedness for nursing home residents [24, 61].
- Activities to promote social interactions are common in nursing homes. We take particular interest in reminiscence related activities, such as the collection of biographical information, storytelling and community initiatives that aim to gather and keep stories from the past.

These observations helped to clearly define our research goals:

1. **To improve social interactions in nursing homes**. We specifically target loneliness and connectedness, aiming to improve social interactions among nursing home residents (potentially leading to friendship formation) and with family members (especially grandchildren, who are the less involved but a source of joy for older adults).

2. **To facilitate reminiscence activities**. We specifically target boredom and sense of purpose. Our intent is to leverage on current nursing home practices and visits from primary caregivers. Helping older adults reminisce on their own life stories, puts them at the center of the activity and strengthen the importance of their contribution. Our hope is also to make visits more enjoyable for family members and to increase older adults' sense of purpose by making them put their lives in perspective, reflect and appreciate their life stories.

Our objective is then to design a reminiscence-based tool to improve social interactions within nursing homes. We conceive this tool as an instrument to support co-located interactions with members of the staff or visiting relatives, by collecting stories from old pictures and allowing to revisit stories later. These same stories could be used to find common life points among nursing home residents and by evidencing them, act as an aid to initiate conversation and potentially contribute towards friendship formation. In addition, we believe that sharing stories in social networks among family members who do not visit (especially grandchildren), can stimulate remote social interactions and increase connectedness.

In order to build such a tool, we pose the following research questions:

TRQ1. Can we define a process that leverages on reminiscence to stimulate conversation?

TRQ2. Is such a process feasible within the nursing home context and adoptable by its stakeholders?

TRQ3. Which kind of uses and contributions can we expect from nursing home stakeholders?

TRQ4. What are designs that facilitate co-located interactions and stimulate conversation?

1.4 Methods and thesis structure

The work presented here is in large part based on research publications conducted during the years of the doctoral studies. For clarity, we will include the citations to these publications. Below, we present the methods followed during our research work, indicated as these are structured in the book.

Chapter 2. Early work: The Gymcentral studies

A summary of the different studies run using Gymcentral, an application to support home-based training by older adults. These studies aimed at assessing: the effectiveness of persuasion strategies to motivate training [53]; the effect of a virtual, social training setting in social interactions [13]; as well as the physical, psychological and social wellbeing outcomes that resulted from training [12]. We focus on the results of these studies that motivated the research described in this book.

The content of this chapter integrates the studies published as:
Baez, M., Far, I. K., Ibarra, F., Ferron, M., Didino, D., and Casati, F. (2017). Effects of online group exercises for older adults on physical, psychological and social wellbeing: a randomized pilot trial. *PeerJ*, 5:e3150 [12].

Baez, M., Ibarra, F., Far, I. K., Ferron, M., and Casati, F. (2016). Online group exercises for older adults of different physical abilities. In *2016 International Conference on Collaboration Technologies and Systems (CTS)*, pages 524–533 [13].

Far, I. K., Ferron, M., Ibarra, F., Baez, M., Tranquillini, S., Casati, F., and Doppio, N. (2015). The interplay of physical and social wellbeing in older adults: investigating the relationship between physical training and social interactions with virtual social environments. *PeerJ Computer Science*, 1:e30 [53].

Another publication related to the content of this chapter is:
Ibarra, F., Cernuzzi, L., Casati, F., and Baez, M. (2014). Virtual Social Gym: Plataforma Web para la Mejora de Actividad Física en Adultos Mayores. In *Memorias de las VI Jornadas AITADIS de Rehabilitación y Tecnologías de Apoyo a la Discapacidad 2014* [81].

Chapter 3. Tools enabling online contributions by older adults

A review on technologies to help older adults remain active in society – in particular, those who cannot leave their homes regularly or easily.

The content of this chapter has been published as: Ibarra, F., Korovina, O., Baez, M., Casati, F., Marchese, M., Cernuzzi, L., and Barysheva, G. A. (2016). Tools enabling online contributions by older adults. *IEEE Internet Computing*, 20(5):58–65 [83]. The final publication is available at IEEE Internet Computing via https://doi.org/10.1109/MIC.2016.20.

Chapter 4. Interventions to reduce loneliness in old age

A systematic literature review on technology-supported interventions to help older adults, living in situations of reduced mobility, overcome loneliness and social isolation. The focus is on remote interactions.

Chapter 5. What Makes People Bond?: Social Interactions and Common Life Points

An online survey run on Facebook using profile and interactions information to understand the relationships between connectedness, social interactions and common life points. A broad age range (starting from 18 years old) is explored to analyze intergenerational interaction and possible applications for technology to reduce social isolation.

The content of this chapter has been published as: Sanchiz, E., Ibarra, F., Nikitina, S., Báez, M., and Casati, F. (2016). What makes people bond?: A study on social interactions and common life points on Facebook. In *2016 International Conference on Collaboration Technologies and Systems (CTS)*, pages 26–30 [144].

Chapter 6. Stimulating Conversations through Technology

A series of studies that led to the concept development of our reminiscence-based tool. We explore the needs and challenges of nursing home stakeholders, with particular attention to current practices from relatives and nursing home staff.

The content of this chapter has been published as: Ibarra, F., Baez, M., Fiore, F., and Casati, F. (2017). Stimulating conversations in residential care through technology-mediated reminiscence. In Bernhaupt, R., Dalvi, G., Joshi, A., K. Balkrishan, D., O'Neill, J., and Winckler, M., editors, *Human-Computer Interaction – INTERACT 2017*, pages 62–71, Cham. Springer International Publishing [79]. The final publication is available at Springer via https://doi.org/10.1007/978-3-319-67687-6_5.

Chapter 7. Design Challenges for Reconnecting

A qualitative study analyzing reconnection —finding out about or re-contacting old friends. This study connects to reminiscence by exploring past, lost friendships. We investigate whether older adults have a wish to reconnect and which are the challenges for those who tried to do so.

Part of the content of this chapter has been accepted for publication as: Ibarra, F., Kowalik, G., Baez, M., Nielek, R., Lau, N., Cernuzzi, L. and Casati, F. (2018). Design Challenges for Reconnecting in Later Life: A Qualitative Study. In *Proceedings of the*

2018 ACM Conference Companion Publication on Designing Interactive Systems, DIS '18 Companion. ACM [84].

Chapter 8. A reminiscence-based tool to improve interactions

Building on the concept developed for our reminiscence-based tool, we conduct validation studies with nursing home stakeholders, considering opportunities and challenges for the use of the tool. In addition, we pilot reminiscence-sessions to validate the crucial step of data collection. We derive a workflow for the use of the tool and social interaction models.

Part of the content of this chapter has been accepted for publication as: Ibarra, F., Baez, M., Fiore, F., and Casati, F. (2018). Designing for Co-located and Virtual Social Interactions in Residential Care. In *Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*, DIS '18 Companion. ACM [80].

Chapter 9. Collegamenti: The design of a tool for co-located reminiscence

Design studies presenting stakeholders with prototypes to evaluate interface and feature alternatives for the collection and browsing of stories. These studies inform design recommendations for co-located reminiscence activities and determined the architecture and conceptual model of our reminiscence-based tool.

Chapter 10. Conclusions and future work

We close by summarizing the contributions of this work and connecting our results to the research questions of this thesis (TRQs). We comment on the limitations of this research and future work.

Part of the future work presented is discussed in:
Ibarra, F., Gantumur, Z., Baez, M., Shcheckotyn, E., Taran, E., Cernuzzi, L., Barysheva, G., and Casati, F. (2017). Efectos de compartir fotografías entre nietos y abuelos: Protocolo de un ensayo controlado y aleatorizado. *IX Congreso Iberoamericano de Tecnologías de Apoyo a la Discapacidad IBERDISCAP 2017* [82].

Chapter 2

Early work: The Gymcentral Studies

2.1 Introduction

The association between physical activity and positive effects in health and wellbeing in later age is well documented in research [151]. Physical activity reduces the risk of falls [160], slows the progression of degenerative diseases [153], and improves cognitive performance and mood in older adults [98]. On the other hand, sedentary behavior has been associated with mortality, risk of depression and adverse effects on the health and wellbeing of older adults [143, 158]. Moreover, by decreasing the participation in social activities older adults risk suffering social isolation. Social isolation has been associated with increased mortality rates, dementia, depression, and cognitive decline [22, 60, 72]; whereas engagement in social interactions is beneficial for the health and wellbeing of older adults [60].

However, despite the evidence of sedentary behavior being a serious health risk factor, physical inactivity is still prevalent in older adults [68]. This can be explained in part due to the many barriers that make maintaining or increasing levels of physical activity difficult for older adults: lack of easy access to facilities and infrastructures, reduced functional abilities and lack of motivation [10, 145].

In response to these challenges for engagement in both physical activities and social interactions, we proposed a home-based training application called Gymcentral, which incorporates the experience from years of research and development of home-based training applications from our research group [55, 54, 147, 148]. The development of our home-based training application is also informed by research work on virtual environments, home-based training and persuasion technologies. An analysis of the related work on these fields can be found in the studies [13, 12, 53] which this chapter summarizes.

In the following, we provide more details on the application, describe the study methods and present a summary of results relevant to the work presented in this thesis book.

2.2 Gymcentral applications

Gymcentral is designed to enable and motivate older adults to participate in physical training sessions from home, under the supervision of a human coach, and by using a tablet device. The application for the trainees, namely the Trainee App, leverages on social support, in the form of social presence during training sessions, and online and offline social interactions to motivate older adults to meet, interact and exercise. An application for the coach, the Coach App, allows the expert to personalize, monitor and provide support to the trainees during the training program.

2.2.1 The trainee app

The design of the application for trainees is based on a virtual environment that mimics the spaces and services found in a real gym. The most relevant components of the application are:

- Virtual environments, represented by the locker room and classroom where trainees can see other peers represented by avatars, thus simulating co-presence during training.
- Messaging, in the form of a bulletin board for public messages, visible to all trainees; private messages, for one-to-one conversation with training peers or the coach; and real-time predefined messages (e.g. "Hi", "Let's train together") available for short interactions in the locker room.
- Individual and social persuasion strategies, such as progress report (including a growing garden metaphor), automatic posts notifying on the completion of a training session by any participant, and invitations to train.

2.2.2 The coach app

The Coach application is designed to enable the human coach to start, manage and monitor the execution of home-based training programs. The system incorporates a human expert in the entire coaching process by allowing the coach to:

- Define the exercise program, including video exercises, performance indicators and intensity levels;
- Assign intensity levels (associated to the exercise program) to trainees, according to an initial physical assessment. This makes it possible for older adults of different abilities to follow the training program together;

- Tailor the exercise program continuously to match the progress of the individual trainees, or to prevent adverse events (e.g. stop an exercise if a trainee experiences pain when performing it);
- Provide support and feedback, communicating suggestions or answering questions via the messaging features.
- Monitor the performance of the trainees, by looking at the performance indicators defined for the training program. The indicators can be collected via self-reports, computed automatically by the trainee app (e.g., completeness, participation) or collected from sensors.

The Trainee and Coach applications work together to offer a personalized training program to participants training from home. The workflow involving the two applications is shown in Figure 2.1

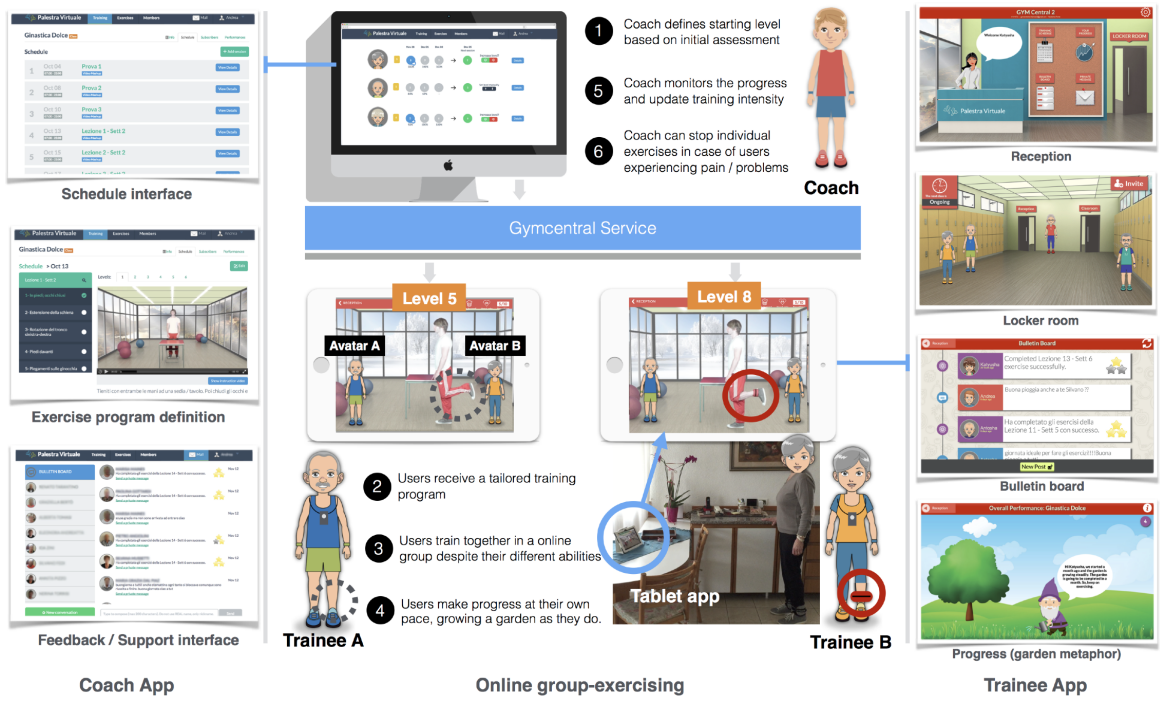

Fig. 2.1 The Trainee and Coach applications working together. The workflow steps are indicated and numbered in the black circles.

2.3 Methods

We considered eligible for the study participants aged 65 or older, independent-living, self-sufficient and with a non-frail, transitionally frail or a mild frailty level. The latter was measured using the Groningen Frailty Indicator (GFI [152]), considering eligible those participants scoring lower than 7 in the scale from zero (not frail) to fifteen (very frail). Participants wearing pacemakers were not considered eligible, since the study required the use of a mobility sensor, as well as participants not able to undergo the exercise program according to their family doctor. Before starting the exercise program, all participants underwent physical assessment with a personal trainer, in order to allow for personal tailoring of exercise type and intensity, and to personalize the starting level of each participant.

We recruited participants through members of local associations that promote initiatives for elderly persons in Trento, Italy. We sent invitations to the 70 persons that visited the associations more recently. Out of these, 10 persons declined the invitation, 6 were excluded because they lived in an area without 3G or LTE coverage, and 14 did not meet the frailty criteria. In the end, a total of 40 participants between 65 and 87 years old were recruited for the study (29 females and 11 males, mean age = 71, s.d. = 5.7). All participants obtained a formal written approval by their family doctor to allow them to participate in the study. Both doctors and participants received a written outline and explanation of the study and signed the consent before participating.

From the initial group of participants, four older adults withdrew at different times during the course of the study due to unpredictable health or family problems. One participant was substituted because the withdrawal occurred before the beginning of the study, while the others could not be replaced since they withdrew during the course of the study. For this reason, the results are based on the data from 37 participants (28 females and 9 males, age range = 65-87, mean age = 71.2, s.d. = 5.8).

Participants were assigned to the experimental (social) condition and to the control condition using a matched random assignment procedure [118, 177]. This technique is particularly useful to help ensure that different groups are equivalent on one or more characteristics prior to treatment. The variables used in the random assignment were age and frailty level of participants. Pre-test analysis of age, frailty, and self-reported physical activity measured with the *Rapid Assessment of Physical Activity questionnaire* [163] did not reveal significant differences between the social and the control group.

In the social condition, participants received a version of the Trainee App that included the virtual social environment, the progress metaphor and the home-based exercise program. In the control condition, participants received a version of the application that focused only on the home-based program without social or individual persuasion features, most notably

the messaging features and the simulation of co-presence during training were missing. Participants were not told which group they were assigned to or that a different version of the application was being tested. We illustrate the difference in the participation to training sessions in Figure 2.2.

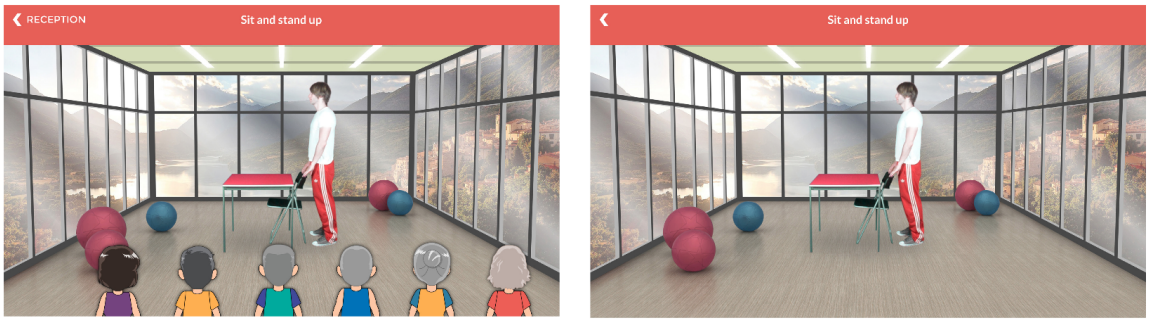

Fig. 2.2 Training sessions as seen in the social condition (left) and control condition (right). Simulated co-presence during training was not enabled for the control condition.

All participants received a 10.1-inch Sony Xperia tablet with Wi-Fi and 3G support, the user guide including the names and telephone numbers of the support team, and instructions about the use of the tablet and the application, one pair of ankle weights to perform the exercises and a folder to allow the vertical positioning of the tablet. Prior to the intervention, three training modules ($\sim$1.5 h each) were offered to the participants. The first two modules regarded the use of the tablet and its main applications, while the third focused on the usage of the Gymcentral application. In this case, control group and social group received appropriate training, based on the features of their application. All participants took part in the lessons. Individual lessons were also organized for those who had questions, and community managers were available on selected days at the associations for participants who had further questions/doubts.

The first week of the study was devoted to technical deployment and application testing, followed by eight weeks of training and one week of post-training measurements. The intervention is based on the OTAGO Exercise Program for fall prevention [63], and consisted of 10 levels of increasing difficulty. The program includes simple exercises based on functional everyday movements that could be safely executed at home (e.g. side hip strengthening exercise, backwards walking for balance). The duration of the exercise sessions ranged from 30 to 40 min, with sessions lasting longer in higher levels.

Participants from both groups were assigned an initial level by the Coach based on the pre-test analysis. During the exercise program, participants were asked to perform at least two exercise sessions per week. They could gradually progress in intensity during the program. In both social and control groups, progression was gradually suggested every week.

If participants agreed to level-up, the following level was unlocked, requiring a confirmation from the personal trainer in the case of the social group.

Every week, the coach was expected to advance trainees in the exercise program (level-up) and give them feedback, or alternatively, upon direct contact from the trainees. In the social group the feedback and support were done within the app via messaging features, while in the control group, they were done by telephone contact due to the absence of social features in that condition.

Through a series of studies supported by the Gymcentral application, we analyzed: the effectiveness of the persuasive strategies included to motivate training [53], the effect of the training setting in social interactions [13], as well as the physical, psychological and social wellbeing outcomes [12].

2.4 Results

In the following section we only report results relevant within the scope of this dissertation. The specific measurement instruments and outcomes are described in detail in each of the studies used to build this chapter [12, 13, 53].

2.4.1 Adherence

Adherence to the exercise program was computed through usage patterns data, collected from the application logs for both the control and social group. To explore the adherence patterns, two measures were considered for each participant: (i) persistence throughout the eight weeks of the exercise program, and (ii) level of completeness of the exercise sessions.

With respect to persistence, a total number of 24 sessions were planned during the eight weeks of the study (3 sessions per week). In order for the exercise program to succeed, participants were asked to carry out at least two of the three sessions that were planned each week. To calculate persistence, the total number of exercise sessions in which each participant took part was divided by 24, the total number of possible training sessions during the period of the study. The general persistence rate in the two groups was 76% (SD = 22.6%). More specifically, in the social group the persistence rate was 85%, while in the control group it was 64%. A t-test for independent samples, used to analyse the difference in persistence during the training program between groups, showed that the social group had a significantly higher persistence rate (M = 85.4%, SD = 16.1%) compared to the persistence rate of the control group (M = 64.2%, SD = 24.1%, $t(35) = 3.18$, $p = .003$).

Indeed, grouping the participation by week, distributing the users by number of participations (1, 2 and 3), we notice that participants of the social group did not only comply with the coach instructions (at least two sessions per week), but did more. This indicates that the various features of Gymcentral were more engaging than the simple app.

The second measure related to adherence is the completeness rate, which refers to the extent to which participants tend to complete all the exercises included in a working session once they have begun to work out. The completeness rate in the social group was slightly higher compared to that of the control group, although it was not statistically significant (respectively, M = 91.75%, SD = 12.46% for the social group, and M = 88.63%, SD = 22.24% for the control group).

2.4.2 Social facilitation

A total of 669 participations to the training sessions were registered in the social group, for the 20 participants, and 451 for the 17 participants in the control group. The co-presence in the social group was of 71.86% (SD = 12.53%). In the control group instead, the co-presence was of 36.52% (SD = 21.92%). In the latter case, co-presence represents the meet-ups by chance as users were not aware of each other.

A t-test for independent samples reveals a significant difference between the social and the control group ($t(35) = 6.14$, $p < .001$). However, to compensate the effect of a higher number of participants in the social group and to get a conservative estimate, we excluded the three most active participants from the social group along with all their data, and analysed co-presence in this new condition. The difference is still significant, with a co-presence of 62.68% for the remaining 17 participants of the social group, compared to the 36.52% of the control group ($t(32) = 3.90$, $p < .001$). This result suggests that participants in the social group were motivated to join the sessions at the same time.

2.4.3 Use and perceived usefulness

We asked participants of the social group - which were assigned the full-featured version of the app - to report on the usage and perceived usefulness of the features of Gymcentral. To analyse usefulness by feature we provided a short questionnaire [1], asking participants to report on a 5-point Likert scale how useful they thought each feature was. The results are illustrated in Figure 2.3.

Features instrumental to the training were naturally experienced by most of the trainees, and these include *exercising in the classroom* and *checking the schedule*. What is interesting

[1] Available at: https://goo.gl/zl7daL

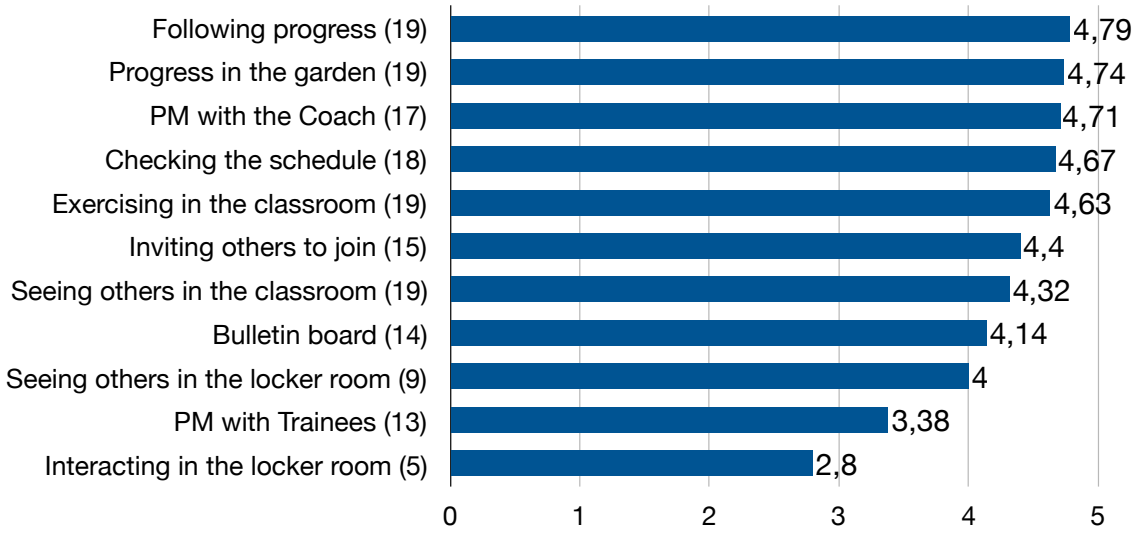

Fig. 2.3 Perceived usefulness of each of the features. The number of users that experimented the feature is indicated in parentheses. ©2016 IEEE.

is that *training in company* was also experienced by most trainees. Together, these features enabling the group training were highly regarded by trainees.

Persuasion features were also among the most experienced and valued. This includes, *following the progress* and visualising their own *progress in the garden* and, still very positive but to a lesser extent, *inviting others to join* a training session.

Social interaction features received mixed results. The most useful and experienced feature was private *messaging with the Coach*, followed by the public messages in the *bulletin board*. Interestingly, *private messages with other trainees* were perceived as less useful, indicating a higher preference of trainees for interaction with the entire group rather than individually.

While the social *presence in the classroom* was highly rated, participants regarded the features present in the *locker room* among the least useful. The locker room was designed as a place for trainees to meet and socialise before starting a training session. They would invite others, wait for them before starting the session, and in the meantime interact via predefined real-time messages. In practice, the user behaviour was different. The application logs show that users were not waiting for others in the locker room after sending their invitations, instead they would go directly to the classroom and wait there for others to join.

2.4.4 Positive and negative aspects

When asked which aspects were the most fun and motivating, the topics that dominated the feedback from the control group were the possibility of training from home (“Being able to exercise at any time, and from my living room”), personal satisfaction (“Satisfaction of performing the exercises every day”) and discipline (“The personal commitment to perform the exercises”). Interestingly, one participant reported the physical meetings as the most fun part (“The meetings with the project organisers”). In the social group the dominant aspect was the social features, with participants citing the possibility of exercising with others (“Feeling that you’re training with others and followed by the Coach”), being invited to join (“Being invited to exercise in the virtual gym”), and messaging with other participants and the Coach (“Very nice to find messages in the bulletin board”). As in the previous group, one participant reported also the initial meetings as one of the highlights.

On the other hand, when participants were asked which aspect they liked the least, both groups reported the same negative aspects regarding the experience. The dominant aspect was the problems with the application, which were due to Internet connectivity issues in some areas of the city (“When [the training] was not loading”). We highlight the feedback from one participant of the social group, who reported to have gone to a friend’s house to use Internet (“The tablet was not working at home, so I had to go to a friend’s house to exercise”). Another issue reported was the monotony of exercises (“I’ve found the exercises repetitive”) which is probably related to the long-term nature of the training.

2.4.5 Analysis of social interactions

Private messages (411) were preferred over the bulletin board (133 messages). To better understand the type of messages exchanged, a manual classification was done. A 20% random sample of all messages was coded manually into top-categories (community building, the Gymcentral app, physical activity, self-disclosure, other) and sub-categories. See [13] for a detailed explanation about the coding procedure and the categories used.

The bulletin board was used mainly to promote community building, in particular togetherness. Participants had an active role, they posted greeting messages (e.g. “Good morning every- body!”) and used a humorous tone in the conversation (e.g. “You are a little crazy”). The bulletin board was also used to publicly thank the Coach and other participants for their help or invitations to train together. To a lesser extent, the Coach contributed to community building by welcoming and greeting participants (e.g. “Have a nice start of the week everybody!”).

The talk about physical activity was centred in congratulating and offering support for the training. In particular, the Coach was very active, encouraging participants to attend to the training sessions, and congratulating them for their performance and the level-up requests (e.g. “Well done everybody... many of you wrote me... to level-up”).

The messages regarding the Gymcentral application were mostly about technical issues. The technician used the bulletin board to broadcast advice and information on these issues. At certain points during the study, participants experienced slow connection problems that compromised the proper functioning of the application, especially the streaming of exercise videos. However, there were also positive comments about the application and the garden metaphor (e.g. “Oh! A bright butterfly appeared in the garden, wonderful, thank you!”).

The private messages were mostly about the Gymcentral application. As in the bulletin board, almost half of the messages about the application were directed to the technician and the Coach to report technical issues or the inability to train because of connection problems. Participants also exchanged some positive notes about the application.

Considering the messages of community building, we can observe that, similarly to the bulletin board, participants promoted a sense of togetherness, but the messages were more personal than the ones in the bulletin board (e.g. “How are you?”, ” ...we missed you”). The more intimate nature of this channel was also used for self-disclosure. Participants talked about their lives outside of the virtual gym, even engaging in conversation with the Coach and the community manager.

In contrast to the bulletin board, when discussing physical activity, participants did not use the private messages to congratulate and support each other. Instead, participants talked about their personal experience with the exercise, and in particular talked to the coach and asked for advice.

2.4.6 Social wellbeing

The effects of the technology-based intervention on the social wellbeing was assessed on the basis of participants’ feedback, collected at the beginning and at the end of the study using a measure of loneliness. To measure loneliness we used a shorter version of the R-UCLA Loneliness Scale (revised version of the UCLA Loneliness Scale developed by University of California, Los Angeles) developed by Hughes et al. (2004) [76]. The scale used includes 3 items scored on a 5-point Likert scale, with the total score ranging from 3 to 15, and higher scores indicating higher levels of loneliness.

We used the median value (i.e., 5) to dichotomise the variable loneliness into “Low” (respondents with less than or equal to median loneliness score) and “High” (respondents with more than median loneliness score). This binary variable is analyzed by means of a

logistic regression with group (control vs. social), time (pre- vs. post- measurement), and persistence as factors. The model includes also the interaction effect of time with both groups and persistence. In the logistic regression, “High” is used as reference level of the dependent variable. In order to interpret significant interactions, we run a post-hoc t-test corrected with Bonferroni.

In the logistic regression performed on the loneliness score, only the factor time was significant in improving (reducing) loneliness (B = 1.121, OR = 3.068, 95% CI [1.177–8.380], p = .024). To investigate the extent of the improvement according to the initial loneliness score (t1) we also tested the interaction between that initial score (grouped in three equally distributed intervals: Low, Medium, High) and time. Although the interaction is not statistically significant we observed a stronger trend for higher initial levels of loneliness. These results suggest that, overall, the perception of loneliness significantly decreased after the training, regardless of the group and adherence to the training. We attribute this effect to the attention given by the Coach to both groups.

To investigate if the use of social features predicts the improvement in the loneliness score for the social group, we performed a correlation test (with Spearman method) using the number of private and public messages as predictors. For private messages we took message received, as the exchanges were nearly symmetrical. The results show that the number of messages received is significantly correlated with the improvement in the loneliness scores (rho = –.635, p = .003). Public messages in the bulletin board, on the other hand, were not correlated (rho = –.244, p = .314).

Overall, the most important findings obtained in the Gymcentral studies can be summarised as follows:

- Participants in the social condition attended to more training sessions that those in the control condition, even participating in more sessions than the two weekly sessions recommended by the coach.
- Co-presence was higher in the social condition, as compared to chance encounters in the control condition (who were not able to see other participants).
- The possibility to train with other was reported as one of the most stimulating aspects by participants in the social condition.
- Participants highly regarded the social features of simulated co-presence ("seeing other in the classroom"), and to a lesser extent the possibility to invite others to train. Social features for interaction (Messaging) received mixed results.

- Private messages were preferred over public ones. The bulletin board was used mostly for community building (e.g. welcome messages, invitations and encouragement to train). Private messages were used for community building to a lesser extent, and more often used by the coach to offer support and encouragement.
- Social wellbeing, measured in terms of perceived loneliness, significantly decreased at the end of the training program for both groups. Participants in the control condition received weekly phone calls from the coach.
- The number of private messages received was significantly correlated to the loneliness scores, while public messages were not correlated.

2.5 Discussion

From the Gymcentral studies, we learned two important lessons that encourage us to explore new research directions.

First, we learned that doing activities along with other people motivates the participation of older adults. We have seen that given the opportunity to train together, older adults choose to do so. The possibility to train with other was in fact reported as one of the most stimulating aspects. Furthermore, participants in the social condition attended to more than the two training sessions recommended by the coach. This suggests that creating the context and providing the opportunity to perform activities together, even remotely and in virtual environments, can result in more engagement from older adults.

Second, social interactions led to a significant decrease in perception of loneliness. The effect of social interactions was very positive even if the eight-week training period is not such a long time. Nonetheless, this effect can be attributed to the contact with the coach, considering that both groups showed a decrease in loneliness and that there were few private messages among participants in the social condition. Results seem to indicate that remotely engaging in activities together is not enough to create bonding or friendship between participants. We did see some attempts to create community building in the public messages (e.g. jokes, messages of welcome or support) but these did not lead to connections between participants during the period of this study.

In subsequent chapters we will explore other activities that could involve working together and that could lead to social interactions. In addition, we will investigate the effect of remote interactions over loneliness by reviewing technology-supported interventions aimed at decreasing loneliness and social isolation in older adults.

Chapter 3

Tools enabling online contributions by older adults

3.1 Introduction

The physical and mental health benefits of having a productive role in society are well-documented in the literature [114, 126]. After retirement, older adults can experience social withdrawal and loss of identity and purpose, which are detrimental to their physical, psychological, and social wellbeing [121]. Engaging in productive activities after retirement, paid or not, has shown to be protective against these effects [114], with greater benefits in volunteering work for and by older adults [107].

However, volunteering (and societal contributions in general) present many challenges for older adults. First, age-related diseases and functional problems –such as visual impairments, depression, arthritis, respiratory and heart diseases, and mental disorders [184] – make contributing difficult (often simply because it is more difficult to get out and around, especially if the environment is poorly designed for accessibility): volunteers tend to be healthier and more integrated individuals [107]. Second, despite the benefits, motivation tends to drop over time: a study that followed volunteers over a decade showed that only six percent sustained continuous volunteering, while most adults volunteered once or never [180].

In this article, we review technologies that enable and facilitate the process of contributing to society in a sustained fashion. Given our focus on older adults, starting at age 60 (according to the World Health Organization [183]) and including those who cannot leave home, we concentrate on technology that enables contributions from home. Applications along these lines are abundant and highly successful (from volunteering sites to crowdsourcing sites), and constitute in principle a tremendous opportunity for enabling contributions by older adults at

home — especially as older adults are increasingly adopting new technologies and tools (such as tablets and online services); see elsewhere [132] for a systematic review on technologies for older adults. This, for the aforementioned reasons, would significantly impact societal well-being. However, as we will show, this opportunity rarely is made available to or exploited by older adults. Thus, here we focus our review on the analysis of online services, particularly volunteering and crowdsourcing sites, in terms of the contribution process, the online opportunities they offer, the type of motivational features they rely on, and more importantly, how they support older adults' work. We complement this analysis with current findings in the literature, to then highlight some gaps between research and practice.

3.2 Tools for online contribution

In an initial phase, we screened more than 200 volunteering and crowdsourcing services that provide paid and non-paid opportunities to work online. We searched for volunteering services through Google's search engine (http:// google.com) using the keywords "online volunteering," "volunteer online," "micro volunteering," and "online volunteering websites," and considered whether they appeared in the first four result pages — as both direct links or indirect links in online lists. Crowdsourcing services, on the other hand, were obtained from the curated list at crowdsourcing. org in the categories "cloud labor," "creativity," and "open innovation" (excluding categories such as crowdfunding and tools, to focus on productive activities), with the English language filter set.

From this list, we excluded platforms, software, and services that were either discontinued or crowd-based but did not offer an option to contribute online. As a result, we included a total of 99 services (49 volunteering, 50 crowdsourcing) listed at https://goo.gl/JZdFtK.

We analyze the tools and the literature based on this set of perspectives:

- *The role of technology in the social contribution process*. For example, technology might help in performing tasks online, in advertising volunteering projects, or in organizing and coordinating work online.
- *Types of online activities, such as the kind of work supported*. This is relevant because some activities are more beneficial and effective than others in terms of their contributions to older adults' health and well-being [114, 126].
- *Motivations and rewards, as they are correlated to the attachment to volunteering activities*. A comprehensive study by Wilson and Musick associates this attachment, among other contextual factors, to the resources older adults bring to these activities and the rewards obtained by participating [179].

- *User interaction with the technology*. We aim to study the possibility of older adults to contribute, including those physically and cognitively challenged. For this population, the interaction paradigms supported are critical to enable contributions [70].

As we discuss in the next sections, older adults enforce specific requirements to each of the aforementioned dimensions. However, lessons from design tell us that when designing for extreme groups, we are making our solutions available to a wider audience. Thus, we expect some of the findings to be equally applicable to the general population, though certainly more critical to our target audience.

3.3 The role of technology

Research on crowdsourcing has identified the following phases of the remote contribution process [164]:

- *matchmaking* (task publication and worker pre-selection), where both the work performer and work provider agree that the performer will do the task;
- *task execution*, where the worker performs the selected task;
- *validation*, where the work is assessed and accepted or rejected; and
- *reward*, where monetary or other kinds of rewards are given upon (successful) completion of the task.

As seen in our analysis, different tools support different phases of this process. General-purpose volunteering services, such as VolunteerMatch (www. volunteermatch.org), act as bridges between volunteers (or potential volunteers) and organizations, focusing mostly on the matchmaking phase (96%). Organizations use these sites to advertise initiatives and find those willing to collaborate who also have the required skills. VolunteerMatch facilitates this matching for older adults, which is particularly important given the fact that they are more likely than young adults to pass on opportunities they do not find "interesting and challenging [170]." Execution and validation are virtually not implemented (execution 4%, validation 0%). The rewards in these sites are implemented only by the 37 percent, due to the fact that the benefit is mostly in the well-being that helping others generates [26]. Volunteering services for a specific purpose, for example Distributed Proofreaders (www.pgdp.net), are much less flexible in terms of matchmaking but they have higher support in terms of execution (56%) and validation (36%).

Crowdsourcing services offer greater support for phases of the remote online contribution process (48 percent of services support three or more phases, against 12 percent for volunteering). In crowdsourcing, there are also both specific and general-purpose services to be found, although there is not a marked distinction in terms of supported phases. However, if we consider the categories given by our crowdsourcing directory, the execution phase has clearly a stronger support for open innovation (50%) than for labor (5%) services. The reason being that for the first type, someone can simply post ideas or suggestions, while crowd labor involves more challenging tasks. Services offering particularly challenging tasks, such as Innocentive (www.innocentive.com), still require the work to be completed out of the systems and submitted later. A surprising finding was that the support for task execution was lower in crowdsourcing services than in volunteering. Nonetheless, crowdsourcing applications allow the definition of specific and custom logic for worker selection and task validation to a greater extent, and the rewards are often in terms of money.

Finally, we mention that the task execution phase can be supported by a variety of tools intended for a completely different purpose — that of connecting people (such as video conferencing, email, or file-sharing applications). Examples include the video conferencing service Skype, which has been used to support a tutoring project involving retired schoolteachers and children [39], and more recently, the Speaking Exchange (www.cna.com.br/speakingexchange) program that also uses video conferencing to connect young Brazilians who want to improve their English skills, with native-speaking older adults.

Work regarding both applications and research studies of online remote contributions for older adults is scant, especially in terms of design, acceptance, and usage. Few applications for remote online contribution target the older adult population specifically — our review shows that only 14 percent of the services do so, and all of them are for volunteering and none are for crowdsourcing. In the literature, however, we find examples targeting older adults, including the tutoring projects Speaking exchange and Skype Grannies [39], as well as work from Masatomo Kobayashi and his colleagues [94, 95] on enabling proofreading tasks through crowdsourcing. Not many online services combine the possibility of matching your skills and abilities, while also allowing users to execute the tasks in context. This increases the need for context switching and learning to use different tools, thus potentially limiting the participation of older adults. Additionally, analysis of usage and acceptance of these applications by older adults has received minimal attention by researchers so far. Kobayashi and his colleagues investigated the participation of older adults in their crowdsourcing application [94] and found that using microtasks and allowing users to choose the tasks based on their skills simplifies the work for seniors. They also found that the accuracy of performance matched that of younger participants. Moreover, older adults were most of the

top contributors and they became "longer-standing workers" once they joined the community. This is encouraging, considering our belief in the potential for contributions by older adults.

We summarized implications for older adults and the findings of our analysis in Figure 3.1.

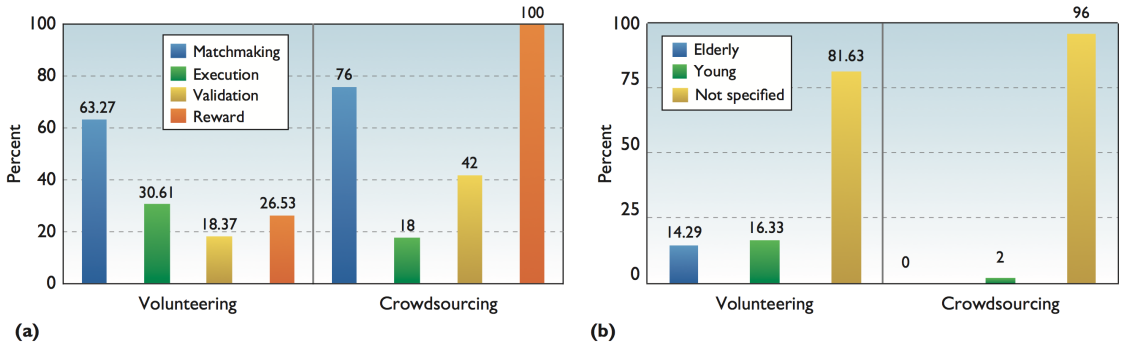

Fig. 3.1 Analysis for the role of technology in volunteering and crowdsourcing services. The following are considerations for older adults: Older adults are more likely to pass on opportunities that they do not find interesting and challenging; and crowdsourcing simplifies the work for seniors. Our findings are as follows: Few applications for remote online contribution target the older adult population specifically (14%); there is scant support for full coverage of the whole remote contribution process, leading to an increased need for context switching and use of different tools, potentially limiting older adult participation; the matchmaking phase is well-supported by both volunteering (63%) and crowdsourcing services (76%); and support for task execution is lower in crowdsourcing services (18%) than in volunteering (31%)

3.4 Type of online activities

The key issue in contributions from home is *what* can be done remotely. In an analysis of two representative services (VolunteerMatch and Amazon Mechanical Turk) we identified different types of activities in terms of the type of online work, and categorized them into the following: *conceptual*, requiring thinking and use of specific skills; *mechanical*, for tasks that do not require higher levels of thinking and can be performed almost mechanically; and *search*, requiring someone to look for additional data on external sources. We also identified different levels of commitment based on work duration, ranging from the following: *short*, for seconds or minutes; *medium*, implying a one-time commitment or hours of work; and *long*, if tasks are performed multiple times over a longer period of time.

Tasks offered by online volunteering services include writing, research, and management, among others, and are performed mainly via email, word processing software, and videocon-

ference. Older adults who have volunteered over the Internet reported engagement in such tasks, although it must be noted that these are skillful and highly educated individuals [125]. Our analysis shows that 92 percent of volunteering services require conceptual work, and to a lesser extent the work of mechanical (35%) and search (29%) types. Another characteristic of volunteering services is the tendency to offer work of medium (67%) or long (71%) duration. However, long-term commitment might be an obstacle for recruiting or retaining older adults as volunteers, given their tendency to lose motivation over long periods of time [180].

Similarly, crowdsourcing services offer work that requires thinking and use of specific skills (92% conceptual work) while mechanical (26%) and search (6%) are less common. However, in contrast to volunteering, crowdsourcing is concentrated mostly toward one-time commitment work (90% medium, 26% short). Although little can be said for older adults, since we found no crowdsourcing services targeting them specifically. Indeed, the participation of older adults in crowdsourcing markets has been shown to be very limited [85] and few studies have explored their potential in crowdsourcing. Among these studies, Kobayashi and colleagues investigated, with positive results, the feasibility of engaging older adults in helping people with print disabilities, by handing proofreading micro-tasks [95].

In summary, while services provide plenty of opportunities to contribute, only a few of them are specifically targeting online work by seniors, and studies involving older adults, especially the "oldest old," are very limited and in some cases anecdotal. Therefore, this is an area where research, studies, and experiments are needed to assess viability and potential.

In Figure 3.2, we complement our findings on volunteering and crowdsourcing services with an analysis of two general-purpose services. We investigated the type of work required in 200 tasks from Amazon Mechanical Turk and 100 tasks from VolunteerMatch to have a deeper understanding of offers within particular services. This analysis shows that while most tasks can be categorized as conceptual, few provide the opportunity to learn or apply competencies.

3.5 Motivation and rewards

Finding the right motives to engage in productive activities is key to long-term attachment[179]. Motivations can be intrinsic (the satisfaction of helping others and enjoyment of the activity itself) and extrinsic (more instrumental motivations such as money, social recognition, and rewards). However, we know that older adults are less likely than younger adults to engage in productive activities for instrumental reasons [57].

Online services rely at different levels on both intrinsic and extrinsic motivation to attract and retain contributors. From our analysis, we observed that 55 percent of volunteering

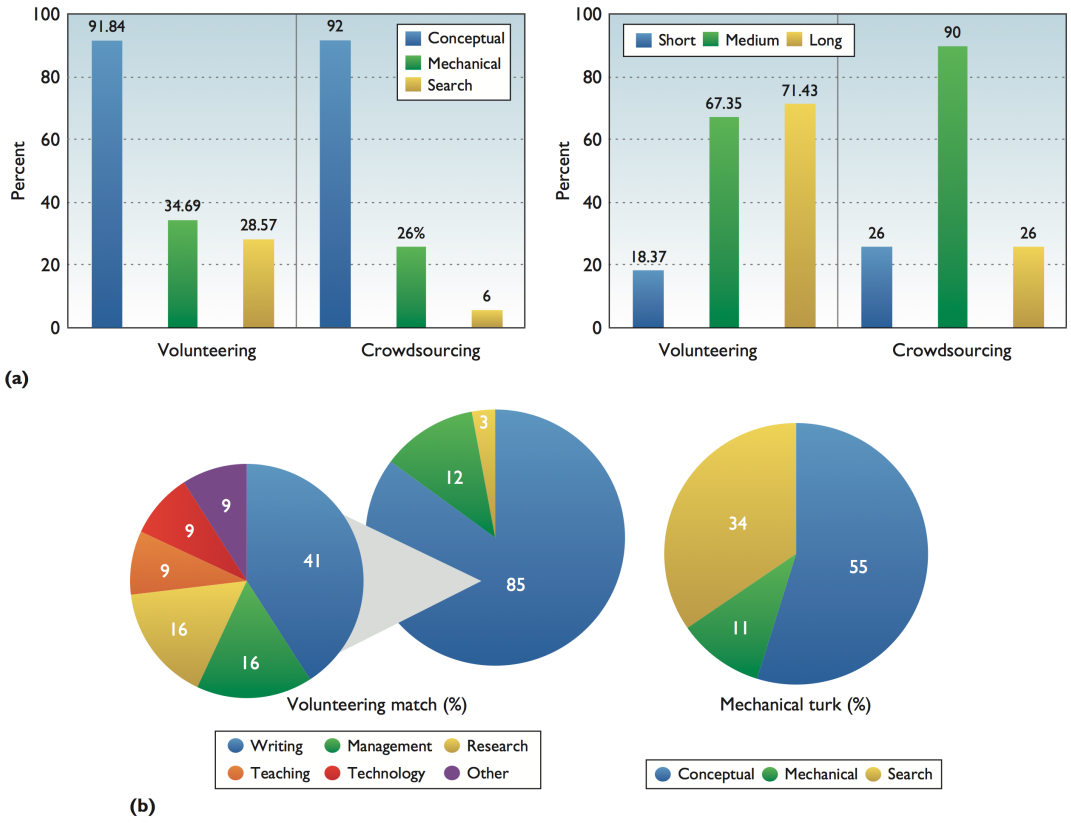

Fig. 3.2 Analyzing and comparing the findings. (a) Analysis and comparison of work in volunteering and crowdsourcing services. (b) Analysis and comparison of work in VolunteerMatch and Mechanical Turk. The following are considerations regarding older adults: Studies report on the engagement of older adults in activities for online volunteering; there are positive results in using micro-tasks as a form of online work in crowdsourcing; and older adults might be difficult to recruit or retain as long-time volunteers, given their tendency to lose motivation over time. Our findings are as follows: First, the type of work offered online is mostly conceptual (92% for both volunteering and crowdsourcing). However, an analysis of particular tools (b), shows that conceptual tasks typically require categorizing text, finding errors, writing questions on a text, or answering questions on all topics. While not mechanical, few of the tasks allow people to learn a subject or apply competencies. Second, the work offered online requires mostly medium- (hours or one-time commitments) to long-term commitments. Third, when comparing our analysis of services to that of particular tools, we have seen that the tendency for types of work are maintained. However, for Mechanical Turk we observe a marked reduction in conceptual tasks in favor of search.

services do not implement motivation strategies. Indeed, older adults mainly volunteer because they feel they make a difference [39, 125], relying strongly in intrinsic motivations. Furthermore, studies show that older adults (55 and over for these studies) are twice as likely to pass on opportunities that they do not find interesting and challenging, and look for something where they can apply their own skills [170]. Indeed, these adults are reported to not volunteer because they do not find the right opportunity nor see that they are learning new skills. We should note, however, that older adults volunteering online tend to be more skilled and highly educated [125].

Some online volunteering sites adopt motivating mechanisms such as ratings and peer recognition. In some cases (such as with UN volunteers; www.unv. org), these are utilitarian as they help organizations to select candidates; in others (such as with SkillsForChange; http://skillsforchange.org), they are meant to create community feeling and recognition. Social interactions during volunteering also act as a strong motivational instrument, and are even responsible for some of the positive effects of volunteering activities (for example, countering depression due to the mediating effect of social resources such as attendance to volunteer work meetings) [126]. We saw social motivation strategies (33%) used slightly more than individual strategies (26%) by volunteering services.

We also found monetary reward to be the prime mover for crowdsourcing services, as reported in the literature [85], with 92 percent of them paying for work. As opposed to volunteering, crowdsourcing uses individual persuasion the most (74%); however, social motivation strategies (42%) are also adopted. The few studies analyzing the participation of older adults in crowdsourcing tasks have shown the importance of the sense of purpose, and in particular social purpose tasks, on motivation [94]. Most studies, however, are limited to experimental settings, where the motivation to contribute was not the main goal.

In summary, the motivational aspect in contributions by older adults is fairly well understood, although there are still only small studies and issues remain in understanding how to promote a sustained contribution. It is worth considering whether the same motivational aspects apply to people contributing from home, as most studies relate to people contributing in person. And there should be further study on whether social interactions play a factor, and to what extent.

3.6 Interactions with technology

Social contribution sites support the “traditional” interfaces for desktops, tablets, and smartphones. New paradigms (from watches to gestures) have not yet entered the volunteering or crowdsourcing domains. As expected, the lack of ICT skills, as well as the decline associated

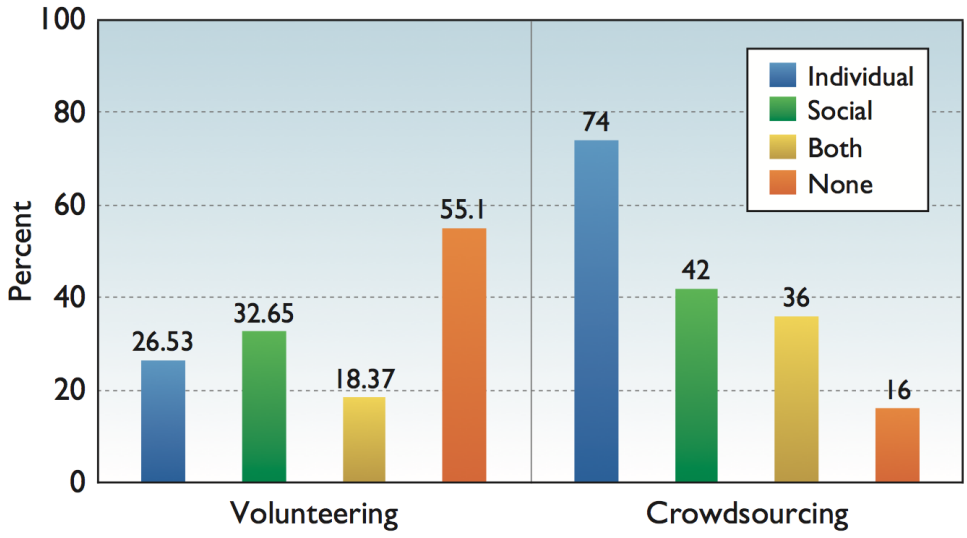

Fig. 3.3 Analysis and comparison of rewards in volunteering and crowdsourcing services. The following are considerations for older adults: Older adults are less likely to engage in productive activities for instrumental reasons (such as career advancement); they volunteer mainly because they feel they make a difference; social interactions during volunteering act as a strong motivational instrument; and the sense of purpose, in particular social purpose tasks, is important for motivation. Our findings are as follows: First, volunteering services do not implement motivation strategies for the most part (55%), solely relying on intrinsic motivation. On the other hand, only 16 percent of crowdsourcing services lack motivation strategies, relying mostly on payment. Second, despite the importance of social interactions, only 33 percent of volunteering services implement social support features. Third, crowdsourcing services rely strongly on individual motivation strategies (74%)

with aging, is a problem for older adults [70], and help from others could be required to overcome usability issues [95].

Perhaps more surprising is that studies report that many social contribution sites have a rather poor design from an accessibility perspective. Indeed, studies on older adults' experiences with online volunteering sites report problems with the layout of websites, Internet connections, and input devices [125]. An analysis on Mechanical Turk's interface, observing Web Content Accessibility Guidelines, noted several problems including a lack of page headings and skip links, no use of alternative text for images, unlabeled input elements, time limits for completion of tasks, nested tables and elements that were not accessible through keyboard navigation, and more [30]. Recommendations emerging from this analysis were to provide accessible templates and guidelines, and to allow workers to request more

time for task completion, mark tasks as inaccessible or requiring specific abilities, as well as filtering them based on abilities required.

The need for "more adult-friendly" mediums and patterns is also acknowledged by Kobayashi and his colleagues [95], who argue in favor of touch devices and simple tasks (such as those requiring yes or no answers); this makes using applications easier for older adults. Because there appears to be consensus on users requiring at least some technology-related skills, to get involved effectively in virtual contributions [39], the aforementioned issues must be considered and dealt with in order for older adults to participate and obtain real benefits out of their online contributions.

3.7 Discussion

This survey points to findings that are in part expected and in part surprising. First, we observe that older adults have a desire and willingness to help others, by making a difference in causes they care about; helping others is in fact the motivating factor [26]. However, as evidenced in our analysis of tools for online contribution, hardly any opportunities are specifically designed for older adults, both in terms of technology and online work. The lack of research on the topic — combined with the success that other areas have witnessed in technologies for older adults [132], and the evidence on the importance that older adults give to being active and feeling helpful [39, 125] — indicates the still-untapped potential of this area.

The analysis also highlights challenges that should be solved to enable online contributions from home:

- *Integrated processes for contributing online*. Today, services that cover the entire online contribution process are few (we only found five in our review), and include motivational elements, task types, and interactions not designed for older adults. A positive aspect is the support for matchmaking, which could enable older adults to find suitable tasks.

- *Task types*. Older adults, more than their younger counterparts, need tasks that let them apply their skills and learn [170]. Even when tasks are conceptual, they hardly offer the opportunity to apply skills or for learning (for example, 41 percent of tasks include writing press releases or reports). We should note, however, that nowadays a very selective group of older adults — skillful and highly educated — participate in virtual volunteering [125], which requires further studies on the topic.

- *Motivation*. Motivations can be intrinsic, although older adults need to understand the purpose and importance of their contribution [39]. We need to highlight that for long-term commitment, motivation features might be needed to ensure sustained participation — whose effectiveness has been demonstrated in other application areas [132].

- *Social interaction*. Part of the positive effects of contributing is due to social interactions [126]. This is also true for older adults. However, less than 40 percent of the services we reviewed offer social support features. We should also note that no formal studies have addressed the effects of online social support during the contribution process.

These observations highlight the need for systems that let people find (challenging) tasks that are in line with their skills, and for causes they care about; that allow for social support during the contribution process; and that are accessible for older adults. This is not easy, but we know from other domains that technology can successfully help adults in later life, and all indications point to a high potential for success on technologies enabling online contributions from home.

Chapter 4

Technology-supported interventions to reduce loneliness and social isolation in old age: A systematic review

4.1 Introduction

Social interactions significantly impact the quality of life of adults in general and older adults in particular. Health risks have been associated with the characteristics of each individual's social network —such as small size [19, 146], lack of diversity [16], infrequent contacts [27], and perceived social isolation [43]. Limited or poor social relationships have been shown to increase the risk of dementia by 60 percent [60]. Loneliness is a known risk factor for depression [29] and has been associated with increased risk of death and with functional decline [133]. A meta-analytic review of 70 studies [73] has shown that the likelihood of mortality increased by roughly 30 percent for reported loneliness, social isolation, and living alone, an effect comparable to those of smoking and obesity.

Several studies report that both loneliness - a subjective measure referring to the "unpleasant" lack of (quality of) social relationships [46] - and social isolation - an objective measure, referring to the lack (absence or low number) of social relationships [46] grow to alarming levels as we age. Results from the European Social Survey (2006-07) run in over 25 countries show that loneliness increases dramatically after the age of 70 [188]. The percentage of persons stating to feel lonely none or almost none of the time is over 70 percent for ages 30 to 69, but drops to around 60 percent for the 70-79 age range, and below 50 percent for those aged 80 or older (people under 30 also reported high levels of loneliness). Furthermore, the

incidence of loneliness and isolation has been increasing over the last decade: A 15 percent increase in people reporting loneliness in the United States [51] and China [187].

Indeed, several risk factors such as institutionalization, sensory incapacity, reduced mobility, as well as reductions in the quality and frequency of contact are associated with loneliness in old age [137]. Predictors of loneliness and isolation for older adults include health problems (such as chronic illness and cognitive decline), widowhood, and living far from relatives or alone [69]. Even when older adults engage in conversation, interactions can be challenging. Williams and Nussbaum [178] reported on the challenges of intergenerational conversations, such as patronizing speech, painful disclosures, and underutilization of topical resources. In particular, lack of conversation topics can generate anxiety in intergenerational conversations [109]. Many of these factors are common for older adults and, more importantly, are usually beyond the affected person's control [173].

Technological innovations, along with social and economic changes, have made interconnected devices commonplace, thus creating opportunities for interaction [48, 71]. Nonetheless, few reviews have focused on technology-supported interventions aiming at reducing loneliness and social isolation for older adults. Choi, Kong, and Jung [36] conducted a meta-analysis on computer and internet training interventions, but did not cover newer devices. More recent reviews have analyzed assistive technologies and ICT interventions, but these have included interventions for general age-related problems, such as falls and medication management [91], or considered interventions that required co-located participation, such as playing video games [35].

In this systematic review we focus instead on interventions enabling long-distance interactions through technology-mediated communication, targeting loneliness and social isolation in old age. Our objective is to identify the findings and limits of the knowledge acquired so far, and to emphasize areas where further research is needed. More specifically, for the interventions analyzed, we investigate the following research questions:

RQ1. What challenges of long-distance interactions are addressed, and how?

RQ2. Which technologies are used by interventions, and how?

RQ3. What are the social interactions facilitated by interventions? And with whom?

In the following we discuss our investigation methods and results.

4.2 Methods

4.2.1 Search and information sources

We conducted a systematic review [65], reported here following the PRISMA statement guidelines [122], searching the Elsevier's Scopus database for related work published in English until June 29, 2017. The search query was constructed using keywords for *older adults* (older adult OR older people OR senior OR elder OR ageing OR aging), the *target problems* (loneliness OR social isolation), *means for interaction* (technology OR internet OR ICT OR IT OR computer OR tablet OR mobile OR smartphone), and *focus on social* (communication OR social interaction OR social network OR social networking OR social participation OR social cognition OR community).

4.2.2 Eligibility criteria

We analyzed the title and abstract of each of the 511 search results, and verified whether the publication targeted older adults (age range or mean was 65 or over, the commonly accepted age to be considered an older person in developed countries [183] and conformed to the following criteria:

- the work included an intervention (i.e. action taken to improve a situation),
- the interactions with people were long-distance,
- the intervention supported mainly technology-mediated communication, and
- the impact on loneliness or social isolation was evaluated.

Despite our focus in loneliness and social isolation, we considered social connectedness, the experience of belonging and relatedness among people, as a valid outcome because it is related to the (dis)satisfaction with contact quantity and quality [168].

4.2.3 Study selection

After the identification and screening phases, 120 publications were left (see Figure 4.1). These publications were read in full, and again discarded if not conforming to our inclusion criteria. An additional exclusion criterion for full paper screening was insufficient detail in reporting interventions, which would prevent a meaningful analysis. After a detailed inspection, 11 publications were left for full analysis.

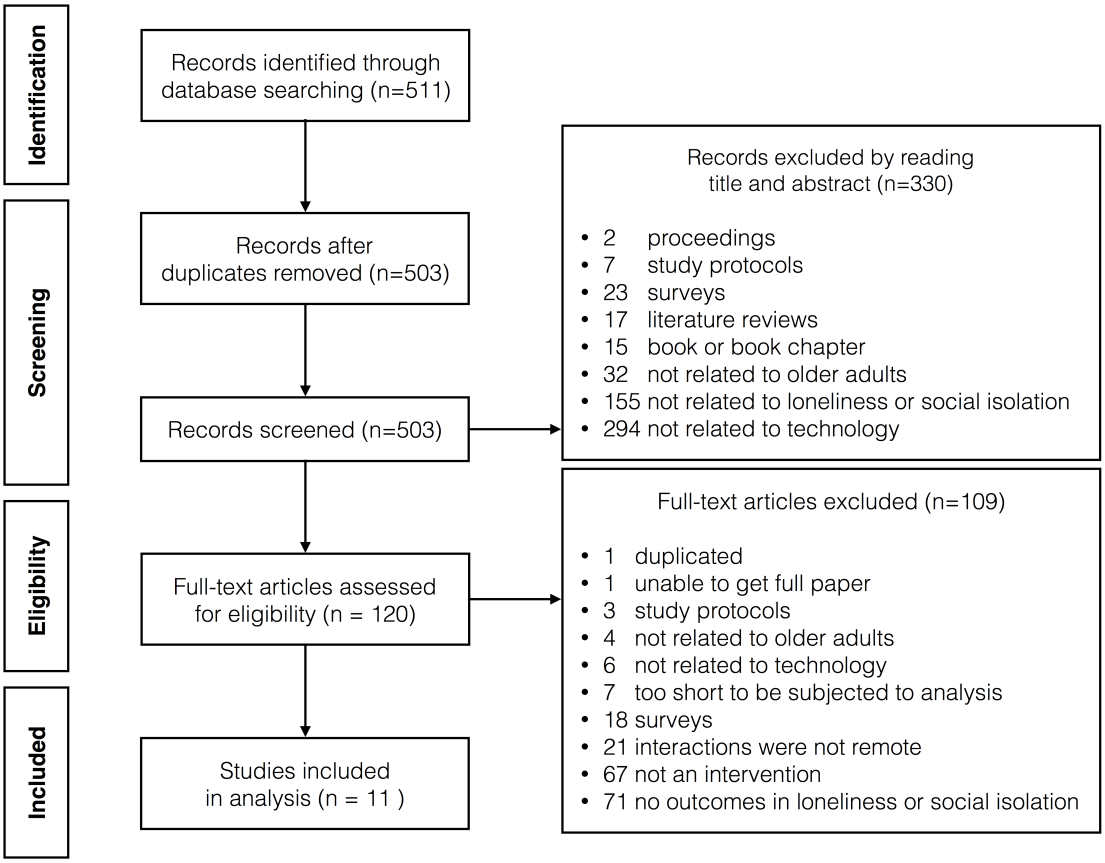

Fig. 4.1 The full selection process, following the PRISMA statement guidelines.

4.2.4 Analysis and synthesis

The review follows a narrative approach to the synthesis of results, given the heterogeneity of the studies included. In order to answer our research questions:

- on the challenges of long-distance interactions addressed by interventions (RQ1), we analyze intervention strategies and outcomes used to accomplish the study goals;
- on the technology used to support interventions (RQ2), we account for the technology and devices as well as the use of the technology by older adults; and
- on the social interactions enabled (RQ3), we describe the different contexts of interaction and the contacts reached by participants.

Some authors were contacted to clarify the devices used in their interventions and the strategies that participants used to meet new people online. For two studies [15, 59] we were able to contact and get a reply from the authors.

4.3 Analysis of the interventions

4.3.1 Study characteristics and outcomes

We start by summarizing the interventions analyzed. Eight interventions considered loneliness as a primary outcome [15, 20, 59, 100, 115, 156, 176], one of which also considered social isolation [45]. The remaining three had loneliness and/or social connectedness as secondary outcomes (see Outcomes in Table 4.1).

Six interventions conducted qualitative studies, relying on direct or indirect (e.g. reports by staff) observation, questionnaires, and interviews (see Study methods in Table 4.1). All qualitative studies had positive outcomes, reporting mainly a decrease in loneliness [15, 20, 32, 115] (see Conclusion in Table 4.1). We must note, however, that some intervention methods were hardly rigorous (e.g. results were sometimes described as "perceptions" or "being anecdotal" [115], and not resulting from "standardized measurement tools" [20]).

Five interventions conducted quantitative studies: two randomized controlled trials (RCTs) [49, 176], one cross-sectional analysis [59], one non-randomized intervention vs. control pre-post evaluation [45], and one randomized crossover study [100]. Four studies reported a decrease in loneliness, one of which reported no difference in social isolation [45], and one reported no difference in loneliness [49] (see Conclusion in Table 4.1).

Eight interventions had measured participants' conditions at baseline. Blažun et al. [20] relied on participants self-reporting feelings of loneliness and the remaining had used the loneliness scales: UCLA (n=4) [45, 100, 115, 176], De Jong Gierveld (n=2) [59, 62], and Hughes (n=1) [49]. Among the three interventions without baseline measures, Ballantyne et al. [15] included participants that perceived themselves as lonely and two interventions indicated that being lonely or isolated was a requirement for inclusion but do not report on how this condition was determined [32, 156].

Finally, we mention the lack of agreement on the effectiveness of video chat and social networks. Széman [156] reported that Skype (video chat) helped to strengthen family ties and expand interpersonal connections, as well as to encourage learning on how to use other tools such as email and chat. However, a computer training intervention by Blažun et al. [20] found that levels of loneliness for those who used Skype did not change, while those less lonely after the training used mainly email, not Skype. Also, regarding social networking sites, Ballantyne et al. [15] reported a decrease in loneliness as a result of using a social network for older adults. These sites gave more control for users to manage their loneliness by giving access to contacts at any time and with no need to leave home. On the other hand, Széman [156] noted that Skype was preferred to Facebook, because it was simpler to use even after participants had become familiar with Facebook and its functionalities. No

other conflicting results were found between the interventions analyzed. Nonetheless, it is interesting to note that all the aforementioned interventions were supported by computers and offered off-the-shelf solutions.

4.3.2 Challenges and intervention strategies

With respect to our first research question, we found that the *lack of social relationships* and *infrequent contacts* have been the most commonly addressed challenges to overcome loneliness and social isolation. One prominent strategy has been to train older adults in the use of computers and internet (n=7) [15, 20, 45, 59, 100, 156, 176], although no technology built specifically for older adults was tested. After an initial training period, older adults in these studies were left to put in practice the skills learned to get in touch with others, with the exception of a single intervention where participants received continuous training [100]. Another strategy has been to ensure that participants had someone to interact with (n=3): volunteers making weekly phone calls [32], trained interviewers having video chat conversations five days a week [49], and trained helpers linked to a virtual companion [115].

Usability and acceptance of the technology by older adults were also challenges taken into account. Here, strategies have been to employ familiar devices, such as the telephone [32]; devices that researchers regarded as more accessible and friendly, such as tablets [115]; or devices that researchers considered simple enough to not require training, such as touch screen computers [49, 62]. Few interventions specifically aimed at solving *conversational issues*, such as the lack of conversation topics. In particular, one intervention [62] offered broadcasts on different topics, which participants could listen to and then go on to discuss by joining a group call. The authors reported that the shared experience provided topics of conversation for the less active participants. Another intervention, providing video chat with an interviewer [49] used pictures as prompts for conversation and prepared a conversation protocol including topics such as the childhood and hobbies of the participants. Although not designed as a part of the intervention, a similar behavior emerged from participants who received weekly phone calls [32]. They reported shared interests as a way to break the ice as well as to establish a “meaningful reciprocal relationship”, and mentioned the importance of knowing about others’ lives and events and wanting to talk about ordinary, everyday topics.

Table 4.1 Summary of the interventions analysed

Intervention	Technology/ Device	Study[1]: length/ participants/ age	Strategies	Study methods	Outcomes: primary / secondary	Measurements[2]/ Conclusion
[15] Ballantyne et al. (2010)	social network (About my age) / computer	3 months / 4 / 69-85	internet and computer training	pilot study, pre-post interviews	loneliness	interview / decrease in loneliness
[20] Blažun et al. (2012)	email, internet, Skype / computer	3 weeks / 45 / 66 in Finland, 77 in Slovenia	internet and computer training	pre-post test without control; no standard tool for assessment	loneliness / ICT knowledge and experience	questionnaire / decrease in loneliness
[32] Cattan et al. (2011)	phone calls / telephone	over 3 months / 34 / 55s-95s	familiar, simple technology; ensure interaction	mixed methods	health and wellbeing / loneliness	questionnaire and interview / decreased feelings of loneliness, increased socialization
[45] Cotten et al. (2013)	email, internet, Facebook / computer	1-2 weeks / 205 (79;126) / 82.8	internet and computer training	cross sectional analysis	loneliness and social isolation / quantity and quality of communications	UCLA 3-items LS and questionnaire / decrease in loneliness, not in social isolation
[49] Dodge et al. (2015)	video chat / touch screen computer	6 weeks / 83 (41;42) / 80.5	familiar, simple technology; ensure interaction; provide topics for conversation	randomized controlled trial	cognitive function / loneliness	Hughes 3-items LS / no difference
[59] Fokkema & Knipscheer (2007)	email, internet / computer	3 years / 26 (12;14) / 66 for intervention, 68 for control	internet and computer training	pre-post test non-equivalent control group, inter-rupted time series	loneliness	De Jong 11-items LS and questionnaire / decrease in loneliness

[1]Numbers of participants in parentheses (intervention;control) is shown for controlled studies; age is indicated as mean, age range, or as reported in the study
[2]Loneliness scale (LS)

Table 4.1 Summary of the interventions analysed

Intervention	Technology/ Device	Study[1]: length/ participants/ age	Strategies	Study methods	Outcomes: primary / secondary	Measurements[2]/ Conclusion
[62] Garattini et al. (2012)	calls, messages, broadcast / touch screen computer-phone hybrid	10 weeks / 19 / 65-84	familiar, simple technology; provide topics for conversation	mixed methods, exploratory study	feasibility / social connectedness	De Jong 6-items LS, log, interview, questionnaire / helped social connection and created interaction
[100] Larsson et al. (2016)	email, internet, Facebook, Skype / computer	3 months / 30 / 61-89	internet and computer training	randomized crossover study	loneliness / satisfaction with social contacts on and offline	UCLA LS / significant decrease in loneliness (both groups); inconclusive for satisfaction with social contacts
[115] Machesney et al. (2014)	virtual companion / tablet	1 week / 13 / 65-93	familiar, simple technology; ensure interaction	one group observational study	loneliness	UCLA LS / decrease in loneliness
[156] Széman (2014)	email, internet, Facebook, Skype / computer	over 6 months / 15 (program) 25 (pilot) / 75+	internet and computer training	case study	loneliness	observation / increase size of social network
[176] White et al. (2002)	email, internet / computer	5 months / 93 (48;45) / 71 for intervention, 72 for control	internet and computer training	randomized controlled trial	loneliness	UCLA LS (modified anchors) / decrease in loneliness (non-statistically significant)

4.3.3 Technology supporting interventions

In answer to our second research question, we found that Internet access was fundamental to support long-distance interactions in all interventions, except for the telephone befriending service [32]. On top of Internet, different combinations of technologies were incorporated, including general internet use for interaction (e.g. discussions in forums) and email (n=6; see Technology in Table 4.2), social networks (n=4), video chat (n=4), virtual companions (n=1), phone calls (n=1), and a social app that allowed for calling, messaging, joining a virtual environment, and participating in broadcasts [62].

Off-the-shelf solutions were favored (n=8; see Table 4.2), including the social networks Facebook and About my age (a social network for older adults), Skype (video chat), a landline telephone service, as well as standard applications to use email and internet. Tailored solutions, designed specifically for interventions (n=3) include a custom video chat system that allowed calling by simply touching the screen [49], a virtual companion controlled remotely by a trained helper [115], and a system that allowed participants to call, write messages, listen to broadcasts, and join a virtual room [62].

Computers, along with mouse and keyboard as input devices, were preferred for supporting interventions (n=7; see Table 4.2). Other interventions employed: traditional telephones (n=1), tablets (n=1), and touch screen computers (n=2), one of which had a telephone handset attached to the screen so that users could get calls as they would on a regular telephone [62].

While interventions clearly report on the technology and devices used, features and channels used for communication are rarely discussed in detail. Garattini et al. [62] reported 574 messages sent, 187 calls answered, 104 broadcasts attended, and 40 entries to the virtual room. Also, Blažun et al. [20] reported two to five emails sent per week and whether Skype was used or not. Interventions with more qualitative insights praised video chat for allowing users to see people on the other side, which was particularly important with grandchildren [156]. One intervention even delivered fully remote training using Skype [100]. Some interventions hinted about other interactions such as photo sharing with relatives [115] or sharing and demonstrating hobbies through video chat [156], but it is unclear whether these were actually practiced. Interventions also reported that participants used internet and computers to re-engage in old interests, explore content, or participate in online communities [15, 20, 59, 100, 156]; sometimes achieving a notorious improvement, even allowing to overcome depression [156].

In terms of understanding the human factors in the interventions and the relation between users and technology, we found that all interventions required older adults to use the technology on their own and, aside for the telephone befriending service, all provided some kind of training or support (see Training or support in Table 4.2). Nonetheless, out of the

interventions including computer training, five required participants not to be proficient with the technology on which they would receive training [15, 20, 59, 100, 156] and two did not enforce this requirement [45, 176]. For interventions that employed touch screen computers, proficiency was not a requirement.

Table 4.2 Technology used in interventions

Intervention	Technology	Custom or off-the-shelf	Devices	Technology ownership / experience	Training or support
[15] Ballantyne et al. (2010)	social network (About my age)	off-the-shelf	computer	non-proficiency required	initial training sessions
[20] Blažun et al. (2012)	email, internet, Skype	off-the-shelf	computer	non-proficiency required	initial training sessions
[32] Cattan et al. (2011)	phone calls	off-the-shelf	telephone	N/A	N/A
[45] Cotten et al. (2013)	email, internet, Facebook	off-the-shelf	computer	did not report	initial training sessions
[49] Dodge et al. (2015)	video chat	custom	touch screen computer	15% had used a PC before	visits for setup; no training
[59] Fokkema & Knipscheer (2007)	email, internet	off-the-shelf	computer	non-proficiency required	initial training sessions
[62] Garattini et al. (2012)	calls, messages, broadcasts, virtual room	custom	touch screen computer with phone handset	68% did not own a computer	visits for training and support
[100] Larsson et al. (2016)	email, internet, Facebook, Skype	off-the-shelf	computer	computer ownership required, non-proficiency required	visits for training and support; remote training
[115] Machesney et al. (2014)	virtual companion (pet avatar)	custom	tablet	did not report	continuous visits; remote support
[156] Széman (2014)	email, internet, Facebook, Skype	off-the-shelf	computer	non-proficiency required	initial training sessions
[176] White et al. (2002)	email, internet	off-the-shelf	computer	9% owned a PC; 60% had no previous experience	continuous visits, remote support

Few interventions provide details on the difficulties in interacting with technology. White et al. [176] reported on computer users having problems with vision, colors on the screen, the mouse, and remembering how to use email and internet. Other computer users withdrew from their studies because learning how to use the computer was too difficult [15, 59] or they had found a better alternative [59]. In touch-screen computer interventions, participants reported frustration on the disengagement of others, difficulties to join into group conversations, as well as limited privacy settings and amount of characters per message [62]. Tablet users

reported feeling silly talking to a virtual pet, problems with audio, and delay in messages [115].

Usability, although not formally an outcome, was analyzed by some interventions. In a computer training course by Blažun et al. [20], which included email, internet, and Skype, participants self-reported on satisfaction (64% were very satisfied or satisfied) and ease of use (74% reported it was easy). On the other hand, some interventions using computers [20, 156] and tablets [115] reported initial feelings of uncertainty and fear regarding use and adoption of technology. These interventions also reported that such feelings were overcome in time, as participants gained confidence and familiarity thanks to both training and use. However, no measurements from standard instruments were collected to support these reports.

4.3.4 Social interaction and contacts

In relation to our third research question, eight out of the 11 interventions involved online groups (see Table 4.3), while in the remaining three participants could only contact one other person (one-to-one interventions).

The majority of interventions (n=8; see Contacts in Table 4.3) focused on interactions between older adults and their family and friends. Five interventions had explicitly planned for contact with family and friends: Garattini et al. [62] asked participants to choose relatives and friends to be added to their contact list, while Larsson et al. [100] had "searching for relatives" as a task on their program. The other three taught participants to communicate with family and friends via internet [45, 59] or Skype [156].

Interestingly, Széman [156] reported that participants wanted to contact only their families in the beginning, but later asked to expand their network to include old friends, acquaintances, new people, and finally other participants. Three interventions reported interactions between older adult study participants, with one even designed to "encourage social interaction among strangers" [62]. Nonetheless, only Fokkema and Knipscheer [59] compared frequency of contact, reporting that out of 12 participants, ten had contact with family and acquaintances, and three with other study participants.

One-to-one interventions limited contacts to trained interviewers [49], trained helpers [115], or volunteers (Cattan et al., 2011) [32], put in place for the interventions. However, interventions that included general internet use and social networks allowed participants to meet new people. Larsson et al. (2016) [100] even had "finding a new friend with the same interests" as a program goal and contacting an unknown person through internet as a task. Authors who replied to our inquiry on how new people were met said that most new contacts were other participants reached through forums [59], or that participants met others in social

network pages about shared interests and during online activities offered by the site, such as "quiz night online" [15].

Intergenerational relationships were also indicated as important. Three computer training interventions explicitly mention interactions with young people. White et al. [176] reported that "some participants agreed to be e-mail pals with middle school students", and Széman [156] reported that opportunities to contact grandchildren was the "biggest motivation" for participants. Moreover, Blažun et al. [20] reported benefits for both parties, with younger volunteers teaching elders new ICT skills, and at the same time, learning themselves from the life stories of the older adults.

Table 4.3 Social interactions and contacts

Intervention	Online group or one-to-one	Contacts	Contact with research staff
[15] Ballantyne et al. (2010)	online group	family and friends, new people	weekly visits first, then fewer; phone call at most 1h/week
[20] Blažun et al. (2012)	online group	family and friends, new people	training once a week; 4h in Finland and 3h in Slovenia
[32] Cattan et al. (2011)	one-to-one	volunteers (predefined)	variable number of weekly calls
[45] Cotten et al. (2013)	online group	family and friends, new people	eight-week training (data from first 2 weeks)
[49] Dodge et al. (2015)	one-to-one	trained interviewers (predefined)	video chat 30-35 min/day; 5 days/week
[59] Fokkema & Knipscheer (2007)	online group	family and friends, new people, other participants, acquaintances	five 2h lessons; visits every 2-3 weeks
[62] Garattini et al. (2012)	online group	family and friends, other participants	Four 1h visits; messages via app; weekly calls (extra calls for technical issues)
[100] Larsson et al. (2016)	online group	family and friends, new people, other participants	individual meeting offered weekly, group meeting every 2 weeks
[115] Machesney et al. (2014)	one-to-one	trained helpers (predefined)	visits and phone calls, available 24/7
[156] Széman (2014)	online group	family and friends, new people, acquaintances	one 1.5h lesson; 1h visits twice a week
[176] White et al. (2002)	online group	family and friends, new people	three 2h lessons, three 1h lessons; trainer visits 2h/week

Interactions in person also occurred. Sometimes participants met during the interventions and formed groups: a computer interest group [176] (which got to publish a newsletter for the community) and a discussion and support group [15]. Two interventions included teaching imparted in person by relatives or volunteers [20, 156]. In addition, visits were made in order to provide assistance or to make sure that systems were working properly [62, 115].

Especially in interventions that provided education for computer and internet use, visits were more or less frequent after the training period [15, 20, 45, 59, 100, 156, 176]. Only two one-to-one interventions did not report visits to participants: the one including video chat with the trained interviewer [49] (one visit for setup only) and the telephone befriending service [32]. It is worth mentioning that in a large part of the interventions there were visits to participants. Since the focus is on loneliness and isolation, the visits may have had an effect on the results.

4.4 Findings

Below, we analyze the findings from our research questions. In terms of challenges addressed by interventions, the strategies applied and the intervention outcomes (RQ1), we observed that most interventions have dealt with the lack of social relationships and infrequent contacts by training participants in the use of computers and internet. While results have been positive, and it is true that training participants or providing simple technology might solve the digital divide, such strategies do not guarantee access to contacts or frequent interactions. We argue that it is important to address the barriers directly, targeting challenges with technology that incorporates strategies by design. Interventions providing simple technology also ensured interaction as a strategy, but these studies are too few to tell whether the strategy is effective. More studies taking this strategy would contribute evidence allowing for comparison with studies that train participants. Also, few studies have tried to improve conversations, by providing some contextual information and conversation topics. This area seems promising, especially in light of the surge of artificial intelligence and conversational agents. As fully automated conversational agents were successful on interventions for young adults with symptoms of depression and anxiety [58], such agents could be designed to target loneliness and social isolation, and adapted to help guide conversations, provide conversational cues, or converse themselves with the older adults.

We also note that future studies should be more rigorous. Despite almost all interventions reporting positive outcomes, only two were RCTs. Studies disagree on the effectiveness of the technologies used (e.g. video chat and social networks) and some qualitative studies reports were obtained without standard measurement tools [20] or based on perceptions [115], making results hard to interpret and analyze. This call for more rigor, is in line with previous reviews which have already highlighted weak methodologies [91] and noted that the quality of studies does not allow to establish conclusive remarks on effectiveness [35]. A methodological guide to designing studies in this area would greatly benefit researchers,

especially those from the IT field, who might be less familiar with user studies with vulnerable subjects.

With respect to the technology used in interventions and how this technology was used by older adults (RQ2), we found that desktop/laptops are still the dominant device. Considering how commonplace long-distance interactions are nowadays and the availability of devices (e.g. mobile phones), we were surprised to find that most were based on desktop computers. Especially since age related limitations experienced by older adult computer users [117] might hinder the interactions enabled, thus leading to poor intervention outcomes. We also found few solutions designed specifically for older adults. This might be due to the higher investment that designing tailored technologies requires. Nonetheless, previous research shows that tailored tools could increase adoption [23] while more general solutions (e.g. Facebook) could pose challenges for older adults [40] and present asymmetries in the interactions (especially for intergenerational communications [66]). This presents a great opportunity for HCI researchers to collaborate with technology-supported interventions to facilitate long-distance interactions for older adults.

The prevailing technologies were email and general internet use for interaction (e.g. discussions in forums), closely followed by social networks and video chat. As a limitation of this work, we must note that the search keywords used to give a focus on social (social network / networking) might have led to an overly represented sample of interventions using social network sites.

Many interventions enabled a combination of features and channels for interaction, however, few reported on how, and how frequently these were used. Since such reports are scant, we cannot assess technology adoption or effectiveness. Therefore, we recommend future interventions to add formal reports on usability (e.g. the System Usability Scale [25]) and to quantify features and interaction channels used by participants. The adoption of technology by older adults largely depends on learnability and perceived difficulty of use [17]. Using standard instruments to measure usability is key to explain the success of technology-supported interventions, while failing to address usability might raise concerns about the validity of the intervention.

Finally, with respect to the social interactions enabled (RQ3), we found that most interventions enabled interaction with online groups, rather than with one person put in place specifically for the intervention. Family and friends was the contact group reported by a majority of the interventions, some highlighting intergenerational relationships as particularly important for older adults. Nonetheless, here we also lack quantitative information on the frequency of contact. Since all interventions with online groups included at least two different groups of people (e.g. family and friends, and other participants), we cannot tell whether

older adults prefer to contact certain groups nor assess the impact the type of relationship has on the effectiveness of interventions. Friendship relationships, for instance, have been associated with stronger effects for subjective wellbeing [136] as compared with familial relationships.

The need for quantitative information also applies to the channels used to interact with people from particular groups. For example, Széman [156] reports that older adults enjoyed seeing their grandchildren through video chat. Future studies should consider analysing the impact on effectiveness of the contacts enabled and the channels used for interactions, as well as quantifying interactions and the contacts reached. This would allow to better understand the motivations and opportunities that exist for conversation between older adults and others.

Furthermore, despite assessing the effect of long-distance interactions, many studies reported interactions in person during the intervention (e.g. with other participants, with researchers). If interactions were frequent, the effect on intervention outcomes should be considered.

4.5 Discussion

For interventions, technology had the fundamental role of enabling long-distance interactions and was used for support in different ways. By facilitating more channels for interaction and providing access to larger audiences, it allowed participants to expand social networks, strengthen existing ties, providing social support, or build community rapport. However, since existing interventions are few, they tell us about the feasibility of using technology for long-distance interactions, but it is still unclear how technology is actually used, what limitations and opportunities exist, and how these affect the success of the intervention.

Therefore, we highlight some recommendations for researchers approaching this field of study. First, on the study methods, it is important to i) design studies as RCTs, ii) leverage standard instruments for measuring loneliness and social isolation, and iii) consider the potential impact of continued (and in person) contact with participants on measurements. This may seem obvious, but we found very few studies with these characteristics. We also recommend to report and discuss separately the results for each interaction channel and by type of relationship (e.g. with friends, children, grandchildren), since without this information it is hard to infer what worked. Second, in terms of challenges, open opportunities lie in studying how technologies can facilitate and improve conversation (e.g. by presenting shared interests as topics), as opposed to enabling them. Finally, a vast majority of current research has focused on training for using a specific technology. To date, little attention has been paid to i) designing interventions that enable or encourage usage of technology in specific

ways (e.g. organizing and encouraging access to chatrooms with specific topics) and on ii) using persuasive technologies, that introduce motivational elements and help users initiate and sustain conversations on shared interests. We feel that addressing these gaps in current research, can lead to a better understanding of the role technology can play in tackling loneliness, one of the biggest diseases of modern society.

Chapter 5

What Makes People Bond?: A Study on Social Interactions and Common Life Points on Facebook

5.1 Introduction

Being socially connected can have a significant impact on the quality of life of older adults. Research has demonstrated the association between health risks and the lack of social network diversity, infrequent contact with network members, and the small size of social networks [19, 27, 146].

Social integration with peers is particularly important for older adults transitioning to residential care. Social integration helps in the adaptation, can foster friendships and sense of belonging, and has been found to be one of the key elements contributing to the quality of life in residential care [24]. Instead, failing to socially integrate contributes to feelings of loneliness, boredom, and helplessness, which are commonly regarded as the plagues of nursing home life [161].

The research and practice on technology-supported social interactions in this context has mainly focused on *enabling* social interactions (see, e.g., [33, 36] for a review), and less in addressing non-technological barriers, motivating social interactions and creating bonding. Addressing this gap requires the study and development of solutions that take into account the users' needs, motivations and barriers.

In our previous work [11] we reported on the results from surveys and visits to nursing homes. We identified that i) friendships in nursing homes are difficult, especially in the transition period, and that ii) contact is rather infrequent between older adults and their

relatives, especially younger adults, often due to the lack of common topics of conversation and the lack of time. We suggested that technologies should go beyond *enabling* interaction, to aim at creating friendships between people and opportunities for meaningful conversations.

In this paper we follow up on these initial results and report on an exploratory study trying to understand the relationship between *connectedness* among friends, *social interactions* and *common life points* on Facebook.

The goal of this study is to understand if, by looking at information of the kind available in people's Facebook profiles and posts, we can predict the feeling of connectedness between two Facebook friends and the intensity of their face-to-face interactions. Specifically, we investigate the following research questions:

RQ1. To what extent can we predict, by looking at profile information on Facebook, the frequency of online and offline communication between two persons? We are interested in understanding if common life points and social interactions are related, and whether certain common aspects can trigger interactions.

RQ2. To what extent can we predict, by looking at profile information and intensity of social interactions, the feeling of connectedness between two persons? This question is fundamental as it will help us understand whether having common aspects and a certain level of interaction is related to connectedness. Connectedness in this context represents the possibility of creating long-term bonds and friendship.

We explore the above questions in the broad population of Facebook users, from younger (18+) to older adults (65+), since we are interested in *intergenerational* as well as in *peer* friend relationships.

In what follows we detail on the motivations, methods and results.

5.2 Background

5.2.1 Technologies to reduce social isolation

Extensive work has been devoted to interventions aiming to reduce social isolation with the help of technology (e.g., [33, 36] for a review). Technology used to enable interactions for older adults include internet and email (e.g., [20]), social networks (e.g., [15]), video chats (e.g., [156]), virtual companions (e.g., [115]), and phone calls (e.g., [32]). Most one-to-one interventions limit the contact to a predefined person, such as a trained interviewer, a trained helper, or a volunteer [32, 115]. However, interventions enabling social interactions with

relatives and friends are more common in recent literature [15, 156]. Interactions between participants and new people are also explored in some interventions [59], in particular in those studying the effect of general internet use and social networks [20, 156].

Research on online social interaction with older adults has focused more on “enabling" communication and sharing, and less on creating opportunities for these interactions to happen. This calls for the development of technology that looks into making these interactions more effective.

5.2.2 Studies on friendship and common life points

The notion that similarities among people lead to creating ties between them is known as homophily [119]. In a review, McPherson et al. [119] described it as *“the principle that a contact between similar people occurs at a higher rate than among dissimilar people"*.

Homophily can be defined from two perspectives: i) *value homophily*, which is based on the attitudes, beliefs and values, and ii) *status homophily*, which is based on the major demographic dimensions such as race, ethnicity, sex, age, and characteristics like religion, education, occupation [102, 119]. A review of studies done by Fehr [56] suggests that both status and value homophily are relevant for building friendship. However, a recent survey by Campbell shows that only value homophily affects friendship chemistry (emotional and psychological connection between persons) [31].

There are studies analysing structural properties of friend networks [165] and empirical studies that have explored homophily in social networks. Kwak [96] studied homophily among Twitter users (with 1000 and less followers) and their friends-followers and found the effect for geographic location and popularity. Lewis et al. [106] studied Facebook profiles of 1640 college students in the US and found significant shared interests (movies, music, books) for certain connections (being Facebook friends, picture friends and reciprocal tagging). A similar study by Nick et al. [129] analysed a Facebook dataset of 100 US Universities and concluded that homophily by dormitory, graduation year, and gender is strong.

The above ideas have also been applied to algorithms. In the literature, the approaches used to match friends can be generally classified as content-based and link-based.

Algorithms relying on content, use the similarity of users’ profiles in order to make friend recommendations. This implies comparing what users state in their profiles to keywords and tags from other profiles [34]. This general approach has been successfully used for recommending books, movies and web sites (e.g., [123]). Link-based algorithms (e.g., friend-of-friend) use social network information only, relying on the idea that if two persons have a lot of friends in common, perhaps they could be friends. For example, the Facebook feature “people you may know" is partially based on this approach [34].

In this work, we build on the notion of homophily - which has been largely studied - but unlike previous works we focus on predicting the feeling of connectedness and social interactions. Our results could inform approaches for recommending friends and conversation topics.

5.3 Methods

5.3.1 Hypotheses

In this exploratory study, we specifically investigate the following hypotheses:

H1. Common life points are related to the level of online and face-to-face interactions This will help us understand if and how we can predict the frequency of social interactions based on the similarity of people (RQ1).

H2. Connectedness is related to common life points and both online and face-to-face interactions. This will tell us if and how we can predict connectedness on the basis of similarity of users and their frequency of interaction (RQ2).

We should notice that the above corresponds to a preliminary work, in which we are setting the direction for further analysis. We do not assume any causal relationship, which should be tested with a controlled trial.

5.3.2 Data collection

We collected information from Facebook users, both automatically (from users' profile, with users' permission) and by explicitly asking users about the frequency and nature of their interactions with friends, as well as the level of connectedness they feel with friends. We analysed profile information (specifically the common aspects between people's profiles) and interactions to build a model for predicting connectedness and actual face-to-face interactions. In other words, our variables are:

- **Connectedness**. Measured using an adaptation of the Inclusion of Other in Self (IOS) scale by Aron et al. [7], a 7-point scale that relies on pictograms.
- **Social interactions**. Described in terms of *online interactions* and *face-to-face interactions*, both measured on a 5-point frequency scale.

- **Common life points**. Described in terms of *shared relationships* (family ties, having lived in the same places, having attended the same institutions), and *shared aspects* (shared beliefs, activities, and interests).

To collect the information needed for the analysis we developed a Facebook application called FriendRover[1]. The workflow of the application is illustrated in Figure 5.1 and detailed below:

1. Users open the application and instructions are shown as well as the request for consent. After giving consent and logging in, the data on participants' Facebook profile, friends, posts, and interactions on their posts, is automatically collected and anonymised.

2. Each participant is presented with a list of 20 friends who have interacted with the participant's posts (through reactions, comments, and tags). These friends are selected in a way such that they are representative of different levels of interaction (We categorised friends into quartiles according to the interaction with the participant and then took a sample from each quartile). From this list, users report on *connectedness* and *social interactions* (Figure 5.1 A).

3. The 10 friends rated as more connected by the participant are listed, and for each friend participants are asked to specify the traits that better describe this friend. On this interface participants report on *common life points* (Figure 5.1 B).

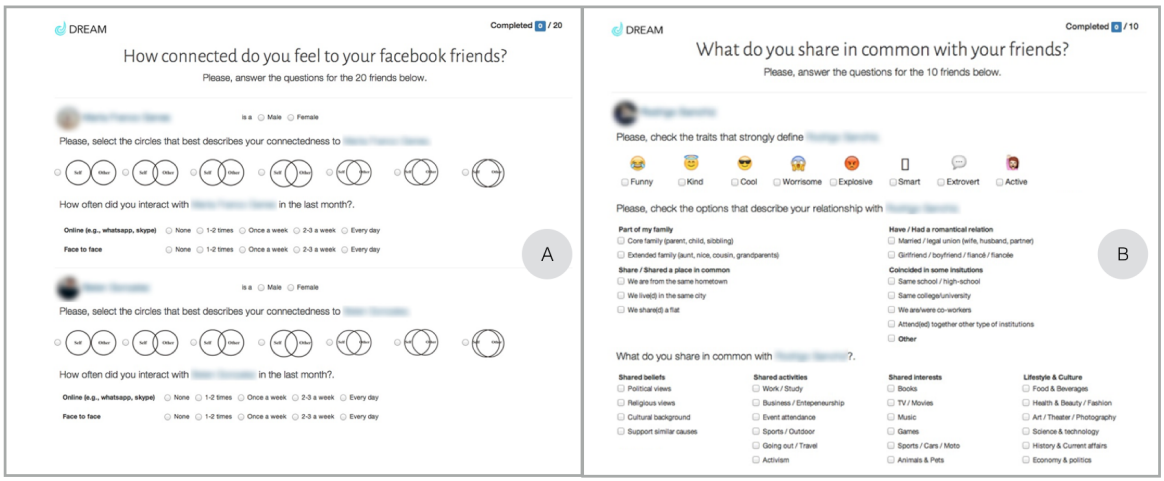

Fig. 5.1 The FriendRover application. Here we show the a) connectedness and b) common life points forms. ©2016 IEEE.

[1] Available at: http://happy.mateine.org/friends

5.3.3 Participants

The study was conducted online with a convenience sample of Facebook users (over 18 years old), obtained by advertising the survey on the Facebook pages of members from the research team. Participants were eligible if they have interacted with at least 20 persons. For this study, we advertised the experiment among Spanish-speaking users.

5.3.4 Resulting dataset

We collected the responses of 33 participants (age range: 32-65, mean: 33 years old, 45% female), which resulted in 660 friendship relationships. The dataset consists of 660 connectedness samples and 280 reports on common life points out of 330 possible reports, this is because some participants did not complete the second part in full.

5.4 Results

5.4.1 Common life points are related to the level of online and face-to-face interactions

We addressed H1 by testing the association of common life points with online and face-to-face interaction separately.

An analysis of variance was performed to determine a statistically significant difference in the level of *online interactions* for the number of common life points, using the number of *shared aspects* and *shared relations* as independent variables. The results show a main effect for number of shared aspects ($F(1, 279)=57.268$, $p<.001$) and a main effect for number of shared relations ($F(1, 279)=15.251$, $p<.001$), but no interaction effect between both variables.

Analysing the individual components of both dependent variables we see a main effect for *shared activities* ($F(1, 279)=27.535$, $p<.001$) and *shared interests* ($F(1, 279)=31.439$, $p<.001$) but no main effect for shared beliefs ($F(1,279)=0.996$, $p=.319$). We also observe main effects for *common institution* ($F(1, 279)=9.483$, $p=.002$) and *common place* ($F(1, 279)=6.798$, $p=.01$) but no main effect for *family ties* ($F(1, 279)=1.547$, $p=.214$).

The above suggests that shared beliefs (religion, politics, cultural background, and causes) do not significantly help predicting online interactions when controlling for other factors. Likewise, social interactions do not significantly differ for relatives vs. non-relatives (family ties), when other factors are considered. Overall, as seen in Figure 5.2, the relationship suggests that **the more aspects one shares, the more frequent the online interactions are** – especially when there are common interests and when people engage in joint activities. This

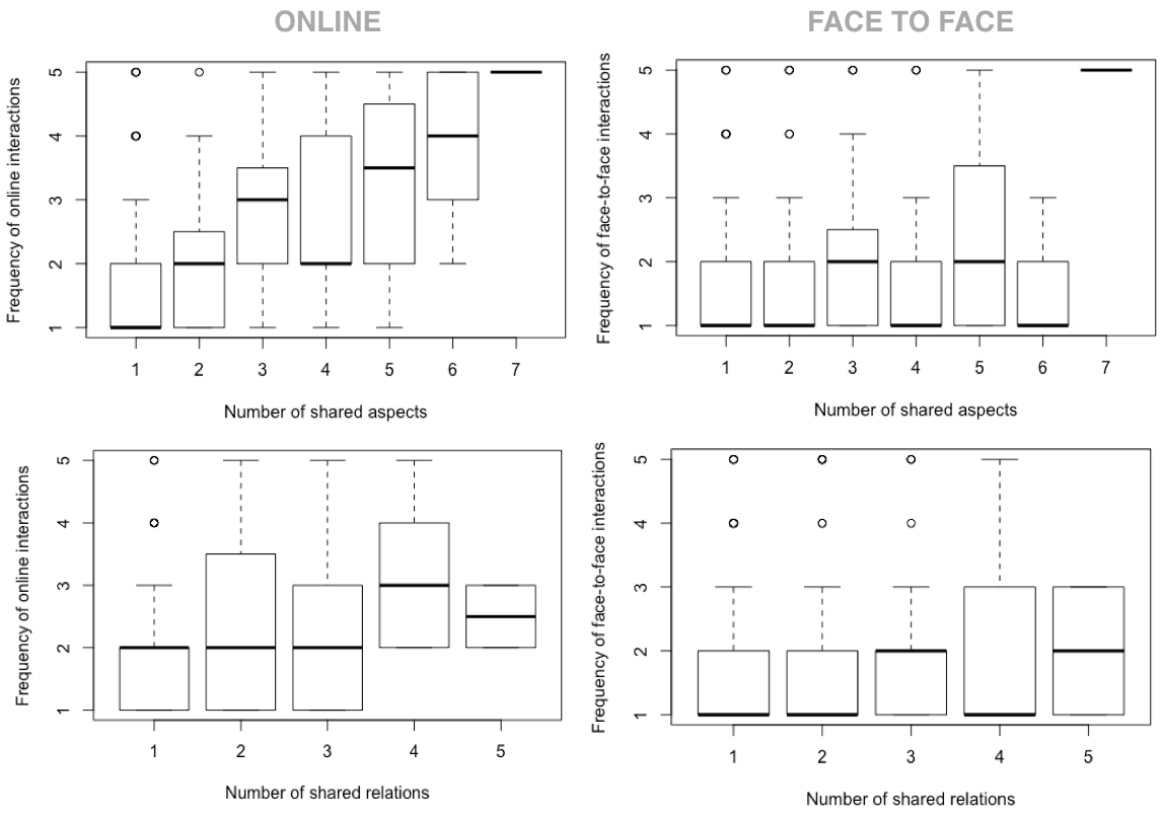

Fig. 5.2 Common aspects and social interactions. ©2016 IEEE.

trend is not present in shared relations, where some relationships might be dominating the effect.

Using the same model with the level of *face-to-face interactions* as dependent variable, the results show a main effect for number of shared relations ($F(1, 279)=8.328$, $p=.004$), a main effect for number of shared aspects ($F(1, 279)=12.587$, $p<.001$), and an interaction effect between both variables ($F(1, 279)=9.420$, $p=.002$).

Replacing the independent variables for their individual components in the model, we see a main effect for *shared activities* ($F(1, 279)=5.388$, $p=.02$) and *shared interests* ($F(1, 279)=11.480$, $p<.001$) but no main effect for shared beliefs. We also observe main effects for *family ties* ($F(1, 279)= 4.940$, $p=.027$) and *common locations* ($F(1, 279)= 4.513$, $p=.034$) but not for *common institutions*. These results are similar to those for online interactions with the difference that **family ties become a relevant predictor of face-to-face interactions**.

5.4.2 Connectedness is related to common life points and face-to-face interactions

To test whether there is a significant difference in connectedness for the various levels of social interactions, we performed an analysis of variance with *connectedness* as a dependent variable and the levels of *online* and *face-to-face* interactions as independent variables.

The results show a significant main effect for the level of face-to-face interactions ($F(1, 659)=388.4$, $p<.001$) and online interactions ($F(1, 659)=218.5$, $p<.001$), and also a significant interaction effect between both variables ($F(1, 659)= 57.8$, $p<.001$).

We illustrate the above relationships in Figure 5.3. For social interactions, the relation suggests a **higher level of connectedness for people interacting more frequently**. The outliers for the lowest levels of interaction correspond to people living abroad but interacting online very frequently (online), as well as people spending time together but not so much of this time online (face-to-face). This is an example of the interaction effect between both variables.

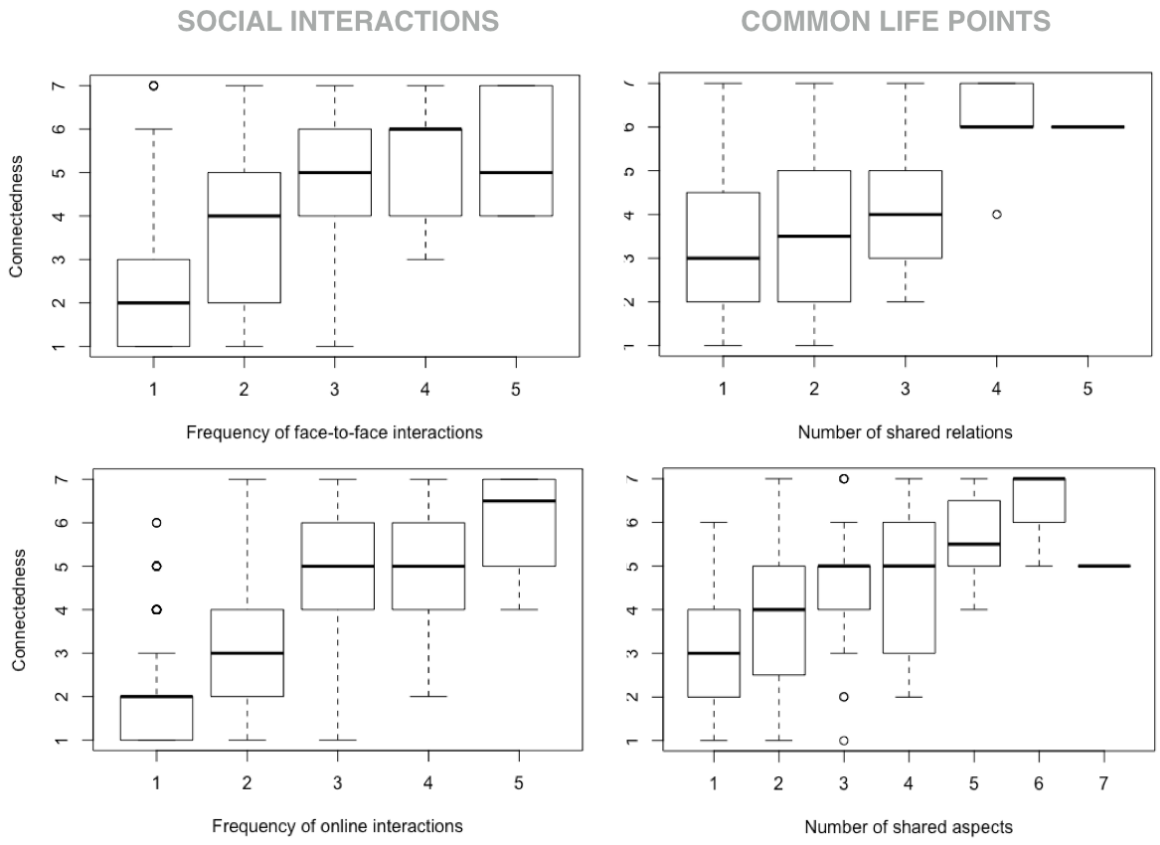

Fig. 5.3 Common life points and connectedness. ©2016 IEEE.

Analysing the relationship with common life points we observe main effects for the number of *shared relationships* (F(1, 279)=43.48, p<.001) and for the number of *shared aspects* (F(1, 279)=46.06, p<.001), but no interaction effect between both variables. These relationships are illustrated in Figure 5.3 and suggest that **having more common life points contributes to a higher level of connectedness**.

More details are presented in Figure 8.1, showing the percentage of shared aspects by connectedness level. In the figure we can see a higher percentage of participants reporting sharing common aspects for higher levels of connectedness. The difference is more pronounced for shared interests.

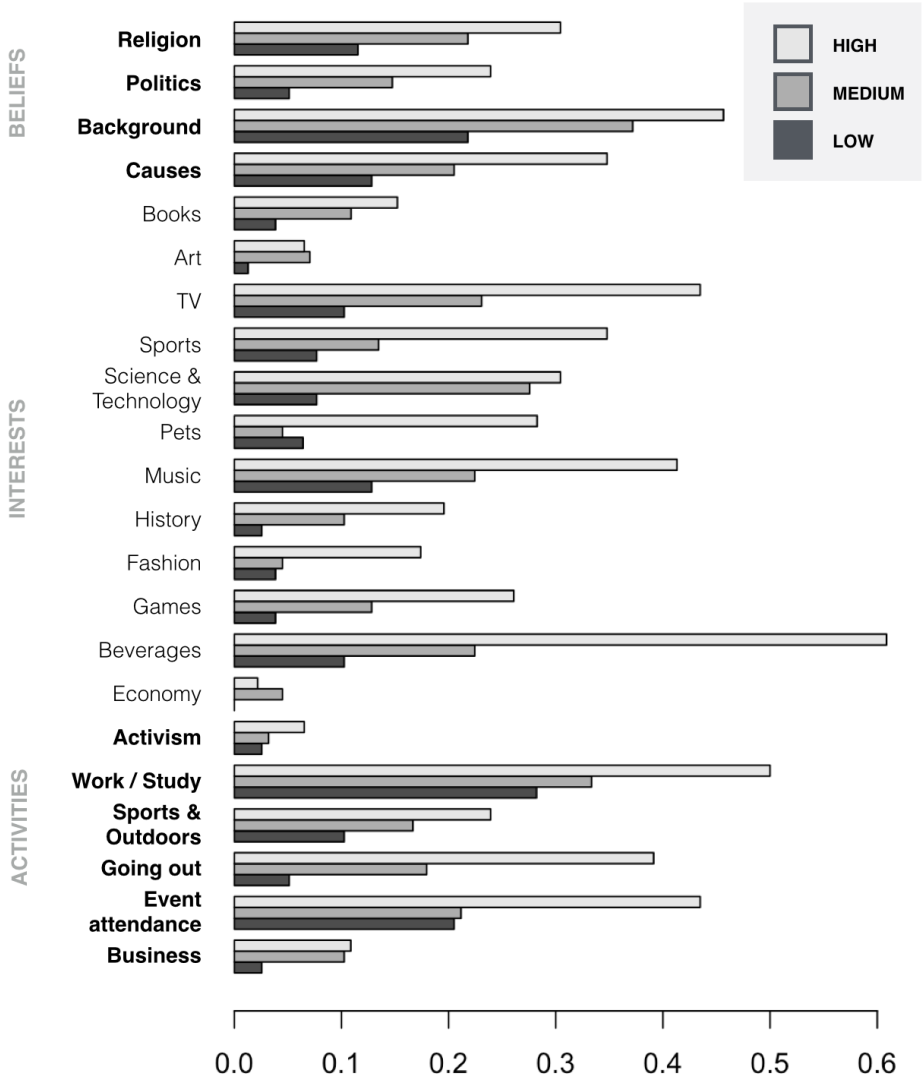

Fig. 5.4 Percentage of relationships featuring each common aspect, grouped and normalized by high, medium and low levels of connectedness. ©2016 IEEE.

5.5 Discussion

In this paper we have explored the relationship between connectedness, social interactions, and common life points on Facebook in two main research questions. As an exploratory work, the questions were approached from a general perspective but still bringing some interesting insights.

With respect to the relation between common life points and social interactions, we have seen that the more *common life points* friends share the more frequent their *online social interactions* are, and that shared interests and activities are determinant to this effect. For *face-to-face social interactions* the relationship is more complex, with family ties becoming a relevant predictor.

Interestingly, by exploring common life points we have seen that shared beliefs, as reported by the participants, is not a good predictor of social interactions, even when the literature points to this as a determinant factor [119]. We argue that this might be due to the homogeneity of the participants targeted by the study (Spanish-speaking), or simply the limitation in the type of metadata available on Facebook. Moreover, we have seen that shared activities are strong predictors, which is in line with previous literature stating that accomplishing practical activities together strengthen social ties.

We have also seen that higher levels of interaction and common life points are related to higher levels of connectedness. This suggests that one potential direction to creating bonds is generating opportunities for similar people to have meaningful interactions.

The above gives empirical support to technology aiming at increasing social interactions and creating long term bonds, by - for example - i) seeking to match users based on common life points, ii) generating conversations around shared interests, and iii) engaging users in shared activities.

As for ongoing and future work, we plan to follow up on this study to extend it to other countries (Costa Rica, Italy, Mongolia, Paraguay, Philippines, Russia, United States) and analyse cross-cultural as well as age-group differences. From a technological standpoint, we are currently incorporating these findings in the design of tools to reduce social isolation in older adults, which involve productive activities (crowdsourcing / volunteering) and socializing online. The latter comes from the fact that social interactions are of particular importance when providing productive activities to older adults [83], and it is one example of how the findings of this paper can be applied to collaborative systems.

Chapter 6

Stimulating Conversations in residential care through technology-mediated reminiscence

6.1 Introduction

Transitioning to long-term residential care demands major adjustments in the life of an older adult and his/her family [103]. In this scenario, connecting with family and peers is a key aspect contributing to adaptation, social integration, sense of belonging, and general wellbeing [24, 61, 161]. However, staying socially active can be challenging in this new environment where older adults are often placed without much choice for alternatives. Failing to remain socially engaged is known to have devastating effects on the nursing home (NH) life, contributing to feelings of loneliness, boredom, helplessness, declining mental health, reduced happiness, and increased mortality [19, 27, 146].

Despite efforts in promoting social activities in NHs, social isolation and loneliness are still main concerns in residential care [159]. The causes include different physical, psychological, and contextual factors that influence the opportunities and motivations of older adults to interact with others.

In this paper we describe the concept development of a reminiscence-based social interaction tool, called Collegamenti, that aims at stimulating conversations in residential care.

Reminiscence is the process of recollecting past memories, a practice that is common at all ages [172] and often conducted with older adults due to its various functions and benefits. Webster [171] identifies eight particular functions: death preparation, identity,

problem solving, teach and inform, conversation, boredom reduction, bitterness revival and intimacy maintenance. Thus, reminiscence serves an important social function in facilitating the sharing of personal memories with others, helping to create bonds between people [175].

In addition to lessons learned from existing reminiscence practices, our own preliminary surveys and visits (described later) identified a set of challenges that can be summarized in i) creating bonds and friendships among residents in NHs, and ii) facilitating and stimulating conversations with family members, especially the younger ones. We also understood that a solution is more likely to succeed if it fits into the processes and practices of the NH and its often overworked staff.

For these reasons, unlike previous research on the design of reminiscence applications (e.g., [8, 104, 105, 174]), the goal is not only that of creating a digital archive that preserves memories or of reminiscing one's own life, but also that of using the information and media to discover and create connections among people (residents) who shared similar experiences, values and events, and to increase bonds with one's own family.

In the following we explore the challenges to the design of Collegamenti, describing the design process from the exploration of user needs and concept development to the early validations with nursing home stakeholders. From this research through design process [189] we derive lessons that contribute to the design of social interaction tools for NH residents.

6.2 Background

6.2.1 Related Work

Previous work on design for reminiscence and storytelling can be summarized in the following topics: facilitating usage by older adults, collecting memories, stimulating memory recall, and supporting conversations.

Using tangible interfaces is a prominent approach to facilitating the use of reminiscence solutions. Memento [174] uses scrapbooks and digital pens for memory collection and sharing, combining tangible scrapbooks that are already familiar to older adults with the benefits of online sharing. A similar setting - using physical albums and digital pens - was tested in [138] with positive results in terms of engagement and social interactions. The "Reminiscence Map" [77] is another example of a digital-physical interface but with a focus on stimulating memories around places. These are great examples of how familiar interfaces can facilitate usage by older adults. However, they do not facilitate the collection of pictures or stories, and offer no support for peer interaction and discovery.

Several solutions support the collection of pictures and stories. For example, PicMemory [105] facilitates memory collection by allowing family members of all ages to collect family stories collaboratively. It also provides a multi-modal interface to facilitate contributions by older family members. PicGo [104] proposes instead a solution to iteratively collect meaningful tags from pictures during reminiscence sessions (picture capturing and browsing) with older adults with dementia. These solutions point to the importance of collaboration and gathering context from stories. However, they do not address the challenge of creating bonds among older adults and limit the use of tags to browsing.

Facilitating social interactions is instead at the center of solutions such as digital photo frames [92]. The CIRCA project [8] explores the use of databases of video, music and photos to prompt conversations among carers, relatives and older adults in residential settings. CaraClock [167] facilitates instead browsing of collective memories via a clock-shaped digital photo album that can be paired to show collective memories of a family from the perspective of each member. Virtual reality has also been explored with older adults affected by dementia, with interesting results for recreating past memories, although the support for group activities remains a challenge [149].

The above solutions provide valuable insights into the design of reminiscence technology, which we take as inspiration for Collegamenti. However, a major gap is still that of supporting social integration and bonding among residents, while also accommodating to the specific needs of older adults in residential care.

6.2.2 Our preliminary studies

To investigate the nature of relationships in residential care, we visited four nursing homes in northern Italy, in the spring and summer of 2016. During the visits, we conducted observations, semi-structured interviews and focus groups. All activities were attended by at least three researchers, in order to collect different perspectives and to reduce the chance of bias.

We found out that it is hard for residents to form friendships in NHs. The staff reports that **residents do not make friends**. In addition to the reasons mentioned in the introduction, budget and efficiency constraints sometimes interfere with fostering relationships. For example, allocation of residents is often based on the evolution of their health condition as well as organizational efficiency needs and not on their preferences.

Family members, especially the primary family caregiver (the spouse, a sibling or a child), visit very frequently, several times per week and, in some cases, every day. Young grandchildren also come along often, with some NHs even providing recreational spaces to encourage the visits, while young adults visit less frequently. This is not surprising, and is

line with surveys to university students, who reported a very low frequency of interactions with their grandparents because of lack of time and common topics of conversation [11].

The NH staff organizes various activities to facilitate social interactions such as volunteering, cooking, handcrafting, religious and animation activities. While this works for some residents, especially those more independent and integrated, stimulating interactions and participation is still a challenge. As reported during a focus group "*At the end of the day, it is up to the ability and sensibility of the staff to identify opportunities for interaction and bringing residents closer*".

Indeed an important take-home message from our preliminary studies is that there is plenty of space to improve the social interactions and the quality of relationships for people in nursing homes and their families, and to bring people together so that they can better integrate and feel part of the NH life. In this regard, **reminiscence provides a great opportunity**. Storytelling and past events are already a prominent theme in the NHs, not only as part of the reminiscence therapies for residents with dementia but as an integral part of the community as a whole:

- Corridors and shared spaces are decorated with old pictures of relevant places and news from the residents' lives (Figure 6.1A, 6.1B).
- Documentaries and films related to the residents' lives are screened as part of the animation activities (Figure 6.1C).
- Personal spaces feature pictures of family members, residents' important events and other mementos (Figure 6.1E).
- Some initiatives such as "Memories in art" from one NH, aim at sharing residents' stories with the NH community (Figure 6.1F).
- Social spaces allow for group activities as well as more intimate family interactions (Figure 6.1D, 6.1G). Some group activities rely on technology support.

The challenge is then to build on the above practices, to support the social function of the reminiscence process, to i) capture stories, taking them from the corridors to the virtual world, to involve more family members, especially younger generations; and ii) use stories to start stimulating conversations, enriching family visits, bringing people together, and creating bonds among residents.

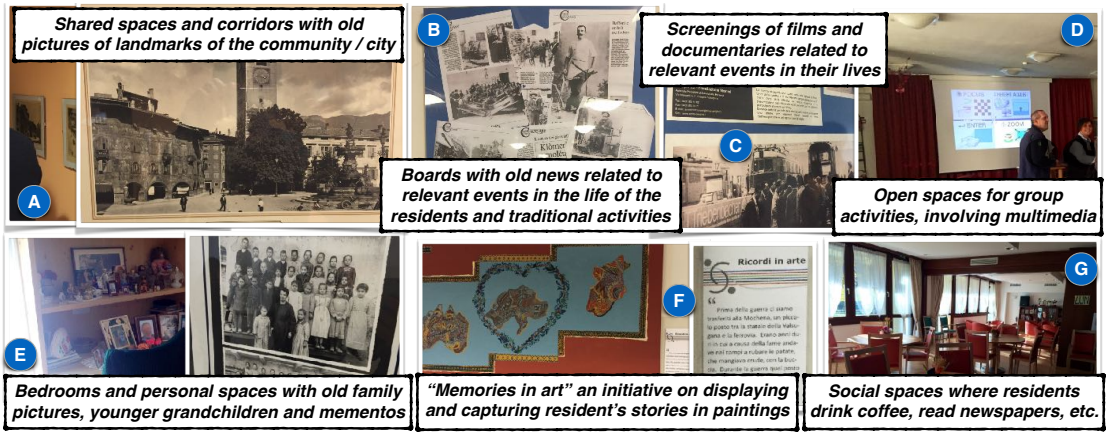

Fig. 6.1 Collage of pictures taken during the visits to the nursing homes.

6.3 Collegamenti

Based on our preliminary studies, we developed the concept of a reminiscence-based tool, namely Collegamenti, that aims at stimulating conversations in residential care. It does so by enabling family members and friends to digitize pictures related to the life of the older adult, to then browse them together in a process that motivates social interactions while collecting stories and relevant information about the life of the person. This information can be used later to summarize important moments in the life of the person and to identify peers sharing similar life events and stories with the purpose of making new friends or reconnecting with old ones.

We based the design and usage scenario on the limitations of frail residents (which are the large majority in NHs), who are not really able to operate a tablet, making the interaction with Collegamenti assisted by family members and staff. Thus, the design allows for a multi-user interaction mode, optimized so that residents are able to see the content, while the family and staff drive the sessions. As seen in Figure 6.2, Collegamenti builds on four main activities:

- **Digitizing pictures**. Family members contribute by adding pictures and tags (place, date, people in the picture), and can even collaborate to collect relevant tags on each other's pictures. This alone allows the family to build an archive of relevant moments. Once digitized, pictures are automatically added to the resident's account, becoming available to all collaborators.

- **Reminiscing and collecting stories**. During the visits, family members (or staff) engage in reminiscence sessions with the residents. Digitized pictures are used as prompts to engage in meaningful interactions and to collect stories. At this phase,

tags can also be refined with the help of the resident. The idea is to make visits more interesting, not only to collect information. Therefore, pictures and stories created can be revisited at any time, becoming a trigger for memories and conversation.

- **Engaging in online interactions**. The stories collected can be shared with the NH community and family members (on social media), which could derive in additional interactions, during visits and also online with the larger family. Residents (with the help of a facilitator) can access the feedback on his/her shared stories. Feedback from social media is captured and displayed in a format that facilitates the consumption and response. In the same way, residents can access pictures and stories from other residents (friends) that could lead to face-to-face interactions. Thus, by enabling online interactions with family and peers we do not only aim at opening a communication channel, but at stimulating conversations.

- **Connecting with other residents**. The stories and tags collected are also used to find potential friends. Building on the homophily effect, which suggests that similarities among people lead to creating ties [119], Collegamenti would suggest friends based on common life events and their likelihood to create bonds. Suggestions include reasons for the connection, that aim at i) introducing the other person, and ii) highlighting the common aspects (e.g., “You and Gianni were born in Parma").

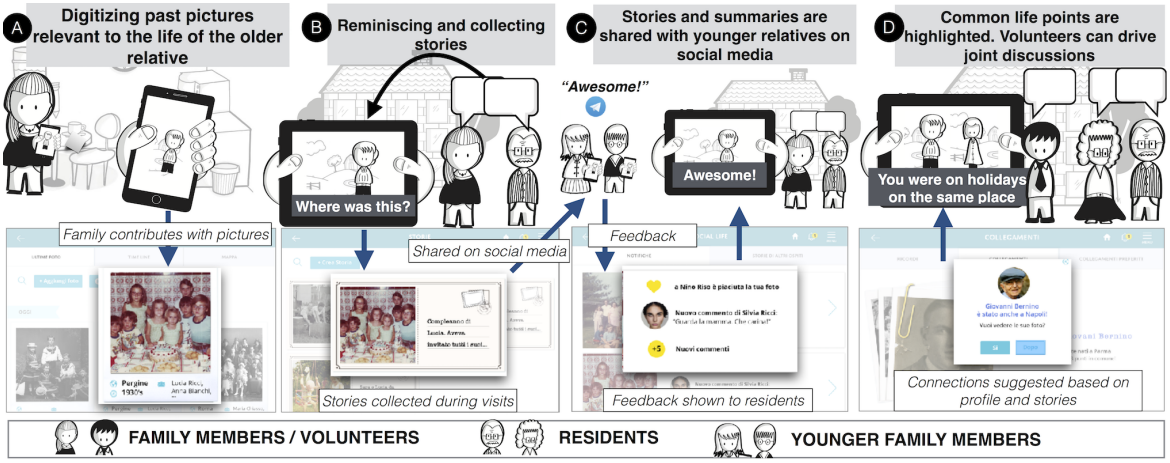

Fig. 6.2 Collegamenti concept and usage scenario.

The above process relies heavily on the cooperation and interest of the NH staff and the primary family caregiver (on average 65 years old). This poses several challenges since we need to understand if such a solution is feasible in the NH context. Aspects that deal with

the interaction design are not addressed in this paper, although the reader can refer to our low-fidelity prototype[1] for a close experience.

6.4 Methods

We conducted interviews with relatives of NH residents and members of the animation staff, and a work table with additional NH actors, aiming at:

- Assessing whether the concept and use of Collegamenti fits into current NH practices and activities performed by both relatives and staff
- Determining whether relatives and staff would be interested and able to perform the four main activities of Collegamenti (see Figure 6.2)

Semi-structured interviews were conducted by two researchers. We contacted one nursing home asking to interview relatives, and at least two members of the animation staff. The NH recruited both relatives and staff. We interviewed five relatives, each of a different resident, about Collegamenti's main activities (see Figure 2) while, one volunteer and the coordinator of animation were interviewed on their current tasks and reminiscence related activities, and on the fitness of Collegamenti in the context of their work. Both interviews were complemented with a description and a storyboard of Collegamenti.

The work table was led by the same two researchers. Eighteen NHs in northern Italy were contacted to participate, among those willing to participate we chose randomly eight people, but ensured an equal number of men and women, and that no two participants belonged to the same NH. The table was attended by three NH directors, four coordinators (one of animation), and one relative. Personas built from our preliminary studies were presented along with a storyboard and a prototype. Participants were asked to write down *challenges in the use of Collegamenti* and *reasons for not using it*, as well as *reasons for being used and liked*. Then, the four main activities were presented and participants were asked to write *challenges for their realization* and *current similar practices*.

6.5 Results

We have aggregated the feedback obtained from both the interviews and the work table, which were in a high level of agreement. Next we present the NH practices, and opportunities and challenges for Collegamenti's adoption.

[1] http://invis.io/USB4KFP7N

6.5.1 Collegamenti in nursing home practices

In some ways some of Collegamenti's activities are already conducted in NHs.

Digitizing pictures. Some residents take their old pictures to the NH, and old pictures have already been used in past activities ("*I have brought photos from home for the story book*"). Moreover, the animation staff is familiar with digitizing pictures ("*now we take pictures of old photos*") and some relatives would also be willing to help ("*I could scan the pictures... and send them by e-mail*").

Reminiscence and story collection. We have identified many comparable activities, such as making the biography on entry to the NH, collecting residents' life stories and interests, and the existence of a NH newspaper about residents' stories and past (such as old traditions, or their old craft). It is worth mentioning that NH stakeholders value such activities ("*There is a therapeutic, rehabilitation aspect to it that is very useful*"), and note that they can help to increase residents self-worth and self-esteem. Moreover, participants observe that the involvement of relatives (in this case as facilitators during reminiscence sessions) would be beneficial since it increases the interactions between relatives and residents, and increases the trust towards the nursing home ("*Involving relatives improves the relation with the NH because they feel part of the care*").

Sharing in social media is also done using NH websites or Facebook pages. Although content is mostly about current events, it was a pleasant surprise to find out that residents already have some sort of online presence. However, despite other means being used for online sharing ("*There is a digital version of the NH newspaper*", "*We share pictures in Whatsapp*"), for residents most sharing still happens offline. The NH newspaper is printed and shared with relatives and within the NH community, and the collection of life stories is sometimes conducted as a group activity. Still, this is encouraging since it indicates a good disposition towards sharing.

Connecting with other residents. Residents can occasionally find out about common points ("*Sometimes we find common points while talking all together*", "*[residents] already share -common points- autonomously or during the life stories activities*"). Nonetheless, participants mentioned that these similarities are quite significant to generate interactions and rapport between residents ("*Common interests are the spark to create a bond*").

6.5.2 Challenges for adoption

Despite the similarities between Collegamenti's main activities and current practices in NHs, there are challenges to NH adoption of Collegamenti as a tool.

Workload of facilitators. The main activities of Collegamenti can be time and effort consuming, and it is well known that the NH staff runs a tight work schedule. Clearly, residents will need support to use Collegamenti, and no one actor can support all the activities. Therefore, participants recognize the importance of collaboration between the residents' relatives and the NH staff ("*A strong involvement of the relatives is needed*").

Privacy management. Participants noted that some of the information collected from pictures and stories can be considered as personal by residents ("*Residents are still very reserved. I see this more as a family thing*"). Participants emphasized that Collegamenti should allow to control which pictures and stories are available for sharing, as well as whom to share with. This becomes particularly important if sharing is automatic (e.g. on social media).

Residents cognitive skills. Despite the assistance of facilitators, not all residents would be able to use Collegamenti. Participants have pointed out that a part of the residents might not be able to remember facts about the picture ("*Only a small percentage of residents would be able to remember all this*"). Participants have highlighted the importance of identifying able and interested residents (as well as relatives who would act as facilitators).

6.6 Discussion

The preliminary studies, along with the literature review, stress the need for promoting social interactions in residential care. This is a complex and challenging problem, requiring the support and collaboration of the care network, since most residents are limited in their ability to seek opportunities on their own.

The studies reported in this paper point to the feasibility of using reminiscence-based technology as a sustainable instrument for promoting social interactions in residential care. The proposed concept of Collegamenti has received positive feedback in terms of i) supporting current NH practices and activities from staff and family members, ii) providing more opportunities, for interaction between the residents and relatives, and for collaboration between staff and relatives, and iii) expanding the reach of reminiscence-based activities, by sharing in online channels to reach younger audiences, and evidencing common life points between residents. However, these results should be interpreted within the studied cultural context. The challenges reported also indicate the need for additional features and further consideration to the process.

Chapter 7

Design Challenges for Reconnecting in Later Life: A Qualitative Study

7.1 Introduction

Friends and family play an essential role in our lives, providing instrumental and emotional support that contributes to our general health and wellbeing. This is true at every age and even more as we grow older [73]. Across the life span, this network of support tends to become smaller [185] and more geographically dispersed [4]. These changes, along with life events such as retirement or bereavement, limit our opportunities to engage in social interactions, thus putting us at risk of loneliness and social isolation [69, 137].

Research on social interactions suggests distinct benefits and challenges of familial and friendship relationships. Friendships are associated with stronger effects on subjective wellbeing [120, 136], impact on morale [181] and better functioning [37] as compared to familial relationships. This relative importance of friendships in later life is explained by the voluntary nature of friendships, which makes them more selective and therefore, potentially of higher quality [3, 181]. For the same reasons, friendships are also more vulnerable than any other type of relation [2], especially to non-normative life events such as relocation [185]. Indeed, the reduction in the social network size with age is particularly present in the friendship social network [169, 185].

In this paper we aim at understanding the challenges and opportunities in *reconnecting* older adults with lost friends and contacts with the help of technology. Reconnecting is an emerging topic [47, 89, 90] motivated by older adults' increasing use of computer-mediated technology, particularly social media, to maintain and re-engage social connections.

Surveys with older adult users of Facebook, for instance, indicate usage to be driven mainly by the need to support and maintain existing social networks, by *checking* what friends are up to, *keeping* in touch with friends, and *re-acquiring* lost contacts [89, 90]. The latter is cited not only a source of great user satisfaction but as an opportunity to build social capital [88]. However, our understanding of reconnection is limited to studies on specific social media platforms and by older adults from specific regions (US mostly). Such limitations motivate a better understanding of how to support reconnection, and what existing or new technologies may support reconnection efforts.

In this paper, we report on a pilot for a larger multi-site study aiming at exploring the potential of reconnection in later life. We focus on the fundamental question of whether there is a wish for reconnecting, and the reasons why older adults fail to reconnect with their friends. In doing so, we aim to identify the main challenges that can help derive design considerations for technology as well as guide future reconnection studies.

The pilot was conducted in Costa Rica and Poland, locations representing different social and cultural contexts. We interviewed 28 participants and found that the wish for reconnecting is real and that the challenges older adults face are only partially addresses by current technology. In the remainder we describe the pilot and our preliminary results.

7.2 Methods

7.2.1 Study locations

In Costa Rica, we studied a rural community near the capital, characterized by very low income, very high crime rate, and high social ties within the community. In Poland, we conducted the study in a small city in a rural area with students of the University of the Third Age, where retired or semi-retired older adults can continue their education and training. In selecting these two locations, our aim was to test the pilot under different conditions, and assess whether the different social, cultural and economic contexts had an impact on the wish and challenges to reconnect.

7.2.2 Participants

We considered eligible, participants aged 65 or older, having no cognitive or vision impairments. We asked participants for pictures related to school, work, vacations, trips, or events (e.g. concerts, sport games), dating back at least 10 years and portraying three or more people (not relatives). These pictures would later be used to identify people with whom they were very close but had lost contact, people of interest (POI). The specific objective of

reconnecting was not disclosed, to prevent participants from thinking of people with whom it would be easier to reconnect.

In Costa Rica participants were recruited via phone calls, from a directory of people who already agreed to participate to a social project organized by the University of Costa Rica, of which this study is part. The social project aims for a comprehensive analysis of the health of older adults, considering biological, psycho-social and educational dimensions, in order to establish the relation with quality of life and a healthy aging. The study described in this paper was approved by Scientific Ethical Committee of the University of Costa Rica, by resolution VI-3149-2016 on May 10, 2016. In Poland, recruitment was done face-to-face at the University of the Third Age.

We conducted semi-structured interviews with 38 older adults (26 female and 12 male). We discarded 10 interviews from Costa Rica from the analysis, resulting in a total of 28 participants (18 female and 10 male, age range: 66-90, mean: 71.8). Interviews were omitted for the following (non-exclusive) reasons: participant had recent contact with POI (7), participant was related to POI (2), participant did not indicate a POI (3), and POI had passed away (1).

7.2.3 Procedure

Before the start of the interview, participants were asked to read and sign the informed consent, along with the permission to record audio and make a copy of the pictures brought in response to our request during the recruitment.

Interviews were face-to-face, between one participant and one researcher. To guide the interviews, the researchers used a form including fields to fill in information and take notes as appropriate. We used the old pictures as the main driver for discussion within the semi-structured interviews. At the beginning of the interview we asked participants to think of a single person, who appeared in their pictures, and with whom they had been very close but had lost contact. After identifying and describing this person (POI), we asked: i) the reason for losing contact with the POI, ii) whether they had tried to find out about, or contact (i.e. *reconnect* with) the POI in the past, iii) strategies used to *reconnect*, if they had tried, or the reasons for not trying.

7.2.4 Data analysis

We conducted an inductive content analysis [52] on the answers to the form, recording transcriptions, and researcher notes. The coding was completed independently by Spanish and Polish native speakers. After this step, the codes as well as the excerpts were translated

to English, and researchers worked together for the grouping and following phases towards a unified categorization of the content.

7.3 Findings

7.3.1 The wish to Reconnect

Our results show that the problem of "losing contacts" is real: We identified friends with whom people had lost contact in nearly all interviews (barring 3 participants who could not identify a POI among the set of pictures they brought). In most cases these were friends from school, work, or neighbors. Moreover, only for 4 out of 28 *randomly* selected lost contacts there was no interest in reconnecting.

The main reasons for disconnecting were people relocating or the association ending (e.g., people changing jobs, finishing school), thereby ceasing the occasion for contact. For relocation, however, economic and social factors differ (e.g. migration and employment instability in Costa Rica and moving to study for Poland). These observations support current literature on the vulnerability of friendship relationships [2, 4] and on how life events shape our social networks making them smaller and more dispersed [4, 185].

The wish to reconnect was manifest in two distinctive ways: *resuming contact* with the lost friend, e.g., by trying to contact them directly, and *checking out* what the lost friend is up to without necessarily engaging in a conversation, e.g., asking a friend about them. These two scenarios are closely related to the motivations of older adults who actually use online social networks [89, 90].

> “She changed phone numbers and then we lost contact...”.
> An attempt to contact directly. (JO, 67M)

> “I wanted to establish contact [with the POI] so I asked friends from school but they did not know anything about [the POI]”.
> An attempt to get updates. (KR, 69F)

7.3.2 Challenges to reconnection

Practical and perceived barriers prevented participants to attempt or realize their wish to reconnect. In most cases, the interest in reconnecting was not followed by actual attempts (17 participants did not try, out of which 4 expressed no interest in reconnecting). Only 5 participants acted (unsuccessfully) on their wish, while other 6 tried only to get updates about their lost friends through common contacts.

For those who did not try to reconnect, reasons were mainly that i) people did not know how or have the means to get in touch (9 people had no way to contact or had lost track of the POI), and ii) it felt awkward just "popping up" in people's life after a long time. This was true in general but particularly among people of opposite genders (3 out of 5 cases were POI and participant were of opposite genders).

Digging deeper on the awkwardness aspect, we identified two salient aspects. The first was a certain discomfort in initiating a call to reconnect. Another issue was the "appropriateness" of contact (e.g. contacting a now married female friend). Thus, the challenge might not only be finding a way to initiate contact but also creating opportunities comfortable for both sides to write or talk. This observation is supported by a recent study on relational and individual factors affecting users decisions to accept friend requests on Facebook from people who had been out of touch for long periods, indicating the influence of factors such as social anxiety, sociability, uncertainty about the partner and perceived reward [140].

"It would have been awkward to stay in touch... back then you had to have respect and keep distance... it was not convenient".
Appropriateness of contact. (GP, 69M)

7.3.3 Opportunities for technology

What we take home here as a first observation is the wish for a "third party" to be involved in creating opportunities for reconnection that takes away the burden of initiating contact and the related awkwardness (and possibly even making the encounter appear as random). Participants referred to this as persons who would organize a reunion, but we speculate that an IT system could play the same (or a supporting) role.

This being said, participants who had last met their contacts in reunions reported the interest in keeping in touch fading after some time. It is therefore clear that reconnection and relational maintenance should go hand in hand. This hints to the importance of social context and associations [139], and building on common aspects [144], so as to motivate meaningful reconnection and strengthen bonds. IT systems should support this need by helping older adults keep connections active or reviving dormant ties (as suggested by previous studies, e.g., [108]).

Another aspect is related to finding contact information on the lost friend. Interestingly, not having the contact at hand, and so having to ask others for help, sets the barrier to reconnecting too high for some participants. Social search features can lower these barriers by allowing users to find their friends online. Still, the limited personal information shared by

older adults on social media [78] and the perceived complexity [90] might pose challenges to an effective use of these tools.

> "I could try to reach [the POI], my daughter in law's sister is working in [the workplace of POI], but I do not want to involve other people into this". Unwillingness to ask for help. (JE, 68M)

Social networks provide a good foundation for enabling reconnection, providing some of the basic features. However, reconnecting is a complex construct that is not guaranteed by the ability to find the contact, thus requiring further studies on how to facilitate serve this specific emerging need.

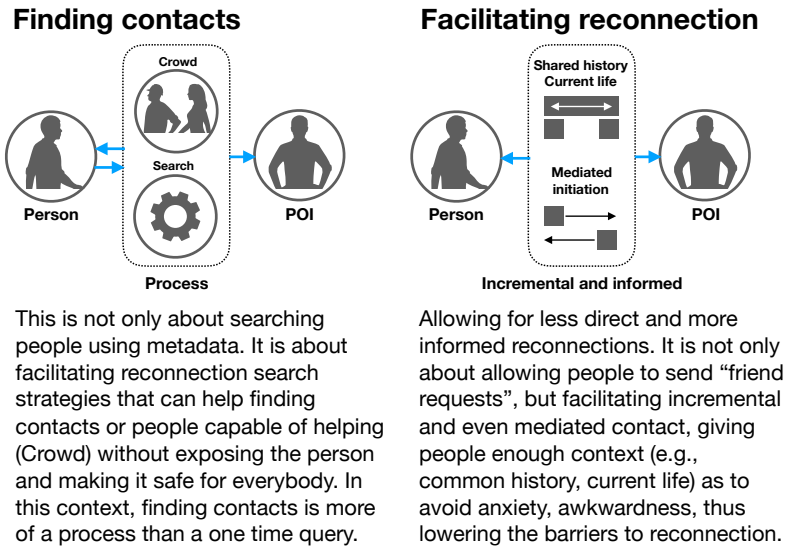

Fig. 7.1 Opportunities for Technology.

7.4 Discussion

Our preliminary studies point to a wish for reconnecting in later life, independently of the cultural context. We found that there is the opportunity for doing so since technology today falls short, failing to address some of the barriers that prevent reconnection attempts. Social networks are a good foundation, but we argue that technology should assist on initiating contact, help to find contact information and keep (re)connections active and meaningful. Search should be more about facilitating strategies that take advantage of the help our network or others can provide to find lost contacts, while friendships request should provide context to reduce awkwardness and become less intrusive (see Figure 7.1).

With respect to culture, we observed that only respondents from Poland did not want to involve other people when trying to reconnect with their lost contacts. This hints to the importance of cultural aspects in the design of suitable solutions. While in Costa Rica relying on one's own social network for help could work, in Poland the adoption of such solution seems less likely.

This pilot helped to identify limitations and considerations for future studies. First, we did not characterize the strength of the connection between participants and their POI. To some extent, this comes from randomly selecting contacts, but a follow up investigation on this aspect could have helped to better identify means for reconnection. Second, we did not evaluate use and role of technology. This aspect would clarify whether current tools are being used, and the effect of challenges, such as complexity and unclear value of use, mentioned in previous studies [90, 127]. Third, it would have been helpful to explicitly ask participants on their intention to reconnect with POIs, if given the chance, and to study successful reconnection cases. These aspects will be considered for our future work.

Chapter 8

Validating a reminiscence-based tool to improve interactions in the nursing home

8.1 Introduction

Failing to maintain meaningful connections and stay socially active is a growing concern in residential care [159]. The transition to this new social context demands adjustments by the older adults and their families that are not easy to assimilate [103], requiring nursing homes to devise special activities that promote social integration and a sense of community. Promoting social activities is fundamental, as failing to keep residents socially engaged can have devastating effects on their quality of life [27].

Despite these efforts, social isolation and loneliness still plague residential care. Surveys among cognitively intact care residents report incidence of loneliness ranging from 29% (sample of 314 participants from Ohio [18]) to 55% (sample of 483 very old participants from Finland and Sweden [130]) of residents. This calls for better support for social participation in residential care.

In this paper we explore the feasibility of reminiscence technology to support and stimulate co-located and virtual interactions in residential care. In our previous work [79], we derived the concept of a social interaction tool inspired by reminiscence therapy, to support nursing home social activities. We now report on the validation and acceptance of this concept via semi-structured interviews with nursing home (NH) stakeholders and pilot studies of co-located reminiscence sessions.

Understanding how technology can support co-located activities is of growing interest in the HCI and CSCW communities. It has been investigated in domains such as supporting collaborative work [112], visiting parks and museums [50, 99], playing games [116, 186]

and digital storytelling. We put emphasis on co-located interactions as they represent the most critical point in the social interaction model we devise, as well as a challenging activity from the design perspective.

While the idea of reminiscence technology is not novel (see [101], a review focused on older adults with dementia), we have seen little work leveraging the collected information to motivate interactions (e.g. [9]), especially within residential care facilities, and to find connections among residents.

In what follows we describe the proposed social interaction model and outline general recommendations for co-located reminiscence sessions supported by technology.

8.2 Design concept

The concept was developed with the aim of stimulating social interactions in nursing homes, via co-located interactions in reminiscence sessions, virtual interactions through shared stories, and creating connections through common life points. This concept is the result of a series of visits to nursing homes, interviews, focus groups and workshops [79].

The process defined by the tool is comprised by the activities illustrated in Figure 6.1. A central figure in this process is the helper, who will be in charge of handling the device and assisting older adult residents by guiding the activities described next:

- **Digitizing pictures**. The family contributes with pictures related to the resident and tags (place, date, people), to create an archive that can later be enriched with stories. Pictures can be added as older adults enter the nursing home, or continuously during their stay.

- **Reminiscing and collecting stories**. During visits, family members use pictures to trigger meaningful conversations and to collect stories. The idea is to make visits more interesting, not only to collect information. Therefore, pictures and stories can be revisited at any time, shared with family and friends online, thus generating memories and stimulating conversation. Nursing home staff can also assist or conduct the activity itself.

- **Engaging in online interactions**. Feedback and comments on the stories shared are displayed in a format that facilitates consumption by the resident. Residents can also access pictures and stories from other residents in the nursing home (friends), potentially leading to face-to-face interactions.

- **Connecting with peers**. The information in stories and tags are used to find common life points among nursing home residents. These common aspects are used to create mutual awareness, and to provide information about similar interests and affinity with certain topics so as to support animation activities.

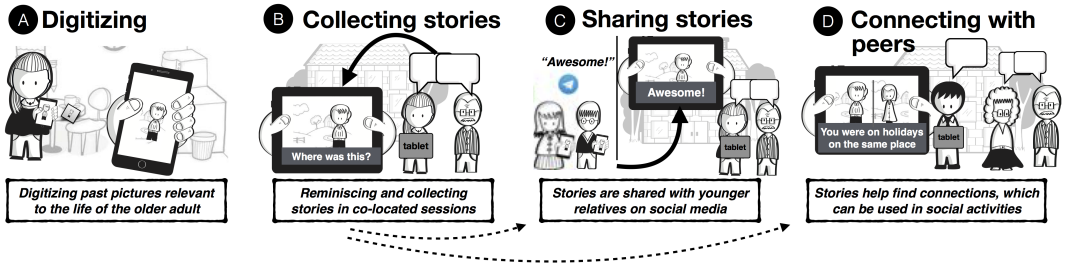

Fig. 8.1 The application concept explained

The process above describes a social interaction model focused on co-located interactions enabled by reminiscence, but also leverages on the opportunities that emerge from sharing and finding common life points.

The design is built considering co-located presence, and in particular, visits from family members as well as social and animation activities in nursing homes. The co-located setting poses two main research questions:

RQ1. How to effectively support co-located social interactions?

RQ2. Can helpers (family members, nursing home staff, volunteers) cooperate in this process? And how?

The latter is instrumental, as we need helpers to play an active role in the activities described above. The co-located setting enables helpers to guide the use of the tool, which is important given the limitations of frail residents (a majority in nursing homes) who are not really able to operate a tablet. Nonetheless, those residents who are able could also operate the tablet and complete the sessions by themselves.

8.3 Methods

We conducted two separate studies in 4 nursing homes in Northern Italy. To recruit participants, we contacted a reference person from each nursing home, who invited relatives of residents as well as staff members dedicated to animation or other related activities.

In the first study, we evaluated the feasibility and perceived value of the tool, putting emphasis on what to expect from family members and nursing home staff in terms of cooperation. In the second study, we prototyped reminiscence sessions, to understand the challenges and dynamics of collecting stories and co-located interactions.

These studies were approved by the Ethical Committee of the University of Trento as research protocol 2017-003 on March and July 2017. All participants were asked for permission to record audio or make copies of their pictures, and to sign an informed consent form.

8.3.1 Study 1. Evaluating feasibility and value

In this study we evaluated the benefits and expected contributions to the main activities of the tool (see Figure 6.1) by the family members and the nursing home staff. In order to differentiate the activities more clearly, we evaluated "browsing" and "collecting" stories (see Figure 6.1B), as well as sharing stories with "family members" and "other residents" (see Figure 6.1C) as separate activities.

We recruited 27 participants (21 females, 15 relatives) but excluded 3 relatives who did not complete the study questionnaires, for a total 24 participants (20 females, 12 relatives). Two participants did not finish because the tool would not work with their relatives (one was blind and one did not speak), while one refused to continue after saying his relative had no old pictures.

At the beginning of the study we used a storyboard to present and describe the concept, each activity and its expected benefits. Using a printed mockup[1] we then presented each activity in more detail, asking on the feasibility to perform the activity and perceived value (5-point Likert scale), as well as open-ended questions to elicit feedback. After evaluating activities, we requested participants to rate (on a 5-point Likert scale) the importance of the objectives addressed by the tool as perceived by them.

8.3.2 Study 2. Prototyping co-located reminiscence sessions

This study prototyped the experience of co-located social interactions in reminiscence sessions among resident-relative pairs. With the help of the nursing home, we recruited 3 resident-relative pairs (4 females, 1 relative was also a staff member). No participants were excluded.

[1] http://invis.io/USB4KFP7N

Prior to the study, relatives were asked to share 10 old pictures from their older adult relatives with the nursing home reference person, who then digitized the pictures shared. We later used these pictures to prepare the supporting tool for the reminiscence session.

The reminiscence session was designed to have the relatives play the role of helpers, using an iPad tablet to browse through old pictures of the nursing home resident and fill in picture related information (e.g. place, time, people, activity) in a form. We use Google Forms to prototype the story collection and reminiscence session (Figure 8.2). The form was designed to give emphasis to the pictures and request picture related information.

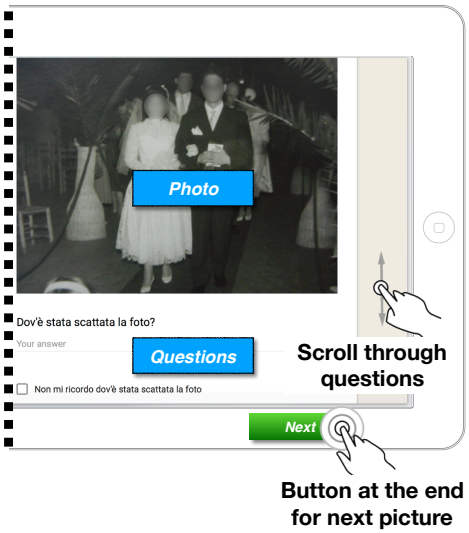

Fig. 8.2 Google form running on an iPad tablet, as used in the reminiscence sessions. Annotations highlight main content and gestures.

The session started with demographic information completed by the family member on the tablet, which we used to quickly train relatives on tablet gestures and navigation through the questionnaire. We then allowed 25 minutes to complete information on as many pictures as possible. Two researchers were present, one to guide the activities and another to observe and take notes.

To evaluate the experience of helpers, we used the System Usability Scale (SUS) [25] and the Enjoyment sub scale of the Game User Experience Satisfaction Scale (GUESS) [135]. We also measured perceived difficulty of the session, ability and willingness to repeat the experience (reminiscence session), and perceived usefulness, with a custom questionnaire using 5-point Likert scales.

Researcher notes, observations, and audio recordings were used to better characterize the participant's behavior and to understand the reasoning behind the reported scores.

8.4 Results

8.4.1 Feasibility and perceived value

We evaluated all activities for feasibility and perceived value as agreement with the statements "*I will be able to perform this activity on my own*" and "*This activity helps to accomplish the objectives described*", respectively. All participants said they would be able to "browse" and "collect" stories, while other activities received neutral or lesser scores. Sharing with "family" (83%) and "NH residents" (58%) were the only activities which received scores lower than neutral. For perceived value "digitizing" and "collecting" had only positive scores. Again, the remaining activities had neutral scores and only sharing with "family" (83%) and "other residents" (66%) had lower (although still overall positive) scores. For both feasibility and perceived value, negative scores were given by the same participant, who was a relative. Staff members only gave neutral scores to "digitizing" and "sharing with NH residents".

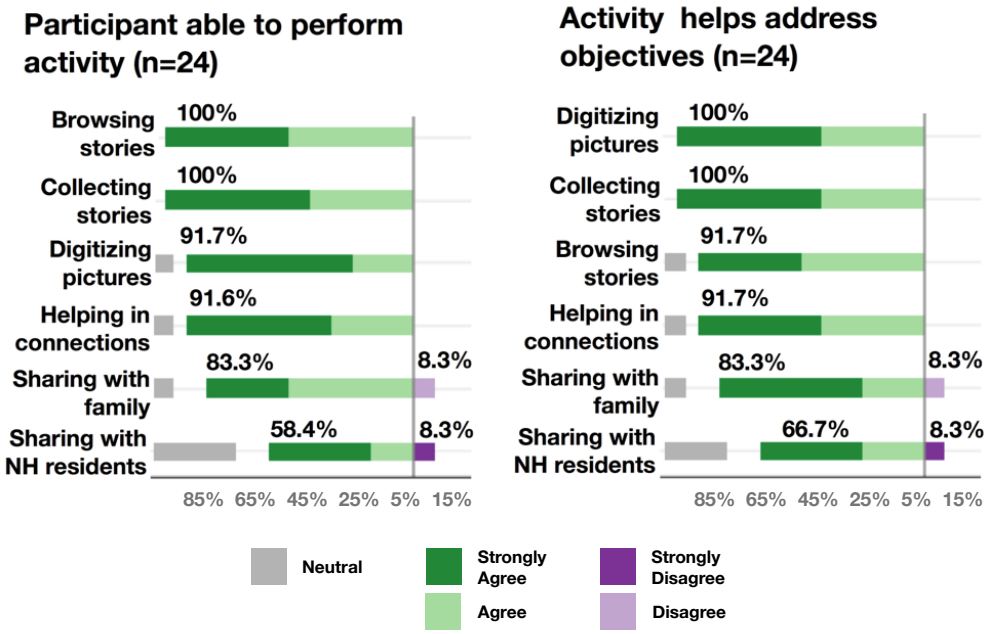

Fig. 8.3 Results on feasibility and perceived use

Participants perceived the objectives addressed by the tool as important or absolutely important. As seen in Figure 8.4, this was the case particularly for "stimulating memory" (100%). Making residents aware of the interest generated by their stories (83%) and fostering bonding among residents, possibly creating new friendships (87%) received a few more

neutral scores, all from family members. Nursing home staff on the other hand saw these objectives as very important.

Perceived usefulness of the tool was quite high for participants (91%) but lower for nursing home residents (71%), as more participants gave neutral (21%) and negative (8%) scores. In this case, staff members gave only positive scores to perceived use of the tool (for themselves) and only relatives gave negative scores to perceived use for nursing home residents (considering only their relative).

Results for intention to use were very positive, in line with the high scores observed throughout. Out of 24 respondents, 20 said they would use they tool. Only, two relatives replied with *I don't know* and each a relative and staff member said they would not use the tool. However, the staff member (a social worker) clarified that the tool would not help in her tasks directly but that it would be very useful for her colleagues.

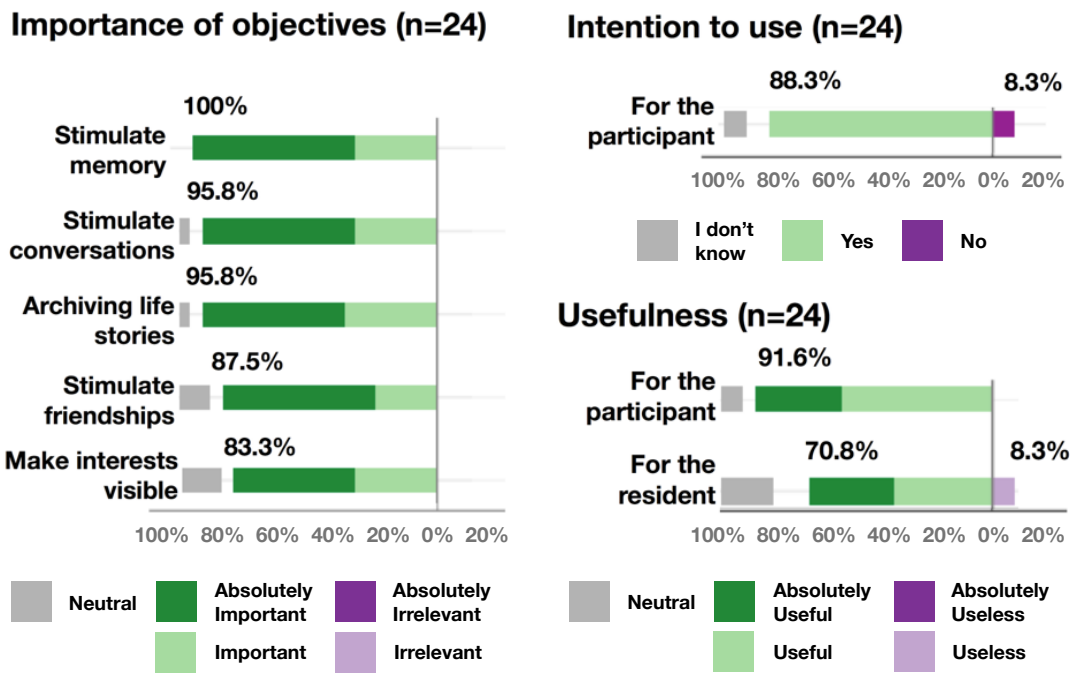

Fig. 8.4 Results related to usefulness and intention to use

8.4.2 Co-located reminiscence session

Since respondents were few, we present results referring to family members as F1 (female, age 37, staff member), F2 (male, age 57) and F3 (female, age 60). The older adult participants assisted in the reminiscence session by their family members, were respectively OA1 (male,

72, had speech impairments), OA2 (female, 88, had memory impairments) and OA3 (female, 80+, provided only range for age).

On the question about how many times participants would "be able" to repeat the activity on their average month, participants said *between once a week and once a month* (F2,F3) and *between once a day and once a week* (F1). Only one participant (F2) said he would "like" to repeat the activity more often, to *more than once a day*.

In general, and considering also the experience of NH residents, participants had a good time during the reminiscence session. The Enjoyment sub scale items from GUESS were rated on a scale from 1 to 7, with 7 representing Strongly agree. The score is obtained by averaging scores given to all items, and ranged from 6.6 (F2, F3) to 7 (F1).

The perceived usefulness of potential uses for the stories and pictures collected in the reminiscence session, were rated on a scale from 1 to 7, with 1 representing Extremely useful. F1 and F2 gave perfect scores for all potential uses but F3, who showed some reluctance towards sharing out of the family, scored the items *Receiving information about common interests between your loved one and other residents* and *Sharing the pictures and stories with other residents* with 3 and 6, respectively.

The scores on difficulty to conduct the session were easy (F3) and very easy (F1,F2). Participants did not experience problems in operating the tablet or in touch-typing. On the usability of the Google Form prepared specifically for the reminisce session, SUS scores were 100 (F1), 95 (F2) and 90 (F3) out of a maximum score of a 100.

Elicitation from family members was mostly prescriptive, heavily based on the form questions, which seem to deter participants from coming up with more engaging questions to generate conversation. We identified well defined information elicitation strategies: *verification questions* (Who is in the picture? It is <Person>, right? [Yes]), which gave little space for symmetric conversation; *leading questions* (Who is this? Which aunt?), in which the family members provided clues in a clear effort to facilitate recall; and *recall questions* (Who is this person?), seeking a direct answer from the older adults. Independently of the strategy, it was clear that family members already had the answers to these questions, and in some cases they filled them out directly without asking the older adult participants. The use of the tablet in this context was alternated between *show* and *type*, and behaviors ranged from controlling (family member) to more shared (family member - older adult).

The sessions were effective in collecting information. All participants collected information for 4 pictures within the 25 minutes allowed, leaving no fields blank. In general, participants were uncertain about what to put in the fields *What is the story behind this picture* and *Keywords*, which we intended to be used as hashtags are used in social networks.

Particularly for *Keywords*, participants put in mostly short phrases (e.g. "A lovely day") rather than single words.

Despite the success observed in collecting information, this focus on collection hindered social interactions. While family members were typing to fill the forms, older adults were mostly silent. This silence occurred both when relatives were discussing the picture first and typing later, and when they were asking for information and typing simultaneously.

Storytelling emerged naturally, with picture aspects (people, time, place) triggering specific memories, even when residents were not able to recall the information for that particular picture (e.g. when revealed that <Person> was in the picture, OA1 would describe this person: "<Person> moved to <City>... he had 5 children"). In the case of F2, who worked with a relative with memory recall issues, the family member would try (unsuccessfully) a question and then tell the related story to the older adult resident. The resident in this case would not tell a story but leave impressions ("The happiest day of my life").

Conversations were more natural when following the topic of conversation that triggered a story. Because of the design of the form, participants tended to follow a script which made the conversation less natural. Interestingly, the family members recurred to few *reactions* in response to pictures (e.g. appraisal, curiosity) to engage older adults.

8.5 Discussion

In this paper we presented the concept validation for a tool and social interaction model based on reminiscence session. The results describe a tool that is considered useful and that addresses objectives considered as very important by the participants – in particular stimulating memory and conversations. Results also point to the feasibility and willingness of family members and nursing home staff to play an active role, especially in what regards the co-located activities. They were, however, less inclined (and neutral) when it came to facilitating online sharing and virtual interactions.

We have seen the results obtained in our initial feasibility study realized while prototyping the reminiscence-session. With minimal training, participants were able to browse through their pictures and collect stories. In terms of design, we learn that i) the interface should motivate more symmetric interactions, avoiding scripted conversations; ii) tagging should be separated from the reminiscence session (reduced, or brought up only when necessary), as family members are able to provide most of the information; and iii) the tool should allow for non-linear navigations, following elements of interest based on the flow of the conversation.

Chapter 9

Collegamenti: The design of a tool for co-located reminiscence

9.1 Introduction

This study builds on our previous research with nursing home stakeholders, which got to a validated proposition for a tool aiming at stimulating social interactions in the nursing homes.

As we have discussed in previous chapters, using reminiscence technology with older adults or in residential care facilities is not unusual. Review work has discussed the use of reminiscence technology, mainly focusing on people with dementia [101, 128, 154]. Our work, in fact, is informed by previous studies on reminiscence [8, 104, 105, 167]. Nonetheless, we have found few studies conducted on nursing home contexts that focus on the use of reminiscence technology to stimulate interactions [9, 41, 97] or finding connections between nursing home residents that could be used to foster friendships.

The focus of this study is then on designing to facilitate co-located interactions during reminiscence activities. We aim to materialize our validated proposition into a design that is easy to use, that would allow to involve nursing home residents, and that maximizes the chances to make connections ("Collegamenti" in Italian). For this purpose, we investigate the following research questions:

RQ1. How can we better convey the concepts of the application, as to facilitate learning and ease of use?

RQ2. How can we facilitate the role of helpers in the co-located sessions?

RQ3. How can we enable easy to set privacy controls?

9.2 Related work

Different frameworks and taxonomies have been proposed to characterize technology for co-located interactions [113, 124, 141]. In this section we take the perspective of how technology can support co-located practices around pictures, such as capturing, organizing, sharing and storytelling in groups. We complement this view by analyzing the technological support by the aim of the design, i.e., inviting, facilitating, encouraging and enforcing co-located interactions [86].

Collaborative capturing and digitizing of pictures has been investigated in outdoors and home settings with single and distributed devices. The Family Archive [93] is an example of a tabletop computer for home settings facilitating collaborative archiving of family memories at home by scanning print photos and even 3D physical objects. Despite this capability, a study with three families revealed that its main use case was individual archiving of memories, while the few co-located interactions were limited to the specific case of showing pictures to each other. Another relevant example is the collaborative photo taking with mobiles phones [87], where findings have shown that enforcing collaborations could lead to positive experiences and encourage interactions.

In what regards sharing pictures in co-located settings, one prominent line of research has focused on logging intent and passing virtual copies in small groups. Share Face2Face [141] was a technology probe built on top of Android sharing mechanism that allowed users to reflect on this option when taking photos. This probe did not capture specific usage and support scenarios but was successful at identifying the need for logging intent. Pass-Them-Around [111], is an example of a mobile application that allows small groups to explore pictures, first individually and then to virtually pass them around to other mobile phones, facilitating sharing by mimicking the way it is done with print photos. A system of four displays mounted on dining tables (4 Photos) [131] was designed to facilitate the sharing of pictures during meals. Pictures in the system are displayed in photo strips, with the possibility of replicating a picture in all screens if desired. Findings from a field study show the potential of co-located sharing in this setting for shared reminiscence, to manage conversational asymmetries and motivate conversations.

Sharing pictures by displaying them in shared setting is another relevant research thread. StoryTrack [14] is a digital photo display that allows pairs of users (a primary and secondary user) to navigate through digital pictures, using physical controls. During tests the device was found easy to use, frequently elicited hand gestures typical of print photos, and triggered photo- and story-driven storytelling. Displaying pictures on TV to facilitate co-located sharing was also explored and compared to printed photos [110]. Results pointed to better gesturing in print photos but otherwise both media showed the potential for enjoyable

interactions. Displays and devices were also designed to encourage co-located sharing. A prominent example is Squeeze [134], a playful display that aims at engaging people at home in co-located experiences. Other interesting concepts and directions for design of family photo displays were explored but without emphasis in co-located experiences [157].

The experiences discussed above provide valuable insights on the design of co-located interactions revolving around pictures. However, little work include older adults as part of these interactions and similarly, few of these interactions have taken place within residential care facilities. The challenges for social interactions in nursing home settings, and the effect that the conditions of older adults can have on the development of these interactions require consideration. Therefore, we frame our study in the context of co-located interactions with older adults.

9.3 Design and development

In previous chapters we have described the concept of our tool. Here, we partly reproduce this description in order to provide clarity on the activities of this study.

The tool, called Collegamenti, aims at stimulating co-located and virtual social interactions among stakeholders of the nursing home setting such as family, staff and other nursing home residents. The tool enables a set of activities related to reminiscence, with the older adult at its center but with a major role from helpers (family members, staff, volunteers) who are the ones in charge of guiding and facilitating the activities with the support of the Collegamenti tool. The main activities are illustrated in Figure 9.1.

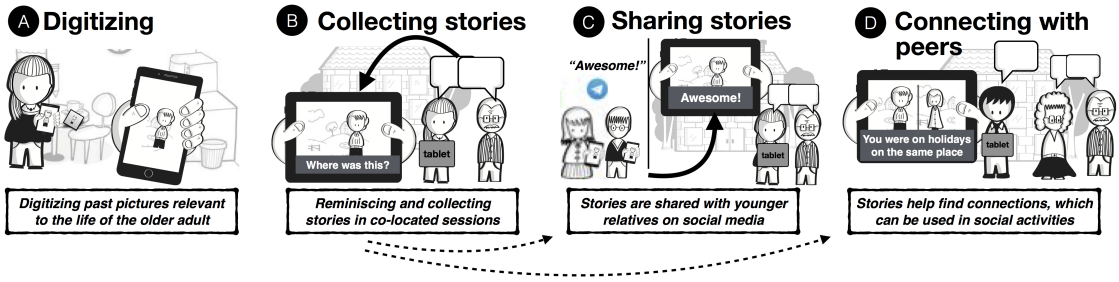

Fig. 9.1 Main activities comprised in the use of the Collegamenti tool.

A large part of this study concentrates on the *collecting stories* activity, where the co-located reminiscence sessions take place. However, this activity does not only entails collecting stories but also allows for helpers and older adults, together, to revisit and discuss on stories that have been previously created.

To design the interfaces and elements to be tested in this study we thought of metaphors that represent real world artifacts, as we believe such representation can evoke the actions for which these elements are used and thus, make the interface easier to navigate and use for participants. Houde and Salomon refer to such representations as meaningful containers, arguing that real world items "provide richer recognition clues" [74].

In the choice for these real world artifacts, we also take into account previous studies conducted with older adults. A great example are cultural probes (e.g. postcards, photo albums, diaries) [64], which have been successfully used to elicit responses from older adult participants. Cultural probes such as diaries, photo albums and scrapbooks have also been proven useful on studies aiming to stimulate reminiscence related activities [6, 174].

For our study, we use as metaphors: polaroids to represent pictures, scrapbooks to represent photo albums, postcards to represent shared stories, and telegrams to represent comments and notifications. As we will later explain, these metaphors are used in a series of graphic interface alternatives, which we compare to more traditional interfaces to understand how these metaphors could affect interactions.

9.4 Methods

We reached reference contact persons from three nursing homes in Northern Italy (two from the province of Ravenna and one from the province of Padua) and invited them to join the study. All three nursing homes agreed to participate and recruit family members of residents and nursing home staff.

A total of 32 people were recruited, including staff (15; 11 female) and family members (17; 6 female), each related to a different nursing home resident. Three family members did not go through the full study and one declined to participate. Incomplete studies were discarded, for a final total of 28 participants (13 family members, 16 female).

Semi-structured interviews were conducted by two teams of two researchers. Before the start of the interviews, all participants were asked for permission to record audio and to sign an informed consent form. The interviews presented different activities prepared to answer each research question. We describe these activities below.

9.4.1 Conveying the concepts of the application

Two alternative graphic interfaces were prepared to evaluate navigation and identification of the user interface elements. One alternative consisted of a continuity of metaphors (metaphors interface), including the aforementioned metaphors based on cultural probes. The second

interface relied on more traditional user interface design (standard interface) and common user experience patterns, such as those found in current social networks sites (e.g. Instagram, Facebook).

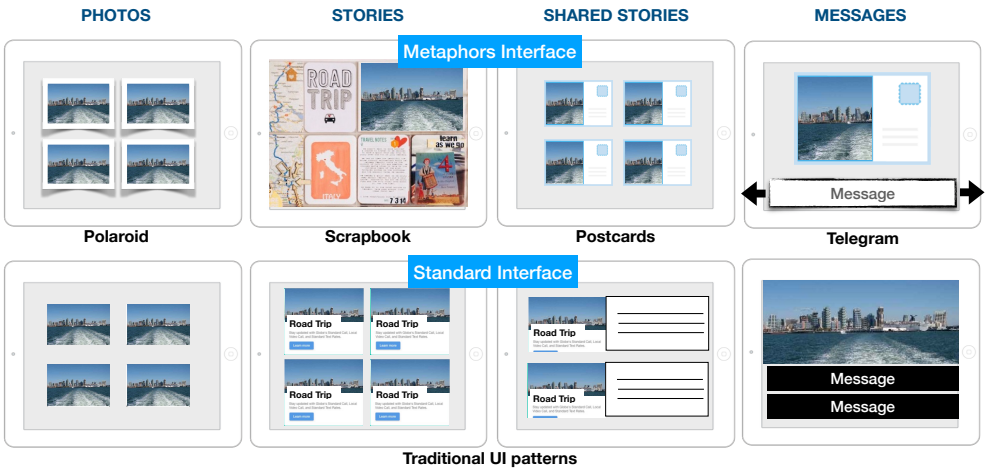

Fig. 9.2 An illustrative example on the differences between the metaphors and standard interfaces.

For both graphic alternatives, four identical tasks were prepared: (T3) digitizing a picture, (T4) creating a story, (T1) sharing an existing story, and (T2) checking a new message. However, we purposely requested the tasks be performed in a different order (shown in parentheses for each task), so as to add complexity to the activity. The tasks were performed on a high-fidelity prototype running on a tablet, with steps of the tasks being mocked towards completion (e.g. forms would fill in automatically when the user tapped on the fields).

A within-subjects, counterbalanced measures design was implemented so that participants could try and evaluate both alternatives. The order of the tasks remained unaltered, the first two task were tested on one graphic alternative and the last two on the other. Taking into account the participants excluded, 12 participants started with the Standard interface while the remaining 16 started with the Metaphor interface.

Task completion was evaluated using the Usability Test Observation Coding Form [166]. In addition, participants were asked to rate the difficulty of the tasks right after they tried each graphic alternative. Difficulty was evaluated using a 5-point Likert scale, with 5 indicating Very easy. After trying both graphic alternatives participants were asked to compare them and state whether they had a preference for either.

9.4.2 Facilitating guidance for the helpers

Three activities were prepared to assess whether participants could exploit the information and design elements presented in the interface. The interfaces were prepared as mock-ups shown on a tablet. Participants were asked to perform the tasks as if they were together with a resident (their relative, in the case of family members), using stories and pictures already created to: describe, ask questions about, and navigate through stories. Stories were created beforehand using pictures from the region were the nursing homes were located or their surroundings.

This time, two alternative graphic interfaces were prepared for each task:

- to describe stories, the *metaphors* and *standard* interfaces were presented;
- to ask questions, we compared *raw* against *enriched* information (e.g. kinship with those portrayed in the picture, "Carlo is your cousin"); and
- to navigate, one alternative allowed to *navigate linearly* by 'turning the page' in a photo album and the other allowed to *navigate dynamically* by tapping on tags to visit related stories (e.g. a story on the same location).

A within-subjects, counterbalanced measures design was implemented having the graphic interface as independent variable. Taking into account the participants excluded, 14 participants started with each alternative.

After completing each of the tasks *describe* and *ask questions*, participants were asked to rate the difficulty of the task. Difficulty was evaluated using a 5-point Likert scale, with 5 indicating Very easy. Participants were also asked to compare the interface alternatives and state whether they had a preference for either. For the *navigate* task, participants were only asked to state a preference.

9.4.3 Enabling privacy controls

This last activity was reserved for family members. Five different sharing scenarios were prepared as mock-up screens shown on a tablet. Each scenario portrayed different actors and situations that simulated past events in the life of the resident, and aimed at stimulating varying degrees of privacy:

- New year's party, showing two people known by the older adult resident, one of which is also a resident in the same nursing home.
- Trip to Bologna, showing the main square from afar and no recognizable faces.

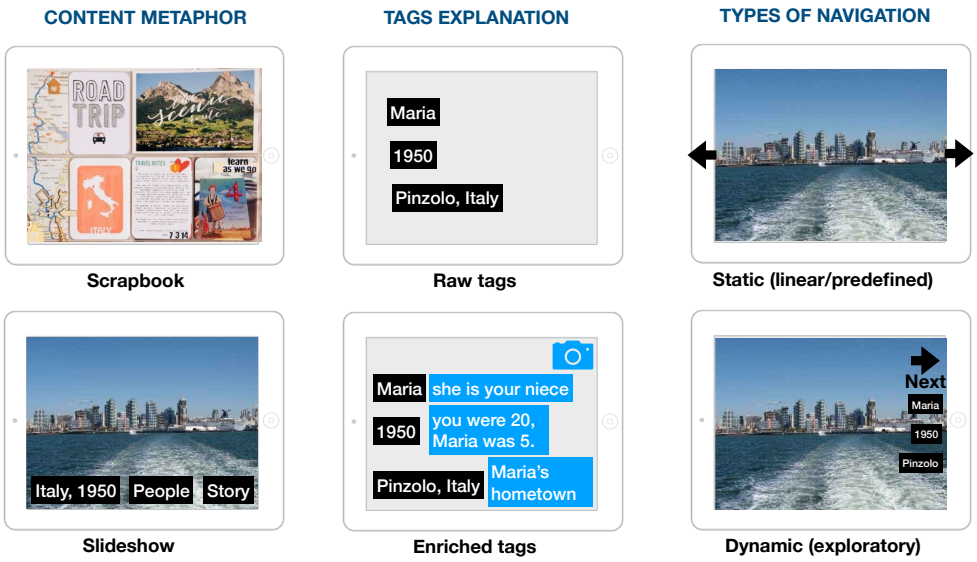

Fig. 9.3 An illustrative example on the differences between the alternative interfaces presented for each activity. The content metaphors used to describe stories, tags to ask for questions, and the types to navigate through stories

- Summer walk, showing a couple portraying the older adult resident and his/her partner when they were younger.
- Birthday party, showing the family member participant when young, along with a cousin and a childhood friend (who portrays also the daughter of another resident in the same nursing home).
- Group picture, showing members of the band of the town, including another resident of the nursing home and a relative of other nursing home residents.

For each sharing scenario, participants were asked with whom they would not share the picture among: their own family, friends, other nursing home residents, and the public in general. Once all sharing scenarios were presented, participants were asked on their feelings of satisfaction with the sharing options (i.e. groups available to share with) and of control of the sharing preferences (e.g. if controls to share with specific people were needed). Both the feeling of satisfaction and of control were evaluated on a 5-point Likert scale, with 5 representing the highest score.

A total 13 family members responded to the sharing scenario questions, but four family members were not asked about their feelings of satisfaction because of time constraints (e.g. participant having to leave).

9.4.4 Qualitative analysis

Open-ended questions from the semi-structured interviews (e.g. comparison between interface alternatives) were analyzed to better understand the reasoning behind the scores and preferences reflected by the quantitative results from the first two research questions.

Audio recordings from the interviews were transcribed into Italian by two researchers, one from each team that conducted the interviews. Inductive content analysis [52] was then conducted on the transcripts by the same two researchers, independently and using the Senior Technology Acceptance and Adoption Model (STAM) [142] as a reference for main categories in the categorization phase. The excerpts from the transcripts were kept in Italian, but the codes were assigned in English. In addition to the STAM codes, each excerpt was annotated with a sentiment value (positive/negative), along with the activity and the interface alternative to which it referred (e.g. RQ2-describe, metaphors interface), as well as a code summarizing the feedback received.

After the two researchers finished all the content analysis steps independently, they met to reach agreement on all excerpts. The other two researchers who conducted the interviews but did not participate in the content analysis were consulted to resolve differences in the codes and interpretations.

9.5 Results

9.5.1 Conveying the concepts of the application

We observed a slightly better task performance of participants on the *standard* interface (52% fully completed, 23% called by the researchers) as compared to the *metaphors* interface (43% fully completed, 39% called by the researchers). However, a Kruskal-Wallis test showed no statistically significant difference in task performance between alternative interfaces, and only a marginally significant difference between age groups ($H(1)=3.745$, $p=.053$). As seen in Figure 9.4, younger participants did better than older participants, and the performance increased as participants went from one task to the next. This was expected as participants were not instructed in the use of the interfaces prior to the start of the activity and were asked to complete the tasks by "guessing" the sequence of actions.

The self-reported ease of performing the tasks on both design was consistent with the results above. The median ease score for the standard interface was 4.25 and for the metaphors interface 4, indicating a slight difference in favor of the standard interface. A Kruskal-Wallis test however showed no statistically significant difference in the ease score between both interfaces.

When asked about their preference, 13 participants chose the metaphor, 11 chose the standard interface, and four said they did not prefer an alternative over the other. Looking at the preference by age, we see a preference of the older group (45-64) for the standard interface and that of the younger group (25-44) for the metaphors interface. Interestingly, the younger group chose the metaphors interface despite performance results favoring the opposite interface. A Fisher's exact test to compare the incidence of age on preference did not show statistically significant results. Comparing performance of participants and preferred interface we observed no significant influence. The performance by interface preference is illustrated in Figure 9.4.

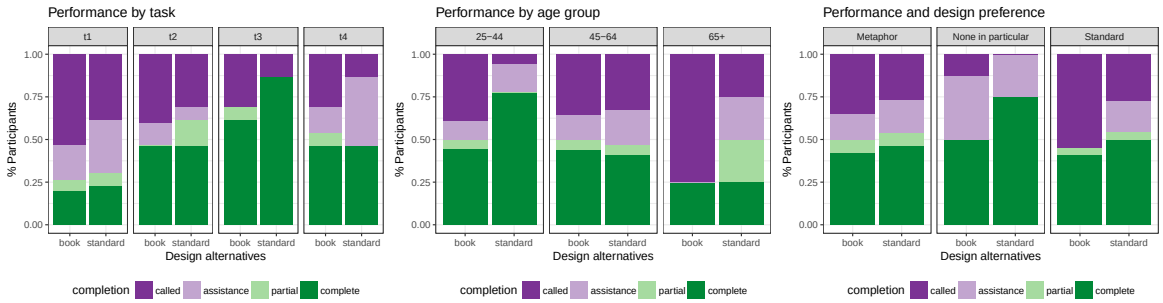

Fig. 9.4 Characterization of task performance on the design alternatives.

As shown in Figure 9.5, the data from our content analysis revealed few negative comments for both alternatives, and that most positive comments were related to *ease of learning and use*. Participants from the younger and older groups praised the standard interface alike, suggesting that it would not be a problem to use it.

Taking into account the preference of participants, those from the older group that preferred the standard interface mentioned that it was easy to use because it is similar to current technology.

> " It is closer to the mobile phone and other things we use, [so] I would handle it better". (S9, 45-64)

> "Just like Facebook, Share... we have a group of cousins on Facebook". (F17, 45-64)

The reasons why participants from the younger group chose the metaphors interface is less clear, but their comments suggest that it could be because they liked the metaphors and thought older adults could relate to them.

> "I like [the metaphors] more... I think it is more personal... like if it was really on a diary". (S4, 25-44)

"One of the residents here has a book... a notebook... so a thing like this, they could really relate to it... [the metaphors interface] is a like board where you can put stickers... it has all these bookmarks". (S5, 25-44)

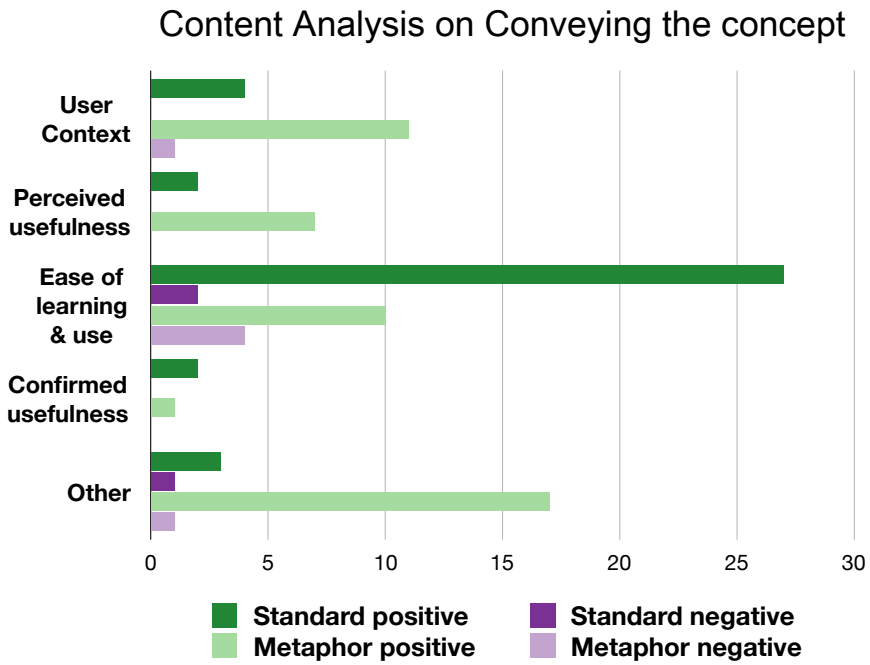

Fig. 9.5 Main categories of the STAM when evaluating how elements conveyed the concepts of the application. The standard interface was praised for its ease of use.

9.5.2 Facilitating guidance: Describing

Both the metaphors and standard interfaces obtained a mean perceived ease score of 5. The score differences were not significant also when age was considered. The difference observed in Figure 9.6 is due to the low number of 65+ participants.

Again, more participants preferred the metaphors interface (14) over the standard interface (12), and two participants did not have a preference for either. However, there is a marked difference when role is considered, as 11 members of the staff chose the metaphors interface and 9 family members chose the standard interface. Also, as in the previous activity, most participants in the younger group (25-44) opted for the metaphors interface indicating that their preference does not change when older adults are involved in the activity.

From the content analysis, more negative comments came out when considering the interfaces for the purpose of describing stories to the nursing home residents. Participants

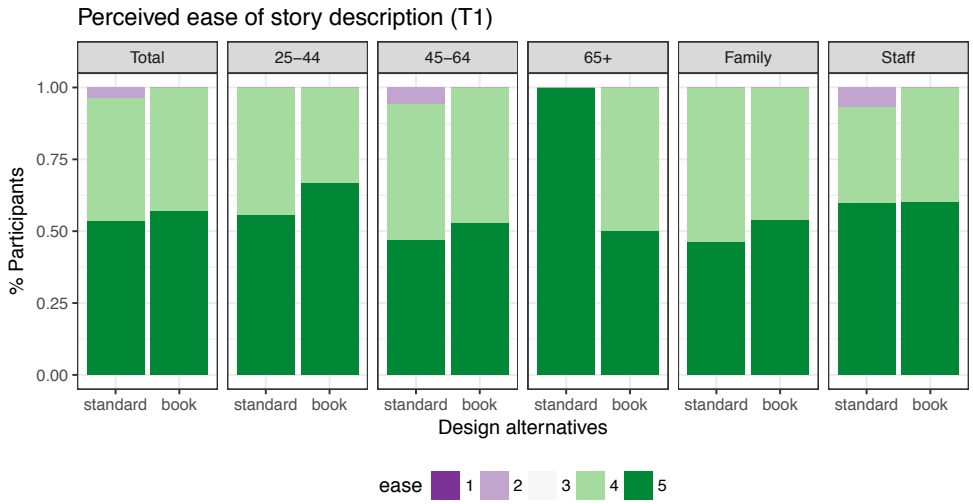

Fig. 9.6 Perceived ease of the story description on the interface alternatives. Higher values indicate a higher perceived ease of task

mentioned potential issues for *ease of learning and use* and considered *user context* as important. Such comments pertained mostly the metaphor interface, since in view of the conditions of the older adults residents, tags and colorful elements were considered for some as too distracting.

> "For the older adults the [standard interface] is better, because if there are too many things, colors... they get lost". (S4, 25-44)

> "The [older adult] will lose focus... will be distracted... there are too many inputs mixed". (F6, 45-64)

Conversely, for others using colorful tags was seen as an advantage since tags would catch the eye and make it easier to find the information. This opinion was shared mainly among members of the staff.

> "With the colors, knowing the people with whom I work here (older adults), I think it can keep the picture in focus" (S8, 45-64)

> "[Tags are] very useful... it is more synthetic than having the story below... there is more visual help... to find the information". (S15, 25-44)

To a lesser extent, another issue mentioned for both interfaces was that the name tags were not clear, since these were not positioned near people in the pictures.

"Biagio and Stefano there, it is not clear who is who... I would make it so that names appear on top of characters". (S3, 25-44)

Despite these comments, there was more positive feedback. The standard interface was positively valued for making pictures clear and visible, while for the metaphor interface the visibility of tags was the more salient aspect.

"The bigger the picture, the more to see... it is very important... because it gives you the way to grasp the details, you don't understand otherwise". (S10, 45-64)

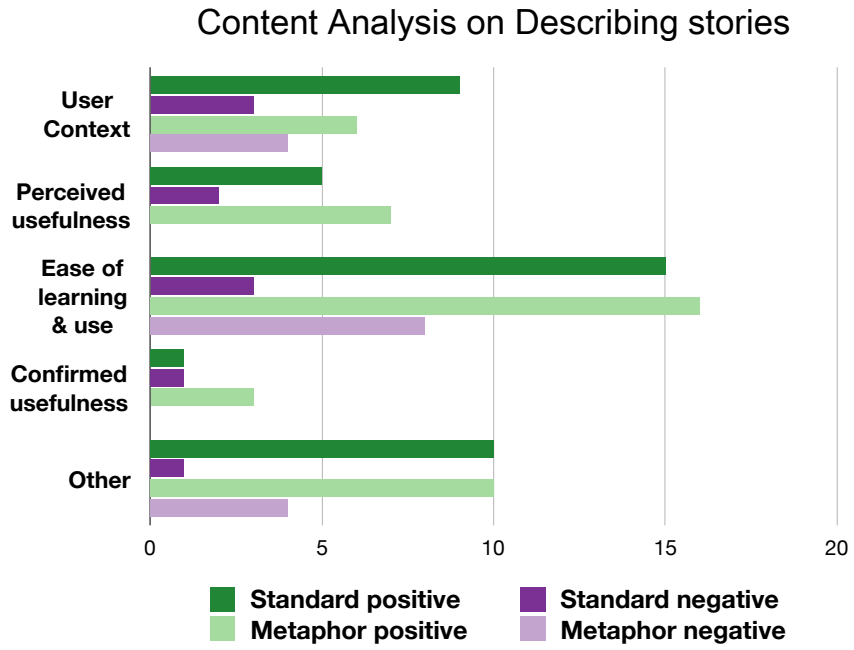

Fig. 9.7 Main categories of the STAM for the story description task. Participants mentioned strengths in both the metaphors and standard interface.

9.5.3 Facilitating guidance: Asking questions

The enriched alternative had a mean perceived ease score of 5, over the mean score of 4 for the raw interface. These scores are reflected on the preference of participants, who overwhelmingly chose the enriched interface (19). Only three participants opted for having raw information (all were in the 45-64 group) and six had no preference for one alternative in particular.

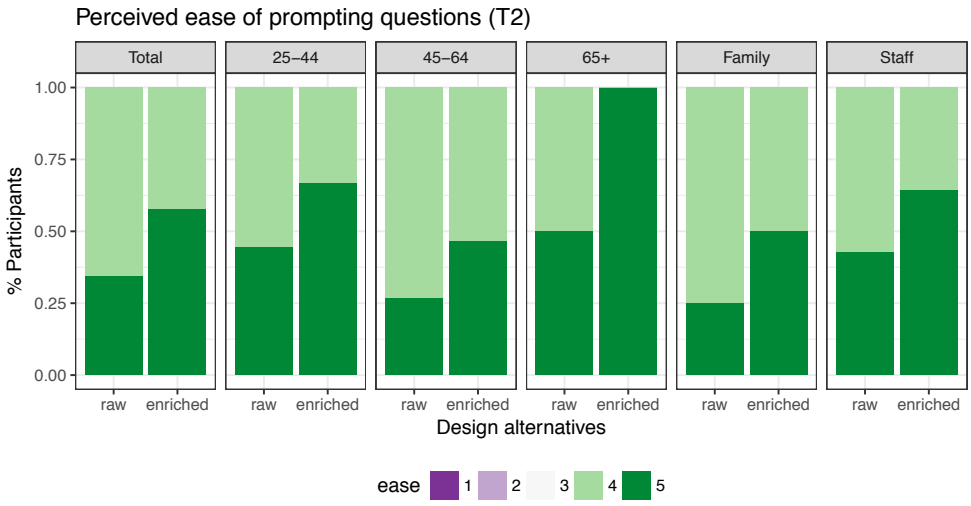

Fig. 9.8 Perceived ease for prompting questions on the interface alternatives. Higher values indicate a higher perceived ease of task

Inspecting the feedback from the coding analysis we got some interesting insights. As was expected, the additional information in the enriched interface was considered helpful in many ways, making *perceived usefulness* the dominant aspect (see Figure 9.9). Participants said the information was useful as a truth check; to provide information to helpers or anyone unfamiliar with the resident, even resident themselves; and most notably as stimuli for more questions and conversation.

> "You can ask the older adult, *is it true?* and if you see that the person does not remember you can try later". (S10, 45-64)

> "Even I could forget, *what was the name of the son?* ... and wanting to interact, I would use [the information] as a key". (S6, 45-64)

> "My children... they could not know... so they would need a hint". (F10, 45-64)

> "Sometimes [the older adults] do not remember and with this [information] you can remind them". (S4, 25-44)

> "It is more interesting... the more information the better". (F16, 45-64)

Nonetheless, some participants felt that having more information could also be distracting, block the exercise of remembering for older adults and discourage questions.

> "With [more information] you spend more time reading and you need a minute to understand". (S13, 25-44)

"[The information] is already there... I would ask if I do not remember... if I put the information here... it could take away a topic of conversation". (F4, 25-44)

" [For] reminiscing, in my view, less information is better, because it is [the older adult] who should give the information". (S8, 45-64)

"You should [check the information] beforehand... or else then, the person is next to you and you are there reading". (S14, 25-44)

Interestingly, some participants suggested that the information could be kept hidden and then activated when needed, which could be a nice feature considering the contrasting views mentioned above.

"What if you do not put the information? You have to put it.. or it could appear later. How it will work from the graphics point of view, that I don't know'. (S10, 44-65)

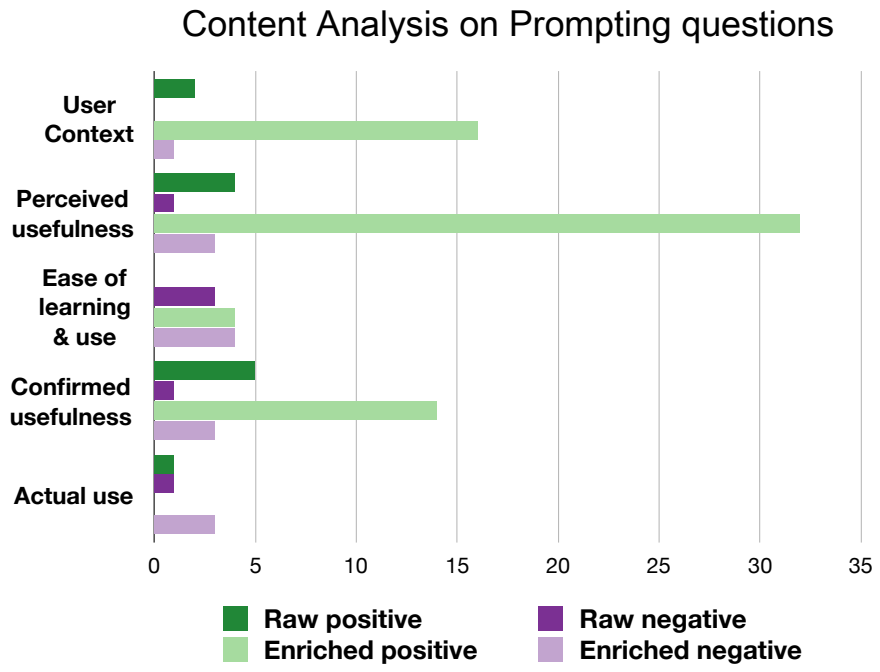

Fig. 9.9 Main categories of the STAM for the prompting questions task. Having enriched information was considered more useful.

9.5.4 Facilitating guidance: Navigating

A majority of participants preferred the linear navigation as 10 participants favored the static choice, closely followed by eight who chose dynamic navigation. Only three participants said they did not prefer one in particular and seven said they would like to have both choices.

Taking roles into account, we observed that the static interface was preferred mostly by the family members (7) but there is no clear preference for members of the staff.

Our content analysis showed that for the static interface, *user context* interplays with *perceived usefulness*, as well as with *ease of learning and use*. Participants felt that the fact that the interface resembled an album made the use easier and could bring back memories.

"Turn the page... that is something [older adults] can do [themselves]". (S2, 25-44)

"Maybe by turning the pages other things come to mind". (S1, 45-64)

"I would say... a succession of images without an option to search... the usual album". (F16, 45-64)

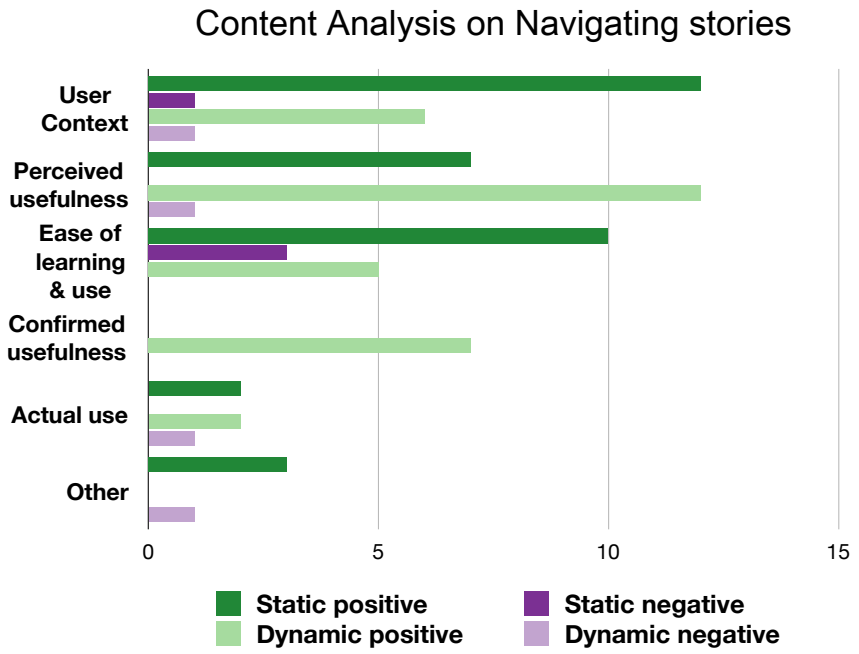

Fig. 9.10 Main categories of the STAM for the story navigation task. The positive views observed for the two alternatives explain the preference of some participants to count with both types of navigation.

On the other hand, the dynamic interface was considered useful since it would stimulate and support conversation by presenting related topics, and help to find related stories when tapping on tags.

"It helps to follow the trail of thought of the discourse of the [older adult]... and to continue that line". (S15, 25-44)

"You show them the picture of a city and then they start... I went there for this... I went [for that]". (F9, 65+)

"If I have a topic of interest, having categories giving me this information... is a good thing". (S3, 25-44)

"When one starts to have so many [pictures]... with categories it might be better... better than looking for the picture". (S1, 45-64)

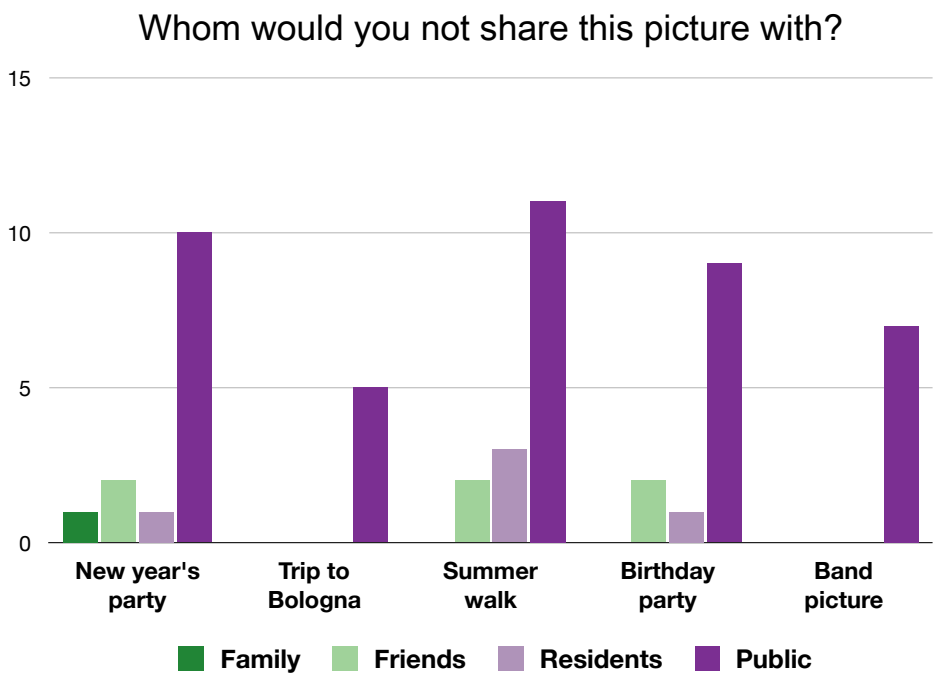

Fig. 9.11 Sharing scenarios with the sharing options available. Intention to not share within the groups is shown.

9.5.5 Enabling privacy controls

Most participants had no major problems with sharing among groups. However, as Figure 9.11 shows, sharing with the public in general (e.g. make the pictures available online) was not

well received. This was the case even for pictures where faces are not distinguishable (i.e. trip to Bologna) or pictures we thought could be considered of cultural interest (i.e. band of the town).

There was some resistance to share on scenarios which were prepared to be considered more intimate, such as the summer walk portraying the older adult resident and a significant other or the birthday party portraying the participant, but in these cases no participant had issues to share among family members. Overall, participants said each picture requires consideration but that the choice to share also revolves around the interest they perceive others could have.

The mean score for feelings of satisfaction with the sharing options and of control of the sharing preferences was 5 in both cases, indicating that simple group sharing is sufficient in this context with no need for more detailed individual sharing controls.

9.5.6 Design recommendations

We have tried different interfaces and design elements to facilitate the (co-located) work and interactions that could be supported by our tool. Below we describe design recommendations which could be adopted on similar contexts and for similar activities.

Large pictures and visible tags. Participants stated the importance of pictures taking as much space as possible on the screen, so they can be shown easily to older adults. Using colorful tags positioned on top of the pictures was useful to make the information more visible. However, too many tags can be distracting and their placement should be thought carefully so as to not cover pictures.

Feature to show and hide more information. The enriched information option was preferred because it was considered more helpful. However, considering the fact that the picture should take most of the space and that having too much information could be discouraging for conversations, a good compromise is to enable a feature to hide this information. The information could then be shown when needed and hidden when the picture has a more central role.

Two navigation modalities. The results suggest that both the linear and dynamic navigation are helpful, each for different purposes. The strength of linear navigation is its simplicity, and it is ideal to involve older adults more or discuss on a single topic (e.g. a wedding). Dynamic navigation allows to find related conversation topics when short of ideas or to follow a topic triggered by the current story (e.g. visits to the same city).

Keep sharing controls simple. Clearly defined, simple groups are sufficient to enable sharing within the nursing home context. None of the participants felt the need for more groups (or the possibility to create them) nor for fine grained sharing (e.g. with particular individuals). This recommendation would be strengthened by asking older adults themselves about their sharing preferences and by explicitly asking participants about the possibility of further control. Testing the act of sharing is also important since more control could increase the complexity of the action.

Finally, we must mention that we could not determine whether metaphors helped on task performance and navigation of the interface. Despite the preferences expressed and the positive feedback obtained for the metaphors and standard interfaces, the latter obtained better performance scores (especially from young participants). Results with respect to ease of use are encouraging (RQ1), considering that participants had no training, although more formal learnability and usability studies are needed to reach a conclusion.

9.6 Resulting architecture and model

In previous chapters (see Chapters 6 and 8) we have defined the concept of the tool and validated this concept with different nursing home stakeholders. This chapter has mainly focused on the design, but through the activities used to test design alternatives we have further understood features and services needed in the system, as well as privacy and sharing requirements that helped to define the architecture and conceptual model of our system.

9.6.1 Architecture

Figure 9.12 shows the architecture and its components, a classical three tier client-server architecture.

At the bottom, we see the different storage components for the *photos*, *stories* (or posts, once the stories are shared), as well as data from the *user* and its *network*.

In the middle we have the application programming interface (API), comprised of a series of modules that both use and provide services for external applications in the upper tier.

The user management module handles user profile information (including pictures and stories), user preferences and notifications.

The network management module takes care of relationships between users, management of groups and very importantly, the profiles managed by a user (e.g. a family member who is able to browse freely through the content of his/her older adults relative).

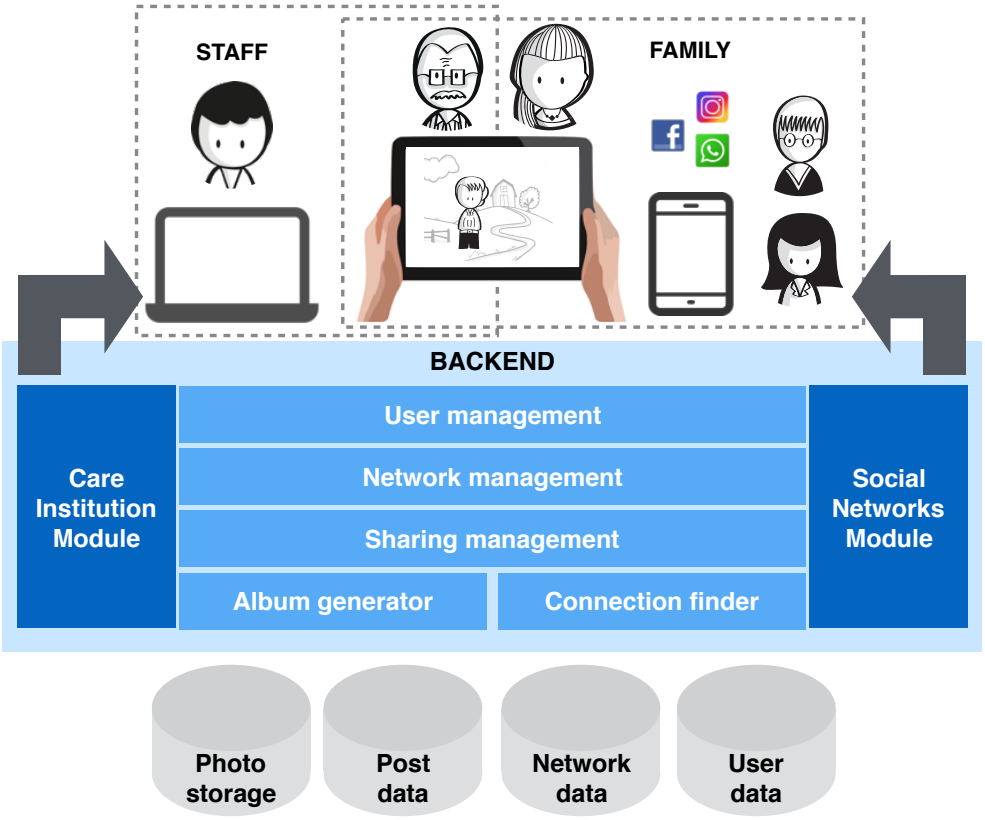

Fig. 9.12 The architecture for the Collegamenti tool.

The sharing management module is in charge of enforcing privacy preferences, especially with respect to the visibility of posts. Also, this module handles the social feedback related to stories, both internally (e.g. from other nursing home residents) and externally (e.g. from a grandchild through a Facebook account).

The API includes two modules working with external services related to the internal network (the nursing home) and the external network (potential contacts in social network sites).

The care institution module connects to the nursing home system to obtain information that allows to populate the residents group as well as to form a list of available staff members (usually, those related to the animation activities). We must note that not all members of the staff are granted access and, in principle, only those who have been assigned to manage the profile of a nursing home residents would be able to use the tool.

The social network module allows to populate the family and friend groups with those who have profile in social networks. This module also collects social feedback, such as comments and reactions in social media, that are later shown in the tool.

Finally, two modules related to the features offered to facilitate the work of helpers and to encourage connections among nursing home residents.

The album generator is in charge of handling albums created by users, but also uses the information provided in the stories to automatically generate albums on specific topics (e.g. family pictures, pictures from Venice). This module is also designed to serve the dynamic navigation feature discussed in the previous section, by creating albums on demand (i.e. when users tap on a specific tag).

The connection finder module is used to explore and find common life points among the stories shared by residents in the same nursing home. These commonalities can be used to suggest friendships and topics of conversation (e.g. on similar interest).

In the upper tier are the applications that connect to the API. Mainly, the tablet application that helpers would use with the older adults during the visits. Nonetheless, the same application could run as a website and be accessed through different devices such as smartphones or laptop computers.

9.6.2 Conceptual model

In Figure 9.13 we show the conceptual model that represents and supports the lower tier of our architecture.

We can see the *User* (to the left) connected to *Relationship* and *Profile*, which define the user profile information and the network of the user. *Organization* indicates the nursing home to which the user belongs. *Permission* determines the level of permission that a user who manages another profile has over that profile.

At the center we have *Memento*, this more general name was given to any media element that can be used to trigger reminiscence. As of now, we focus on pictures but the model could be expanded to use other type of media such as audio and video. When a memento is used to create a story it becomes a *Post*. Posts include additional information on mementos such as the tags, or the time of creation. Such information can be used to create connections among residents and albums on similar topics. We note the inclusion of an attribute in the post, to indicate whether the post or story can trigger an emotional response from the older adult. This would allow to helpers to avoid the story or prepare in advance to deal with the reactions of the older adult.

Social feedback such as *Comments* and *Likes* are also related to Post, indicating the feedback received on that particular post. Who can see the posts and mementos is defined by *Visibility*.

At the bottom to the right we have the *Album*. Albums are comprised of posts and can be created by users or automatically. The *Custom* specification corresponds to albums created by users or created based on keywords defined by users (e.g. an activity like fishing), while the *Favourite* specification includes the albums that user signal as their favorites. The remaining specifications, *Time period*, *Place* and *Person* are mostly automatically generated albums based on the information and tags on stories (posts). However, albums created by users that correspond to these categories would also be defined as the corresponding specification.

Last, we have *Connection*, where the common life points between a pair of users are stored. The data is connection is what they system uses to suggest friendships and topics of conversation. Connections get a score to indicate how well the suggestion has worked.

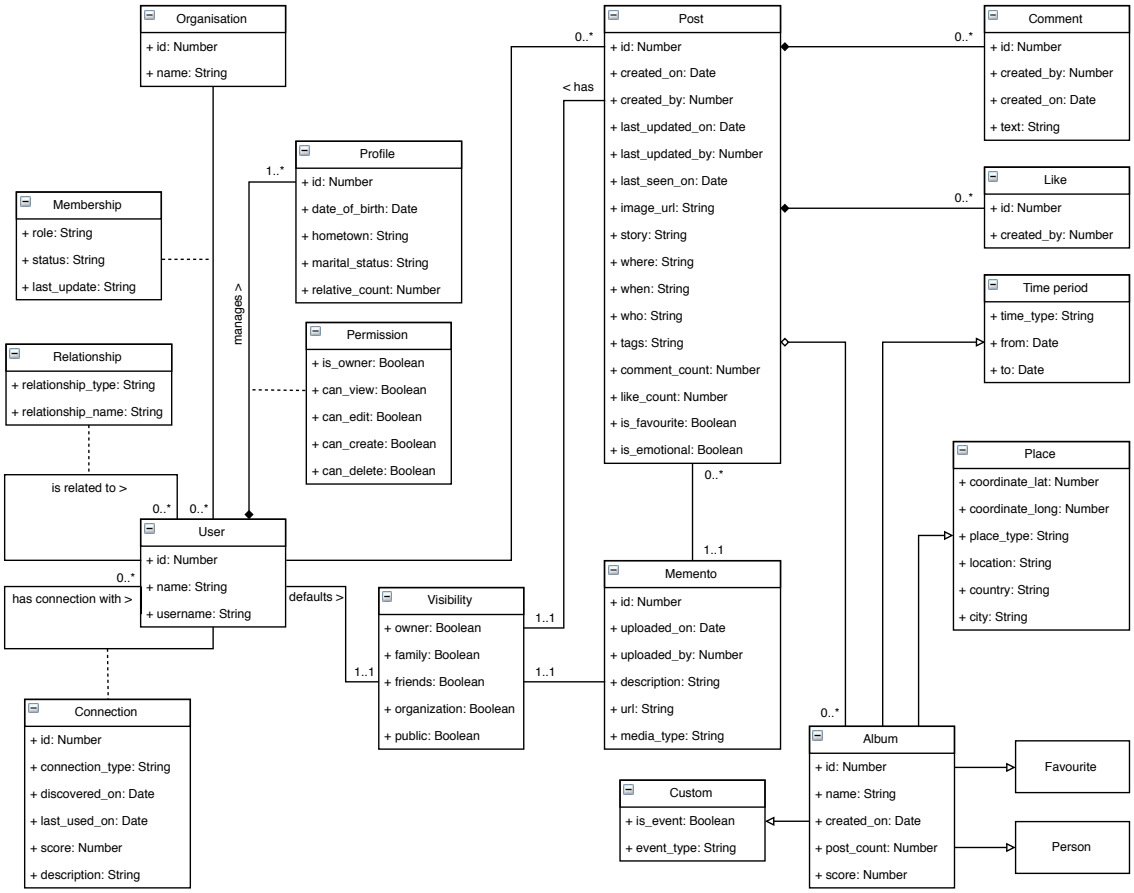

Fig. 9.13 The conceptual model for the Collegamenti tool

9.7 Discussion

In this paper we took the last steps towards the design of our reminiscence-based tool and presented the architecture and conceptual model to support such tool.

Our results suggest that some of our proposed design choices could indeed facilitate the co-located work and also stimulate interactions.

Nonetheless, we could not determine whether metaphors had a positive effect on performance. Performance results suggest that using metaphors is feasible and that some metaphors were effective to convey the concept of the application (RQ1), as participants were able to go through the tasks with no training at all. Based on the choice of participants, there is also no indication of which interface might be preferred. A similar study relying on the scrapbook metaphor [5] also found differing preferences between members of the staff and people with dementia, the former preferring the scrapbook and the latter opting for a simpler screen presentation. The study hypothesized that the screen might have been preferred due to reduced cognitive ability, but concludes that it was more likely a matter of personal choice. To clarify our findings, more studies on usability and learnability on interfaces relying on metaphors are needed.

Results on co-located activities were more positive (RQ2), as reflected on the high scores for perceived ease and the feedback that emerged from our content analysis. This is in line with a previous study [155], which reported that in the view of staff, family members and people with dementia, using digital life storybooks was very useful to trigger memories.

As an outcome of our study, we pose the following design recommendations:

- **Use large pictures and visible, well positioned tags**, which help older adults to focus on the picture and makes information easier to find for older adults and for the helpers using the tool.
- **Allow to hide and show additional information about stories**, so that this information can be brought forth when useful but also quickly removed when distracting (e.g. covering part of the picture when showing the picture to older adults).
- **Implement different navigation modalities for stories**. A linear simple one, just like turning the page, which even older adults could perform; and a dynamic one jumping to related topics, which is more complicated to manage, but more useful.
- **Keep sharing simple**, by presenting sharing options with groups of people adjusted to the context, with no need for elaborated controls that would complicate the sharing process.

Moreover, we have found little resistance to share pictures and stories within the nursing homes. Our results suggest that sharing with clearly recognizable groups of the network (e.g. family, friends) give users enough control in this context (RQ3). Results for sharing intention appear to be slightly more positive with respect to sharing with other nursing home residents in this study than on our previous studies to define and validate the concept. One possible reason is that the concept of the tool has matured and that by interacting with the prototype, participants got a clearer idea on how sharing would happen and to what purpose sharing is useful. Another reason could be that the sharing scenarios we designed did not trigger any feeling of invasiveness in participants. Despite some scenarios been purposely designed to be considered more private (which was the case of the picture portraying a couple, as Figure 9.11 shows) participants might have not connected these scenarios to their own. Therefore, studies where pictures that belong to older adults are shared are needed, in order to assess the sharing intention properly. Such studies are indeed part of our current work, by trying to share old pictures in social networks between older adults and grandchildren.

Chapter 10

Conclusion and future work

At the end of the first chapter we listed the different studies that were conducted over the years and that helped us build, incrementally, this research work. In this closing chapter we will outline our contributions, provide answers to the thesis research questions, and discuss limitations as well as future work. Before we do that, we would like to summarise how each of the studies that did not have the reminiscence-based tools as focus, were used to inform our research and decisions behind the design of the tool presented in Chapter 9.

We focus on the later studies, since the influence that their outcomes have had on shaping our work has been discussed in less detail. Chapters 6, 8 and 9 will be discussed following this summary and in the context of the thesis research questions.

Chapter 2. Early work: The Gymcentral studies

These studies opened new research directions for us. The main outcome was to support the use of technology to improve the wellbeing of older adults. In particular, the studies indicated positive results on enabling joint activities among older adults and on the positive effects of technology-mediated interactions over loneliness.

Chapter 3. Tools enabling online contributions by older adults

This study showed that there is little research on supporting remote contribution by older adults through technology. However, the study allowed us to identify current barriers as well as motivating factors on the engagement of older adults towards facilitating online contributions. Most notably, having a sense of purpose and perceiving that their contribution is important are strong motivators.

Chapter 4. Interventions to reduce loneliness in old age

Our literature review indicated a lack of strong evidence on the positive effect that remote technology-mediated communication has on loneliness and social isolation for older adults. The review also highlighted a focus in current research towards training older adults to use existing technology. Research seems to be more oriented on enabling social interactions, than on improving social interactions by addressing barriers for communication directly.

As we discussed in the introduction, these initial studies made us reconsider and refine our initial problems space, moving to a context which not necessarily involved remote interactions. We kept in mind two main considerations: i) that the role of technology should not be limited to enabling interactions, but rather look to improve social interactions and support them; and ii) that older adults should be at the centre, highlighting the importance of their contributions. The result was moving from the use of technology independently at home to assisted use in a nursing home setting, leveraging on reminiscence activities where the life stories of older adults are the main contribution.

Chapter 5. What Makes People Bond?: Social Interactions and Common Life Points

In this survey study we found that people who interact more often have higher levels of connectedness. People having more common life points also have higher levels of connectedness and in addition, online interactions are more frequent when people have more aspects in common.

These findings were incorporated to the concept of our reminiscence-based tool in two ways. First, using stories to discover common life points among older adults and then using these common aspects as a trigger for social interactions. Second, increasing connectedness by stimulating more interactions as well as evidencing common life points and shared interests.

The tool would allow to share stories in social network sites with the relatives of older adults. In this way, we hope to get the attention of relative who do not visit often (especially the young) and to open a new channel for communication that could lead to an increase in social interactions between older adults and the members of their families. With respect to social interactions among older adults within the nursing home, we consider the relationship between online interactions and common aspects. We hypothesise that making older adults aware of common aspects with other nursing home residents could lead to an increase of face-to-face social interactions.

Chapter 7. Design Challenges for Reconnecting

In the context of reminiscence, we explored reconnection —finding out about or re-contacting old friends. The results of this study indicate that there is a wish to reconnect in later life. However, current technology does not address barriers, such as not having the means to get back in touch or the awkwardness of initiating contact, that prevent reconnection from happening.

Since reconnection is a complex process that requires further studies, it was not added to the concept of the Collegamenti tool. Nonetheless, we believe that a reminiscence-based tool could help to overcome some of the barriers to reconnecting with old friends. We discuss how our tool could assist in facilitating reconnection as part of future work.

10.1 Contributions

Simply put, the process of this thesis can be divided into two main phases: first, the preliminary work and different research studies which led to a clear definition of our problem space and to focusing on a more specific scope; and second, our core contribution which relates to the design of a reminiscence based-tool.

Our contributions from the first phase are:

- A technology solution to enable home-based training, which contributes further evidence to the potential of ICT solutions for improving the wellbeing of older adults, in particular social wellbeing.
- A review on tools for remote contribution by older adults and a systematic review on interventions to reduce loneliness in older adults, which highlight the need for more studies in the areas of remote work and interactions for older adults.
- A survey work which indicates toward the potential of common aspects between people to increase connectedness.

The goal of the second phase was to design a reminiscence-based tool aiming at improving social interactions for older adults in residential care facilities. The contributions of this phase can be summarized into:

- A deep understanding of design challenges for tools aiming to encourage social interactions in residential care settings.

- A process and social interaction model to increase social interactions that fits into current nursing home practices.
- Design recommendations to facilitate co-located interactions and stimulate conversations with older adults, leveraging on reminiscence material.
- The design of a tool, as well as the supporting architecture and conceptual model, to increase social interaction for older adults; this could be expanded to other settings, preceded by a careful study of the context of use.

More specifically, in response to our thesis research questions.

To define a process that leverages on reminiscence to stimulate conversation **(TRQ1)**.

We defined a concept for our tool that determines a process with reminiscence at its center, and a social interaction model designed to take advantage of the reminiscence activity and its byproducts. This was the result of a series of preliminary studies, which include visits to nursing homes and focus groups with nursing home stakeholders.

In Chapter 6 we describe how the activities and process are refined taking into account existing practices from nursing home stakeholders. Mainly, by including not only staff, but also family members as supporters and contributors to the activities in the process; and by paying particular attention to privacy concerns, emphasized by the need for sharing controls.

Four main activities are comprised in the process: digitizing pictures, collecting stories, sharing stories and evidencing common life points. The burden for nursing home staff is reduced by allowing family members to contribute in the activities, but especially by digitizing pictures from home and thus providing more material for reminiscence. Collecting and sharing stories can be done with staff and volunteers, but also with family members during visits. Finally, making older adults aware of common life points was considered to work best when managed by the staff. Since staff members are more knowledgeable about the characteristics of the other residents, they are in a better position to decide whether trying to connect two residents or not.

Collecting stories, where reminiscence session takes place, is where social interactions start from. However, we plan for social interactions to keep happening in three ways: in person, on occasions when a person is helping older adults to collect their stories; remotely, when stories are shared and feedback is received (e.g. from grandchildren in social networks); and both in person and remotely with other nursing home residents, by discovering common aspects. In this way, our system uses reminiscence as the trigger to stimulate social interactions, by providing conversation topics and by reaching more people through different channels of communication.

To determine the feasibility of the process and the intention to adopt the tool **(TRQ2)**.

We validated the concept of the tool in four different nursing homes. We analyzed the responses of 12 family members and 12 members of the staff with respect to feasibility, perceived used, importance of the tool and intention to use. Our findings, reported in Chapter 8, show consistently positive results. Although we must note some resistance and skepticism with respect to sharing. The tool was considered useful to participants (92%) and to the older adult residents (71%), and only two people said they would not use the tool (one of whom clarified it would be very useful for her colleagues).

In addition, we conducted pilot reminiscence sessions with three relative-resident pairs. All three pairs were able to complete a 25 minute reminiscence session, with minimal training (only tablet gestures were demonstrated prior to the session), and family members reported high scores on perceived ease, usability and enjoyment of the activity. The reminiscence sessions are a fundamental step in the process, since the stories collected are what enable sharing and discovering common life points.

To determine the expected uses and contributions from stakeholders **(TRQ3)**.

The results from Chapters 8 and 9 indicate that nursing home stakeholders would contribute to all activities in the process as expected. This finding is supported mainly by the scores for perceived used across studies, the experience with the pilot reminiscence sessions and what we can call "simulated" reminiscence sessions during the design studies where participants were asked to describe stories and ask questions. Questions on the importance of the objectives of the tool (e.g. stimulate conversation, stimulate friendships) also received high scores, indicating that participants perceive the tool and the activities as valuable. Sharing in social networks and with other residents were partially resisted, although we obtained more favorable results when defining sharing scenarios (see 9.5.5).

To identify designs that facilitate co-located interactions and stimulate conversation **(TRQ4)**. We report in Chapter 9 that the use of metaphors resembling real world artifacts are helpful for some of the activities, as these can provide clues on their intended use. In some cases, metaphors were even considered useful to trigger memories. We provide design recommendations to facilitate co-located interactions and to stimulate conversations in similar settings as an outcome of Chapter 9.

10.2 Limitations

One of the limitations of this work is the inclusion of few older adults in the studies. Although we must note that some of our participants were over 65 years old, even if they were relatives to the nursing home residents; and that we also included older adult residents in our pilot reminiscence sessions. However, we do feel this is a limitation, especially with respect to understanding the privacy concerns and the preference toward metaphors or colorful elements used in the interfaces studied.

This is in part due to the difficulty to recruit older adult participants but also because some activities conducted to define and validate the concept could present abstract concepts difficult to grasp for participants. This is the reason why we did include older adults in more practical activities such as the reminiscence session, were older adults had a concrete experience with the system.

Another limitation is that the results of this work have to be interpreted in context. The studies were conducted in nursing homes in Northern Italy but for instance, challenges and preferences might differ in other countries. Even among the nursing homes included in the studies participants mentioned the importance of the context, since nursing homes might have different regulations, provide different services, count with more or less resources and personnel.

Our studies investigating reconnection provide some interesting insight on this aspect, showing the potential of reminiscence in the locations were the studies took place (since old pictures were used to remind lost friends). However, the study settings were quite different. For example, participants from Costa Rica had less access to technology and in another experience in Paraguay we were not able to recruit older adults living in residential care facilities.

Finally, with respect to sharing it would have been helpful to conduct studies using real pictures and trying to share real stories. This would allow to analyze not only the intention to share, but other aspects such as the interest from the network of older adults in their stories and the reaction of older adults to social media feedback such as likes, as well as the effect the type of picture can have on the engagement of older adults in storytelling. Our results on intention to share stories as well as points in common are not conclusive, since we have observed some resistance in the initial studies but later obtained more positive opinions towards sharing when we designed and evaluated specific sharing scenarios.

10.3 Future work

The outcome of this thesis, the design of the Collegamenti tool, has allowed for future studies on the suitability of the tool but it also has produced new interesting research questions.

With respect to the suitability of the tool. Ongoing work is devoted to evaluating the usability of the proposed design. We have developed a prototype taking into account the design recommendations that derived from our studies as well as the lesson learned from the pilot reminiscence sessions. To assess usability we consider efficiency, errors, and user satisfaction when evaluating some of the main tasks: annotating pictures, collecting the stories, sharing, and navigating through stories. In addition, more reminiscence sessions will be conducted using the prototype. While this study is a step further to validate the tool, many aspects could be evaluated in the context of reminiscence sessions.

An interesting aspect to analyze is how reminiscence sessions differ when they are guided by relatives as compared to members of the nursing home staff. In Chapter 8, we argue that the form designed to collect the information can greatly impact the interactions during information elicitation, but we also observed that the information that relatives know beforehand can make them fill in the form without involving their older adult relative. Who gets more information? Who makes the session more engaging? With whom are the sessions more enjoyable? These are all interesting questions that could help to design systems and interfaces with a more active role in supporting conversation, by better understanding the effect that different information elicitation styles have.

Similarly, understanding what type of content (pictures) can facilitate storytelling and increase the engagement of older adults is an interesting question. This same question can be posed with respect to common life points that could be more effective to stimulate conversation. The staff has already mentioned to us that as part of their strategies to initiate conversation, they use topics such as former occupation, recipes, or hobbies.

Also related to the reminiscence session, although more specifically to the collected data, such information could help overcome some of the barriers for reconnecting discussed in Chapter 7. In particular in relation to search and providing context to initiate reconnection, the data collected on many pictures and stories could help to build the profile of an old friend. The profile could then be used on a search, even leveraging on common acquaintances in a user's network, and in the case of a successful search to provide context to both parties when trying to re-initiate contact.

Another aspect, which we have already mentioned, is to study sharing in more detail. More importantly, that participants get to share real pictures from their past. On this direction, we are already conducting studies to analyze the effect sharing old pictures from their grandparents have in young people [82]. In particular, we analyze how interested young

people are, how proud, how likely they are to re-share the picture and how discovering these stories from the past alters the feelings of connectedness between grandchild and grandparent. On the other hand, it will be interesting to understand how older adults react to the interactions (e.g. likes, comments) from others to the shared stories.

As a final future activity, we believe that the most important outcome would come from evaluating the effect the tool has on social interactions, and subsequently social wellbeing (e.g. reducing loneliness). The tool could support many forms of social interaction and with different stakeholders (with relatives in the reminiscence session, with grandchildren through stories shared online, with other residents through common aspects). It would be interesting to measure the effect that the type of interactions have. Especially, whether the interactions facilitated can lead to an increase in connectedness with those who do not visit often and to friendship formation among older adults residents.

References

[1] Achenbaum, W. A. (2014). Robert n. butler, md (january 21, 1927–july 4, 2010): Visionary leader. *The Gerontologist*, 54(1):6–12.

[2] Adams, R. G. (1986). A look at friendship and aging. *Generations (Journal of the American Society on Aging)*, 10(4):40–43.

[3] Adams, R. G. and Taylor, E. M. (2015). *Friendship and Happiness in the Third Age*, pages 155–169. Springer Netherlands, Dordrecht.

[4] Ajrouch, K. J., Blandon, A. Y., and Antonucci, T. C. (2005). Social networks among men and women: The effects of age and socioeconomic status. *The Journals of Gerontology: Series B*, 60(6):S311–S317.

[5] Alm, N., Arnott, J. L., Dobinson, L., Massie, P., and Hewines, I. (2001). Cognitive prostheses for elderly people. In *2001 IEEE International Conference on Systems, Man and Cybernetics. e-Systems and e-Man for Cybernetics in Cyberspace (Cat.No.01CH37236)*, volume 2, pages 806–810 vol.2.

[6] Alm, N., Dye, R., Gowans, G., Campbell, J., Astell, A., and Ellis, M. (2007). A communication support system for older people with dementia. *Computer*, 40(5):35–41.

[7] Aron, A., Aron, E. N., and Smollan, D. (1992). Inclusion of other in the self scale and the structure of interpersonal closeness. *Journal of Personality and Social Psychology*, 63(4):596–612.

[8] Astell, A., Alm, N., Gowans, G., Ellis, M., Vaughan, P., Dye, R., and Campbell, J. (2009). Working with people with dementia to develop technology: The circa and living in the moment projects. volume 17, pages 36–39. Hawker Publications Ltd.

[9] Astell, A. J., Ellis, M. P., Bernardi, L., Alm, N., Dye, R., Gowans, G., and Campbell, J. (2010). Using a touch screen computer to support relationships between people with dementia and caregivers. *Interacting with Computers*, 22(4):267–275.

[10] Baert, V., Gorus, E., Mets, T., Geerts, C., and Bautmans, I. (2011). Motivators and barriers for physical activity in the oldest old: A systematic review. *Ageing Research Reviews*, 10(4):464 – 474.

[11] Baez, M., Dalpiaz, C., Hoxha, F., Tovo, A., Caforio, V., and Casati, F. (2016a). Personalized persuasion for social interactions in nursing homes. In Orji, R., Reisinger, M., Busch, M., Dijkstra, A., Stibe, A., and Tscheligi, M., editors, *Proceedings of the Personalization in Persuasive Technology Workshop, Persuasive Technology 2016*, pages 101–106.

[12] Baez, M., Far, I. K., Ibarra, F., Ferron, M., Didino, D., and Casati, F. (2017). Effects of online group exercises for older adults on physical, psychological and social wellbeing: a randomized pilot trial. *PeerJ*, 5:e3150.

[13] Baez, M., Ibarra, F., Far, I. K., Ferron, M., and Casati, F. (2016b). Online group-exercises for older adults of different physical abilities. In *2016 International Conference on Collaboration Technologies and Systems (CTS)*, pages 524–533.

[14] Balabanović, M., Chu, L. L., and Wolff, G. J. (2000). Storytelling with digital photographs. In *Proceedings of the SIGCHI conference on Human Factors in Computing Systems*, pages 564–571. ACM.

[15] Ballantyne, A., Trenwith, L., Zubrinich, S., and Corlis, M. (2010). 'I feel less lonely': what older people say about participating in a social networking website. *Quality in Ageing and Older Adults*, 11(3):25–35.

[16] Barefoot, J. C., Grønbæk, M., Jensen, G., Schnohr, P., and Prescott, E. (2005). Social network diversity and risks of ischemic heart disease and total mortality: Findings from the copenhagen city heart study. *American Journal of Epidemiology*, 161(10):960–967.

[17] Barnard, Y., Bradley, M. D., Hodgson, F., and Lloyd, A. D. (2013). Learning to use new technologies by older adults: Perceived difficulties, experimentation behaviour and usability. *Computers in Human Behavior*, 29(4):1715 – 1724.

[18] Bekhet, A. K. and Zauszniewski, J. A. (2012). Mental health of elders in retirement communities: Is loneliness a key factor? *Archives of Psychiatric Nursing*, 26(3):214 – 224.

[19] Berkman, L. F. and Syme, S. L. (1979). Social networks, host resistance, and mortality: A nine-year follow-up study of alameda county residents. *American Journal of Epidemiology*, 109(2):186–204.

[20] Blažun, H., Saranto, K., and Rissanen, S. (2012). Impact of computer training courses on reduction of loneliness of older people in finland and slovenia. *Computers in Human Behavior*, 28(4):1202 – 1212.

[21] Bohlmeijer, E., Smit, F., and Cuijpers, P. (2003). Effects of reminiscence and life review on late-life depression: a meta-analysis. *International Journal of Geriatric Psychiatry*, 18(12):1088–1094.

[22] Bower, B. (1997). Social links may counter health risks. *Science News*, 152(9):135–135.

[23] Boyd, K., Nugent, C., Donnelly, M., Sterritt, R., Bond, R., and Lavery-Bowen, L. (2015). Easisocial: An innovative way of increasing adoption of social media in older people. In Bodine, C., Helal, S., Gu, T., and Mokhtari, M., editors, *Smart Homes and Health Telematics*, pages 21–28, Cham. Springer International Publishing.

[24] Bradshaw, S. A., Playford, E. D., and Riazi, A. (2012). Living well in care homes: a systematic review of qualitative studies. *Age and Ageing*, 41(4):429–440.

[25] Brooke, J. et al. (1996). Sus-a quick and dirty usability scale. *Usability evaluation in industry*, 189(194):4–7.

[26] Brown, S. L., Nesse, R. M., Vinokur, A. D., and Smith, D. M. (2003). Providing social support may be more beneficial than receiving it: Results from a prospective study of mortality. *Psychological Science*, 14(4):320–327. PMID: 12807404.

[27] Brummett, B. H., Barefoot, J. C., Siegler, I. C., Clapp-Channing, N. E., Lytle, B. L., Bosworth, H. B., Williams, R. B. J., and Mark, D. B. (2001). Characteristics of socially isolated patients with coronary artery disease who are at elevated risk for mortality. *Psychosomatic Medicine*, 63(2):267–272.

[28] Butler, R. N. (1963). The life review: An interpretation of reminiscence in the aged. *Psychiatry*, 26(1):65–76. PMID: 14017386.

[29] Cacioppo, J. T., Hughes, M. E., Waite, L. J., Hawkley, L. C., and Thisted, R. A. (2006). Loneliness as a specific risk factor for depressive symptoms: Cross-sectional and longitudinal analyses. *Psychology and Aging*, 21(1):140–151.

[30] Calvo, R., Kane, S. K., and Hurst, A. (2014). Evaluating the accessibility of crowdsourcing tasks on amazon's mechanical turk. In *Proceedings of the 16th International ACM SIGACCESS Conference on Computers & Accessibility*, ASSETS '14, pages 257–258, New York, NY, USA. ACM.

[31] Campbell, K., Holderness, N., and Riggs, M. (2015). Friendship chemistry: An examination of underlying factors. *The Social Science Journal*, 52(2):239 – 247.

[32] Cattan, M., Kime, N., and Bagnall, A.-M. (2011). The use of telephone befriending in low level support for socially isolated older people – an evaluation. *Health & Social Care in the Community*, 19(2):198–206.

[33] Cattan, M., White, M., Bond, J., and Learmouth, A. (2005). Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions. *Ageing and Society*, 25(1):41–67.

[34] Chen, J., Geyer, W., Dugan, C., Muller, M., and Guy, I. (2009). Make new friends, but keep the old: Recommending people on social networking sites. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '09, pages 201–210, New York, NY, USA. ACM.

[35] Chen, Y.-R. R. and Schulz, P. J. (2016). The effect of information communication technology interventions on reducing social isolation in the elderly: A systematic review. *Journal of Medical Internet Research*, 18(1):e18.

[36] Choi, M., Kong, S., and Jung, D. (2012). Computer and internet interventions for loneliness and depression in older adults: A meta-analysis. *Healthcare Informatics Research*, 18(3):191–198.

[37] Chopik, W. J. (2017). Associations among relational values, support, health, and well-being across the adult lifespan. *Personal Relationships*, 24(2):408–422.

[38] CJ, B. and KL, F. (2013). Mobility limitation in the older patient: A clinical review. *JAMA*, 310(11):1168–1177.

[39] Clark, J. and Hall, I. (2011). The skype grannies project final report. Technical report, Technical report, Newcastle University Centre for Learning and Teaching, 2011. Retrieved September 21, 2016 from http://www. ncl. ac. uk/cflat/news/documents/TheSkype GranniesProjectupdated110811. pdf.

[40] Coelho, J. and Duarte, C. (2015). Socially networked or isolated? differentiating older adults and the role of tablets and television. In Abascal, J., Barbosa, S., Fetter, M., Gross, T., Palanque, P., and Winckler, M., editors, *Human-Computer Interaction – INTERACT 2015*, pages 129–146, Cham. Springer International Publishing.

[41] Cohen, G. D. (2000). Two new intergenerational interventions for alzheimer's disease patients and families. *American Journal of Alzheimer's Disease*, 15(3):137–142.

[42] Colman, A. M. (2008). *A dictionary of psychology*. Oxford University Press, 3 edition.

[43] Cornwell, E. Y. and Waite, L. J. (2009). Social disconnectedness, perceived isolation, and health among older adults. *Journal of Health and Social Behavior*, 50(1):31–48. PMID: 19413133.

[44] Cotelli, M., Manenti, R., and Zanetti, O. (2012). Reminiscence therapy in dementia: A review. *Maturitas*, 72(3):203 – 205.

[45] Cotten, S. R., Anderson, W. A., and McCullough, B. M. (2013). Impact of internet use on loneliness and contact with others among older adults: Cross-sectional analysis. *Journal of Medical Internet Research*, 15(2):e39.

[46] de Jong Gierveld, J., van Tilburg, T., and Dykstra, P. A. (2006). *Loneliness and Social Isolation*, page 485–500. Cambridge Handbooks in Psychology. Cambridge University Press.

[47] Desiato, C. (2013). Virtualizing the past: Re-connecting on facebook and emerging social relationships. In *2013 46th Hawaii International Conference on System Sciences*, pages 3363–3372.

[48] DiMaggio, P., Hargittai, E., Neuman, W. R., and Robinson, J. P. (2001). Social implications of the internet. *Annual Review of Sociology*, 27(1):307–336.

[49] Dodge, H. H., Zhu, J., Mattek, N. C., Bowman, M., Ybarra, O., Wild, K. V., Loewenstein, D. A., and Kaye, J. A. (2015). Web-enabled conversational interactions as a method to improve cognitive functions: Results of a 6-week randomized controlled trial. *Alzheimer's & Dementia: Translational Research & Clinical Interventions*, 1(1):1 – 12.

[50] Durrant, A., Rowland, D., Kirk, D. S., Benford, S., Fischer, J. E., and McAuley, D. (2011). Automics: Souvenir generating photoware for theme parks. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '11, pages 1767–1776, New York, NY, USA. ACM.

[51] Edmondson, B. (2010). All the lonely people. *AARP: The Magazine*, page 83.

[52] Elo, S. and Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, 62(1):107–115.

[53] Far, I. K., Ferron, M., Ibarra, F., Baez, M., Tranquillini, S., Casati, F., and Doppio, N. (2015). The interplay of physical and social wellbeing in older adults: investigating the relationship between physical training and social interactions with virtual social environments. *PeerJ Computer Science*, 1:e30.

[54] Far, I. K., Ibarra, F., Baez, M., and Casati, F. (2014). Virtual social gym: a persuasive training platform for independently living seniors. In Spagnolli Anna, Chittaro Luca, G. L., editor, *Persuasive Technology. 9th International Conference, PERSUASIVE 2014. Adjunct Proceedings*, pages 34–36. CLEUP.

[55] Far, I. K., Silveira, P., Casati, F., and Baez, M. (2012). Unifying platform for the physical, mental and social well-being of the elderly. In Park, J. J. J. H., Jeong, Y.-S., Park, S. O., and Chen, H.-C., editors, *Embedded and Multimedia Computing Technology and Service*, pages 385–392, Dordrecht. Springer Netherlands.

[56] Fehr, B. (2008). Friendship formation. In Sprecher, S., Wenzel, A., and Harvey, J., editors, *Handbook of relationship initiation*, chapter 2, pages 29–54. Taylor & Francis.

[57] Fischer, L. R. and Schaffer, K. B. (1993). *Older volunteers: A guide to research and practice.* Sage Publications, Inc.

[58] Fitzpatrick, K. K., Darcy, A., and Vierhile, M. (2017). Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (woebot): A randomized controlled trial. *JMIR Ment Health*, 4(2):e19.

[59] Fokkema, D. T. and Knipscheer, K. (2007). Escape loneliness by going digital: A quantitative and qualitative evaluation of a dutch experiment in using ect to overcome loneliness among older adults. *Aging & Mental Health*, 11(5):496–504. PMID: 17882587.

[60] Fratiglioni, L., Wang, H.-X., Ericsson, K., Maytan, M., and Winblad, B. (2000). Influence of social network on occurrence of dementia: a community-based longitudinal study. *The Lancet*, 355(9212):1315–1319.

[61] Friedemann, M.-L., Montgomery, R. J., Maiberger, B., and Smith, A. A. (1997). Family involvement in the nursing home: Family-oriented practices and staff–family relationships. *Research in Nursing & Health*, 20(6):527–537.

[62] Garattini, C., Wherton, J., and Prendergast, D. (2012). Linking the lonely: an exploration of a communication technology designed to support social interaction among older adults. *Universal Access in the Information Society*, 11(2):211–222.

[63] Gardner, M. M., Buchner, D. M., Robertson, M. C., and Campbell, A. J. (2001). Practical implementation of an exercise-based falls prevention programme. *Age and Ageing*, 30(1):77–83.

[64] Gaver, B., Dunne, T., and Pacenti, E. (1999). Design: Cultural probes. *interactions*, 6(1):21–29.

[65] Grant, M. J. and Booth, A. (2009). A typology of reviews: an analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal*, 26(2):91–108.

[66] Gutierrez, F. J., Ochoa, S. F., and Vassileva, J. (2015). Mediating asymmetries in family communication: Supporting the einclusion of older adults. In Antona, M. and Stephanidis, C., editors, *Universal Access in Human-Computer Interaction. Access to Today's Technologies*, pages 438–448, Cham. Springer International Publishing.

[67] Harrington, T. L. and Harrington, M. K. (2000). *Gerontechnology Why and How*. Shaker.

[68] Harvey, J. A., Chastin, S. F., and Skelton, D. A. (2013). Prevalence of sedentary behavior in older adults: a systematic review. *International journal of environmental research and public health*, 10(12):6645–6661.

[69] Havens, B., Hall, M., Sylvestre, G., and Jivan, T. (2004). Social isolation and loneliness: Differences between older rural and urban manitobans. *Canadian Journal on Aging / La Revue canadienne du vieillissement*, 23(2):129–140.

[70] Hawthorn, D. (2000). Possible implications of aging for interface designers. *Interacting with Computers*, 12(5):507–528.

[71] Haythornthwaite, C. (2005). Social networks and internet connectivity effects. *Information, Communication & Society*, 8(2):125–147.

[72] Heikkinen, R.-L. and Kauppinen, M. (2004). Depressive symptoms in late life: a 10-year follow-up. *Archives of Gerontology and Geriatrics*, 38(3):239 – 250.

[73] Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., and Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science*, 10(2):227–237. PMID: 25910392.

[74] Houde, S. and Salomon, G. (1993). Working towards rich and flexible file representations. In *INTERACT '93 and CHI '93 Conference Companion on Human Factors in Computing Systems*, CHI '93, pages 9–10, New York, NY, USA. ACM.

[75] Hsieh, H.-F. and Wang, J.-J. (2003). Effect of reminiscence therapy on depression in older adults: a systematic review. *International Journal of Nursing Studies*, 40(4):335 – 345.

[76] Hughes, M. E., Waite, L. J., Hawkley, L. C., and Cacioppo, J. T. (2004). A short scale for measuring loneliness in large surveys: Results from two population-based studies. *Research on Aging*, 26(6):655–672. PMID: 18504506.

[77] Huldtgren, A., Vormann, A., and Geiger, C. (2015). Reminiscence map - insights to design for people with dementia from a tangible prototype. In *ICT4AgeingWell 2015 - Proceedings of the 1st International Conference on Information and Communication Technologies for Ageing Well and e-Health, Lisbon, Portugal, 20-22 May, 2015.*, pages 233–242.

[78] Hutto, C. J., Bell, C., Farmer, S., Fausset, C. B., Harley, L., Nguyen, J., and Fain, W. B. (2015). Social media gerontology: Understanding social media usage among older adults. *Web Intelligence*, 13(1):69–87.

[79] Ibarra, F., Baez, M., Fiore, F., and Casati, F. (2017a). Stimulating conversations in residential care through technology-mediated reminiscence. In Bernhaupt, R., Dalvi, G., Joshi, A., K. Balkrishan, D., O'Neill, J., and Winckler, M., editors, *Human-Computer Interaction – INTERACT 2017*, pages 62–71, Cham. Springer International Publishing.

[80] Ibarra, F., Baez, M., Fiore, F., and Casati, F. (2018a). Designing for co-located and virtual social interactions in residential care. In *Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*, DIS '18 Companion. ACM.

[81] Ibarra, F., Cernuzzi, L., Casati, F., and Baez, M. (2014). Virtual social gym: Plataforma web para la mejora de actividad física en adultos mayores. In *Memorias de las VI Jornadas AITADIS de Rehabilitación y Tecnologías de Apoyo a la Discapacidad 2014*.

[82] Ibarra, F., Gantumur, Z., Baez, M., Shcheckotyn, E., Taran, E., Cernuzzi, L., Barysheva, G., and Casati, F. (2017b). Efectos de compartir fotografías entre nietos y abuelos: Protocolo de un ensayo controlado y aleatorizado. In *IX Congreso Iberoamericano de Tecnologías de Apoyo a la Discapacidad IBERDISCAP 2017*.

[83] Ibarra, F., Korovina, O., Baez, M., Casati, F., Marchese, M., Cernuzzi, L., and Barysheva, G. A. (2016). Tools enabling online contributions by older adults. *IEEE Internet Computing*, 20(5):58–65.

[84] Ibarra, F., Kowalik, G., Baez, M., Nielek, R., Lau, N., Cernuzzi, L., and Casati, F. (2018b). Design challenges for reconnecting in later life: A qualitative study. In *Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*, DIS '18 Companion. ACM.

[85] Ipeirotis G., P. (2011). Demographics of mechanical turk. Technical report, NYU Working Paper No. ;CEDER-10-01. Available at SSRN: https://ssrn.com/abstract=1585030.

[86] Jarusriboonchai, P. (2016). *Understanding Roles and User Experience of Mobile Technology in Co-located Interaction*. Tampere University of Technology. Publication. Tampere University of Technology.

[87] Jarusriboonchai, P., Olsson, T., Lyckvi, S. L., and Väänänen, K. (2016). Let's take photos together: exploring asymmetrical interaction abilities on mobile camera phones. In *Proceedings of the 18th International Conference on Human-Computer Interaction with Mobile Devices and Services*, pages 529–540. ACM.

[88] Joinson, A. N. (2008). Looking at, looking up or keeping up with people?: Motives and use of facebook. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '08, pages 1027–1036, New York, NY, USA. ACM.

[89] Jung, E. H. and Sundar, S. S. (2016). Senior citizens on facebook: How do they interact and why? *Computers in Human Behavior*, 61:27 – 35.

[90] Jung, E. H., Walden, J., Johnson, A. C., and Sundar, S. S. (2017). Social networking in the aging context: Why older adults use or avoid facebook. *Telematics and Informatics*, 34(7):1071 – 1080.

[91] Khosravi, P. and Ghapanchi, A. H. (2016). Investigating the effectiveness of technologies applied to assist seniors: A systematic literature review. *International Journal of Medical Informatics*, 85(1):17 – 26.

[92] Kim, J. and Zimmerman, J. (2006). Cherish: Smart digital photo frames for sharing social narratives at home. In *CHI '06 Extended Abstracts on Human Factors in Computing Systems*, CHI EA '06, pages 953–958, New York, NY, USA. ACM.

[93] Kirk, D. S., Izadi, S., Sellen, A., Taylor, S., Banks, R., and Hilliges, O. (2010). Opening up the family archive. In *Proceedings of the 2010 ACM conference on Computer supported cooperative work*, pages 261–270. ACM.

[94] Kobayashi, M., Arita, S., Itoko, T., Saito, S., and Takagi, H. (2015). Motivating multi-generational crowd workers in social-purpose work. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, CSCW '15, pages 1813–1824, New York, NY, USA. ACM.

[95] Kobayashi, M., Ishihara, T., Itoko, T., Takagi, H., and Asakawa, C. (2013). Age-based task specialization for crowdsourced proofreading. In Stephanidis, C. and Antona, M., editors, *Universal Access in Human-Computer Interaction. User and Context Diversity*, pages 104–112, Berlin, Heidelberg. Springer Berlin Heidelberg.

[96] Kwak, H., Lee, C., Park, H., and Moon, S. (2010). What is twitter, a social network or a news media? In *Proceedings of the 19th International Conference on World Wide Web*, WWW '10, pages 591–600, New York, NY, USA. ACM.

[97] Lancioni, G. E., Singh, N. N., O'Reilly, M. F., Sigafoos, J., D'Amico, F., Ferlisi, G., Denitto, F., De Vanna, F., and Belardinelli, M. O. (2015). Patients with moderate alzheimer's disease engage in verbal reminiscence with the support of a computer-aided program: a pilot study. *Frontiers in Aging Neuroscience*, 7:109.

[98] Landi, F., Abbatecola, A. M., Provinciali, M., Corsonello, A., Bustacchini, S., Manigrasso, L., Cherubini, A., Bernabei, R., and Lattanzio, F. (2010). Moving against frailty: does physical activity matter? *Biogerontology*, 11(5):537–545.

[99] Lanir, J., Wecker, A. J., Kuflik, T., and Felberbaum, Y. (2016). Shared mobile displays: an exploratory study of their use in a museum setting. *Personal and Ubiquitous Computing*, 20(4):635–651.

[100] Larsson, E., Padyab, M., Larsson-Lund, M., and Nilsson, I. (2016). Effects of a social internet-based intervention programme for older adults: An explorative randomised crossover study. *British Journal of Occupational Therapy*, 79(10):629–636.

[101] Lazar, A., Thompson, H., and Demiris, G. (2014). A systematic review of the use of technology for reminiscence therapy. *Health Education & Behavior*, 41(1_suppl):51S–61S. PMID: 25274711.

[102] Lazarsfeld, P. F. and Merton, R. K. (1954). Friendship as a social process: A substantive and methodological analysis. In Berger, M., Abel, T., and Page, C., editors, *Freedom and Control in Modern Society*, pages 18–66. Van Nostrand, New York.

[103] Lee, D. T., Woo, J., and Mackenzie, A. E. (2002). A review of older people's experiences with residential care placement. *Journal of Advanced Nursing*, 37(1):19–27.

[104] Lee, H.-C., Cheng, Y. F., Cho, S. Y., Tang, H.-H., Hsu, J., and Chen, C.-H. (2014). Picgo: Designing reminiscence and storytelling for the elderly with photo annotation. In *Proceedings of the 2014 Companion Publication on Designing Interactive Systems*, DIS Companion '14, pages 9–12, New York, NY, USA. ACM.

[105] Lee, H.-C. and Hsu, J. Y.-j. (2016). Picmemory: Enriching intergenerational family interaction and memory collection. In *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, CHI EA '16, pages 3715–3718, New York, NY, USA. ACM.

[106] Lewis, K., Kaufman, J., Gonzalez, M., Wimmer, A., and Christakis, N. (2008). Tastes, ties, and time: A new social network dataset using facebook.com. *Social Networks*, 30(4):330 – 342.

[107] Li, Y. and Ferraro, K. F. (2006). Volunteering in middle and later life: Is health a benefit, barrier or both? *Social Forces*, 85(1):497–519.

[108] Lim, E.-P., Correa, D., Lo, D., Finegold, M., and Zhu, F. (2013). Reviving dormant ties in an online social network experiment. In Kiciman, E., Ellison, N. B., Hogan, B., Resnick, P., and Soboroff, I., editors, *ICWSM*. The AAAI Press.

[109] Lin, M.-C., Harwood, J., and Bonnesen, J. L. (2002). Conversation topics and communication satisfaction in grandparent-grandchild relationships. *Journal of Language and Social Psychology*, 21(3):302–323.

[110] Lindley, S. E. (2005). Designing interfaces to afford enjoyable social interactions by collocated groups. In *CHI'05 Extended Abstracts on Human Factors in Computing Systems*, pages 1122–1123. ACM.

[111] Lucero, A., Holopainen, J., and Jokela, T. (2011). Pass-them-around: collaborative use of mobile phones for photo sharing. In *Proceedings of the SIGCHI conference on human factors in computing systems*, pages 1787–1796. ACM.

[112] Lucero, A., Jones, M., Jokela, T., and Robinson, S. (2013). Mobile collocated interactions: Taking an offline break together. *interactions*, 20(2):26–32.

[113] Lundgren, S., Fischer, J. E., Reeves, S., and Torgersson, O. (2015). Designing mobile experiences for collocated interaction. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, pages 496–507. ACM.

[114] Luoh, M.-C. and Herzog, A. R. (2002). Individual consequences of volunteer and paid work in old age: Health and mortality. *Journal of Health and Social Behavior*, 43(4):490–509.

[115] Machesney, D., Wexler, S. S., Chen, T., and Coppola, J. F. (2014). Gerontechnology companion: Virutal pets for dementia patients. In *IEEE Long Island Systems, Applications and Technology (LISAT) Conference 2014*, pages 1–3.

[116] Mahmud, A. A., Mubin, O., Shahid, S., and Martens, J.-B. (2010). Designing social games for children and older adults: Two related case studies. *Entertainment Computing*, 1(3):147 – 156.

[117] Mayhorn, C. B., Stronge, A. J., McLaughlin, A. C., and Rogers, W. A. (2004). Older adults, computer training, and the systems approach: A formula for success. *Educational Gerontology*, 30(3):185–203.

[118] McBurney, D. H. and White, T. L. (2009). *Research methods*. Cengage Learning.

[119] McPherson, M., Smith-Lovin, L., and Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27(1):415–444.

[120] Mellor, D., Firth, L., and Moore, K. (2008). Can the internet improve the well-being of the elderly? *Ageing International*, 32(1):25–42.

[121] Moen, P., Fields, V., Quick, H., and Hofmeister, H. (2000). A life-course approach to retirement and social integration. *Social integration in the second half of life*, pages 75–107.

[122] Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., and Group, T. P. (2009). Preferred reporting items for systematic reviews and meta-analyses: The prisma statement. *PLOS Medicine*, 6(7):1–6.

[123] Mooney, R. J. and Roy, L. (2000). Content-based book recommending using learning for text categorization. In *Proceedings of the Fifth ACM Conference on Digital Libraries*, DL '00, pages 195–204, New York, NY, USA. ACM.

[124] Mubarak, O. (2015). A taxonomy of multi-user co-located interaction environments. In *27ème conférence francophone sur l'Interaction Homme-Machine*.

[125] Mukherjee, D. (2011). Participation of older adults in virtual volunteering: A qualitative analysis. *Ageing International*, 36(2):253–266.

[126] Musick, M. A. and Wilson, J. (2003). Volunteering and depression: the role of psychological and social resources in different age groups. *Social Science & Medicine*, 56(2):259 – 269.

[127] Nef, T., Ganea, R. L., Müri, R. M., and Mosimann, U. P. (2013). Social networking sites and older users – a systematic review. *International Psychogeriatrics*, 25(7):1041–1053.

[128] Newell, A. F., Carmichael, A., Gregor, P., and Alm, N. (2003). The human-computer interaction handbook. chapter Information Technology for Cognitive Support, pages 464–481. L. Erlbaum Associates Inc., Hillsdale, NJ, USA.

[129] Nick, B., Lee, C., Cunningham, P., and Brandes, U. (2013). Simmelian backbones: Amplifying hidden homophily in facebook networks. In *2013 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2013)*, pages 525–532.

[130] Nyqvist, F., Cattan, M., Andersson, L., Forsman, A. K., and Gustafson, Y. (2013). Social capital and loneliness among the very old living at home and in institutional settings: A comparative study. *Journal of Aging and Health*, 25(6):1013–1035. PMID: 23988810.

[131] O'Hara, K., Helmes, J., Sellen, A., Harper, R., ten Bhömer, M., and van den Hoven, E. (2012). Food for talk: Phototalk in the context of sharing a meal. *Human–Computer Interaction*, 27(1-2):124–150.

[132] Parra, C., Silveira, P., Far, I. K., Daniel, F., Bruin, E. D. D., Cernuzzi, L., D'Andrea, V., and Casati, F. (2014). Information technology for active ageing: A review of theory and practice. *Foundations and Trends® in Human–Computer Interaction*, 7(4):351–448.

[133] Perissinotto, C. M., Stijacic Cenzer, I., and Kenneth, E. C. (2012). Loneliness in older persons: A predictor of functional decline and death. *Archives of Internal Medicine*, 172(14):1078–1084.

[134] Petersen, M. G. (2007). Squeeze: designing for playful experiences among co-located people in homes. In *CHI'07 extended abstracts on Human factors in computing systems*, pages 2609–2614. ACM.

[135] Phan, M. H., Keebler, J. R., and Chaparro, B. S. (2016). The development and validation of the game user experience satisfaction scale (guess). *Human Factors*, 58(8):1217–1247. PMID: 27647156.

[136] Pinquart, M. and Sörensen, S. (2000). Influences of socioeconomic status, social network, and competence on subjective well-being in later life: A meta-analysis. *Psychology and Aging*, 15(2):187–224.

[137] Pinquart, M. and Sörensen, S. (2001). Influences on loneliness in older adults: A meta-analysis. *Basic and Applied Social Psychology*, 23(4):245–266.

[138] Piper, A. M., Weibel, N., and Hollan, J. (2013). Audio-enhanced paper photos: Encouraging social interaction at age 105. In *Proceedings of the 2013 Conference on Computer Supported Cooperative Work*, CSCW '13, pages 215–224, New York, NY, USA. ACM.

[139] Quinn, K. (2013). We haven't talked in 30 years! *Information, Communication & Society*, 16(3):397–420.

[140] Ramirez, A., Sumner, E. M., and Hayes, J. (2016). Reconnect on facebook: The role of information seeking behavior and individual- and relationship-level factors. *Cyberpsychology, Behavior, and Social Networking*, 19(8):494–501.

[141] Reitmaier, T., Benz, P., and Marsden, G. (2013). Designing and theorizing co-located interactions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pages 381–390. ACM.

[142] Renaud, K. and van Biljon, J. (2008). Predicting technology acceptance and adoption by the elderly: A qualitative study. In *Proceedings of the 2008 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries: Riding the Wave of Technology*, SAICSIT '08, pages 210–219, New York, NY, USA. ACM.

[143] Rezende, L. F. M. d., Rey-López, J. P., Matsudo, V. K. R., and Luiz, O. d. C. (2014). Sedentary behavior and health outcomes among older adults: a systematic review. *BMC Public Health*, 14(1):333.

[144] Sanchiz, E., Ibarra, F., Nikitina, S., Báez, M., and Casati, F. (2016). What makes people bond?: A study on social interactions and common life points on facebook. In *2016 International Conference on Collaboration Technologies and Systems (CTS)*, pages 26–30.

[145] Schutzer, K. A. and Graves, B. (2004). Barriers and motivations to exercise in older adults. *Preventive Medicine*, 39(5):1056 – 1061.

[146] Seeman, T. E., Berkman, L. F., Blazer, D., and Rowe, J. W. (1994). Social ties and support and neuroendocrine function: the macarthur studies of successful aging. *Annals of Behavioral Medicine*, 16(2):95–106.

[147] Silveira, P., van de Langenberg, R., van het Reve, E., Daniel, F., Casati, F., and de Bruin, D. E. (2013a). Tablet-based strength-balance training to motivate and improve adherence to exercise in independently living older people: A phase ii preclinical exploratory trial. *J Med Internet Res*, 15(8):e159.

[148] Silveira, P., van het Reve, E., Daniel, F., Casati, F., and de Bruin, E. D. (2013b). Motivating and assisting physical exercise in independently living older adults: A pilot study. *International Journal of Medical Informatics*, 82(5):325 – 334.

[149] Siriaraya, P. and Ang, C. S. (2014). Recreating living experiences from past memories through virtual worlds for people with dementia. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '14, pages 3977–3986, New York, NY, USA. ACM.

[150] Sixsmith, A. and Gutman, G. (2013). *Technologies for active aging*, volume 9. Springer US.

[151] Spirduso, W. W. and Cronin, D. L. (2001). Exercise dose–response effects on quality of life and independent living in older adults. *Medicine & Science in Sports & Exercise*, 33(6, Suppl.):S598–S608.

[152] Steverink, N., Slaets, J., Schuurmans, H., and Van Lis, M. (2001). Measuring frailty: development and testing of the groningen frailty indicator (gfi). *Gerontologist*, 41(1):236.

[153] Stuart, M., Chard, S., Benvenuti, F., and Steinwachs, S. (2008). Community exercise: a vital component to healthy aging. *Healthcarepapers*, 10(1):23–8.

[154] Subramaniam, P. and Woods, B. (2012). The impact of individual reminiscence therapy for people with dementia: systematic review. *Expert Review of Neurotherapeutics*, 12(5):545–555. PMID: 22550983.

[155] Subramaniam, P. and Woods, B. (2016). Digital life storybooks for people with dementia living in care homes: an evaluation. *Clinical interventions in aging*, 11:1263.

[156] Széman, Z. (2014). A new pattern in long term care in hungary: Skype and youth volunteers. *Anthropological notebooks*, pages 105–117.

[157] Taylor, A. S., Swan, L., and Durrant, A. (2007). Designing family photo displays. In Bannon, L. J., Wagner, I., Gutwin, C., Harper, R. H. R., and Schmidt, K., editors, *ECSCW 2007*, pages 79–98, London. Springer London.

[158] Teychenne, M., Ball, K., and Salmon, J. (2010). Sedentary behavior and depression among adults: A review. *International Journal of Behavioral Medicine*, 17(4):246–254.

[159] Theurer, K., Mortenson, W. B., Stone, R., Suto, M., Timonen, V., and Rozanova, J. (2015). The need for a social revolution in residential care. *Journal of Aging Studies*, 35:201 – 210.

[160] Thibaud, M., Bloch, F., Tournoux-Facon, C., Brèque, C., Rigaud, A. S., Dugué, B., and Kemoun, G. (2012). Impact of physical activity and sedentary behaviour on fall risks in older people: a systematic review and meta-analysis of observational studies. *European Review of Aging and Physical Activity*, 9(1):5–15.

[161] Thomas, W. H. (1996). *Life worth living: How someone you love can still enjoy life in a nursing home: The Eden Alternative in action*. VanderWyk & Burnham, Acton, MA.

[162] Topinková, E. (2008). Aging, disability and frailty. *Annals of Nutrition and Metabolism*, 52(Suppl. 1):6–11.

[163] Topolski, T. D., LoGerfo, J., Patrick, D. L., Williams, B., Walwick, J., and Patrick, M. M. B. (2006). Peer reviewed: the rapid assessment of physical activity (rapa) among older adults. *Preventing chronic disease*, 3(4).

[164] Tranquillini, S., Daniel, F., Kucherbaev, P., and Casati, F. (2015). Modeling, enacting, and integrating custom crowdsourcing processes. *ACM Trans. Web*, 9(2):7:1–7:43.

[165] Traud, A. L., Mucha, P. J., and Porter, M. A. (2012). Social structure of facebook networks. *Physica A: Statistical Mechanics and its Applications*, 391(16):4165 – 4180.

[166] Tullis, T. and Albert, W. (2008). *Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics*. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.

[167] Uriu, D., Shiratori, N., Hashimoto, S., Ishibashi, S., and Okude, N. (2009). Caraclock: An interactive photo viewer designed for family memories. In *CHI '09 Extended Abstracts on Human Factors in Computing Systems*, CHI EA '09, pages 3205–3210, New York, NY, USA. ACM.

[168] van Bel, D. T., Smolders, K. C. H. J., IJsselsteijn, W. A., and de Kort, Y. (2009). Social connectedness: concept and measurement. In *Intelligent Environments*.

[169] van Tilburg, T. (1998). Losing and gaining in old age: Changes in personal network size and social support in a four-year longitudinal study. *The Journals of Gerontology: Series B*, 53B(6):S313–S323.

[170] VolunteerMatch (2007). Great expectations: Boomers and the future of volunteering.

[171] Webster, J. D. (1993). Construction and validation of the reminiscence functions scale. *Journal of Gerontology*, 48(5):P256–P262.

[172] Webster, J. D. and Gould, O. (2007). Reminiscence and vivid personal memories across adulthood. *The International Journal of Aging and Human Development*, 64(2):149–170. PMID: 17451043.

[173] Wenger, G. C., Davies, R., Shahtahmasebi, S., and Scott, A. (1996). Social isolation and loneliness in old age: Review and model refinement. *Ageing and Society*, 16(3):333–358.

[174] West, D., Quigley, A., and Kay, J. (2007). Memento: a digital-physical scrapbook for memory sharing. *Personal and Ubiquitous Computing*, 11(4):313–328.

[175] Westerhof, G. J. and Bohlmeijer, E. T. (2014). Celebrating fifty years of research and applications in reminiscence and life review: State of the art and new directions. *Journal of Aging Studies*, 29:107 – 114.

[176] White, H., McConnell, E., Clipp, E., Branch, L. G., Sloane, R., Pieper, C., and Box, T. L. (2002). A randomized controlled trial of the psychosocial impact of providing internet training and access to older adults. *Aging & Mental Health*, 6(3):213–221. PMID: 12217089.

[177] Whitley, B. E., Kite, M. E., and Adams, H. L. (2013). *Principles of research in behavioral science*. Routledge.

[178] Williams, A. and Nussbaum, J. F. (2001). *Intergenerational communication across the life span*. Routledge, Mahwah, New Jersey.

[179] Wilson, J. and Musick, M. A. (1999). Attachment to volunteering. *Sociological Forum*, 14(2):243–272.

[180] Wilson, J. and Musick, M. A. (2000). *Women's Labor Force Participation and Volunteer Work*. Aspen Institute, Nonprofit Sector Research Fund.

[181] Wood, V. and Robertson, J. F. (1978). Friendship and kinship interaction: Differential effect on the morale of the elderly. *Journal of Marriage and Family*, 40(2):367–375.

[182] World Health Organization (2002a). *Active Ageing: A Policy Framework*. Geneva : World Health Organization.

[183] World Health Organization (2002b). Definition of an older or elderly person: Proposed working definition of an older person in africa for the mds project. http://www.who.int/healthinfo/survey/ageingdefnolder/en/. Accessed: 2018-01-19.

[184] World Health Organization (2011). *World Report on Disability*. World Health Organization.

[185] Wrzus, C., Hänel, M., Wagner, J., and Neyer, F. J. (2013). Social network changes and life events across the life span: a meta-analysis. *Psychological bulletin*, 139(1):53.

[186] Xu, Y., Gandy, M., Deen, S., Schrank, B., Spreen, K., Gorbsky, M., White, T., Barba, E., Radu, I., Bolter, J., and MacIntyre, B. (2008). Bragfish: Exploring physical and social interaction in co-located handheld augmented reality games. In *Proceedings of the 2008 International Conference on Advances in Computer Entertainment Technology*, ACE '08, pages 276–283, New York, NY, USA. ACM.

[187] Yang, K. and Victor, C. R. (2008). The prevalence of and risk factors for loneliness among older people in china. *Ageing and Society*, 28(3):305–327.

[188] Yang, K. and Victor, C. R. (2011). Age and loneliness in 25 european nations. *Ageing and Society*, 31(8):1368–1388.

[189] Zimmerman, J., Forlizzi, J., and Evenson, S. (2007). Research through design as a method for interaction design research in hci. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, CHI '07, pages 493–502, New York, NY, USA. ACM.