



5. DESIGNING TECHNOLOGIES FOR SOCIAL CONNECTION WITH OLDER PEOPLE

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SOCIAL PARTICIPATION AND INTEGRATION IS important for mental and physical wellbeing. However, for many older people, declining health, reduced mobility, and separation from family members and friends can make it difficult to maintain an active social life. A large number of technological interventions have been developed to prevent social isolation and alleviate loneliness. Information and communication technologies (ICTs) have the potential to maintain social inclusion by supporting social interaction. However, these are generally designed for younger users, and may not always meet the needs and wishes of older people with regard to social connection.

This chapter focuses on the development of ICTs to help older people remain socially connected. Our starting point is that the design of such interventions must be grounded in an understanding of how older people manage their social relationships and deal with loneliness to ensure that any technologies developed are easy to use and fit for purpose. In turn, this can only be achieved if older people are involved in the design process. ‘Co-design’ refers to a range of methods and tools to enable users to engage fully in the design process and so assist IT professionals and other stakeholders to understand users’ everyday practices, needs and experiences (Hartswood et al. 2008).

The first section looks at the range of interventions to prevent and alleviate loneliness in older adults. The second section focuses on the involvement of older people in the design of ICTs to support social connection. The final section explores the deployment of technology prototypes in real social contexts and calls for providers of technologies and services for older people to pay more attention to ‘co-deployment’, supporting users in exploring, learning and adapting technologies and services ‘in-use’.

Preventing and Alleviating Loneliness through ICTs

Loneliness and health

The terms 'social isolation' and 'loneliness' have often been used interchangeably but are actually distinct concepts. Social isolation is a term related to social network size, frequency of contact and level of support. Loneliness, on the other hand, refers to the negative subjective experience related to a perceived lack of social contact or companionship than that desired, and is therefore a subjective state. Some people may be isolated but not feel lonely, some may feel isolated and lonely, and some may have frequent social contact but still feel lonely.

The concept of loneliness has also been divided further. Weiss (1973) made a distinction between 'social loneliness' related to a lack of social contacts or integration (e.g. friends, neighbours) and 'emotional loneliness' resulting from the absence of a close emotional attachment (e.g. spouse, close friend). Social loneliness may occur, for example, following relocation or restricted mobility due to illness, whereas emotional loneliness could arise from loss of a partner relationship through divorce or widowhood. Distinctions have also been made on the basis of duration, frequency and severity of loneliness. Young (1982) distinguished between 'transient' (brief and occasional), 'situational' (resulting from a specific change or event) and 'chronic' (stable, long-term) loneliness.

Research suggests that between 5 and 16 per cent of older people often or always experience loneliness (Pinquart and Sorensen 2001; Victor et al. 2002). However, these figures may be an under-estimate because of under-reporting (due to the negative connotations of being lonely). A number of self-report scales to measure the type and severity of loneliness have avoided explicit reference to loneliness. The UCLA Loneliness Scale, for example, consists of twenty items (e.g. 'How often do you feel you lack companionship?', 'How often do you feel there is no one you can turn to?'). In a revised version of the scale, ten of the items were reversed to reduce the negative wording (Russell et al. 1980). Similarly, the De Jong Gierveld Loneliness Scale includes positive and negative items related to the 'social' loneliness dimension (e.g. 'There are plenty of people I can rely on when I have problems') and 'emotional' loneliness dimension (e.g. 'I sense a general feeling of emptiness') (De Jong Gievelde et al. 2006).

Aside from age, other risk factors for loneliness include living alone, widowhood, poor physical and mental health, cognitive impairment, income and education (Victor, Bowling and Bond 2002; Victor et al. 2005). Loneliness may also be exacerbated by social or environmental factors, such as design of urban areas, changes to service infrastructure (e.g.

transport, closure of post offices), crime and population change (Phillipson 2007; Scharf and De Jong Gierveld 2008).

Links between loneliness and health are well documented. Loneliness is closely related to mental health problems including depression (Golden et al. 2009; Cacioppo et al. 2006), anxiety (Fees et al. 1999) and cognitive decline (Tilvis et al. 2004; Wilson et al. 2007); and with physical health conditions such as lung disease (Penninx et al. 1999), high blood pressure (Hawkey et al. 2006; Steptoe et al. 2004), poor sleep (Cacioppo et al. 2002; McHugh and Lawlor 2012), obesity (Lauder et al. 2006) and arthritis (Penninx et al. 1999).

Although associations are well documented, the chain of causation between loneliness and health remains speculative. Decline in mental and physical health has often been considered as a cause as well as a consequence of loneliness. For example, restricted physical mobility could reduce engagement in social activities, which could further increase depression, alter sleep or disrupt appetite, leading to further decline in health and subsequent increase in isolation (Tijhuis et al. 1999). Various mediating factors might also come into play, such as personality, stress and social support networks (Hawkey and Cacioppo 2003; Schnittger et al. 2012; McHugh and Lawlor 2012).

Reducing loneliness through ICTs

A number of interventions have been developed to help older people establish and maintain satisfying interpersonal relationships, including group meetings or activities (e.g. bereavement support, carer support, exercise and gardening projects) and befriending schemes, in which a volunteer would routinely visit those who are isolated or homebound. A systematic literature review of intervention studies conducted between 1970 and 2002 concluded that their effectiveness remained unclear (Cattan et al. 2005). In that review, group interventions with an educational component, such as training workshops on health, exercise and caregiving, showed most potential for alleviating social isolation and loneliness in older people. They found that the involvement of the target groups in planning and developing these activities facilitated the effectiveness of the interventions. A review by Dickens et al. (2011) also indicated that social and support activities in a group format appeared more effective than one-to-one interventions, particularly when they involved active input from participants (e.g. peer support, sharing experiences), rather than simply being recipients of the training and education.

ICTs have long been considered as potential tools for alleviating loneliness. Telephone befriending services, in which the older person receives one-to-one

or teleconference calls at scheduled times for a chat, have been widely used (Hartke et al. 2003; Cattan et al. 2011). Older users have reported positive outcomes from these services, which provide them with a 'sense of belonging', a feeling that somebody cared about them, and self-confidence to become more physically and socially active (Cattan et al. 2011). One reason for the success of these schemes is that the telephone is a familiar technology. It is immersed in cultural understanding and routine and does not require time to learn how to use it (Monk and Reed 2007). However, there are some possible limitations, most notably the need to be available to receive the call, and the absence of face-to-face and non-verbal communication (Heller et al. 1991; Cattan et al. 2011; McHugh et al. 2012).

Internet and mobile devices could provide further scope and flexibility in communication. However, there are a number of barriers to their use by older people. Recent reports show that most people over 65 are not regular computer users. In the UK, the Oxford Internet Survey for 2011 found that only 25–35 per cent of people over 65 used the internet (Dutton and Blank 2011). The UK Office for National Statistics also reported that only 30 per cent of adults aged 75 years and over had never used the internet (Office for National Statistics 2012). Although mobile phone ownership has grown rapidly among older adults, from 47 per cent in 2005 to 68 per cent in 2012, use of smart phones still remain low. In 2012, only 3 per cent of people over 65 used a smart phone, compared to 66 per cent of those aged 16 to 24, and 60 per cent of those aged 25 to 34 (Ofcom 2012).

With this in mind, a number of studies have evaluated the effect of providing older people with computer training and internet access (Cody et al. 1999; Fokemma and Knipscheer 2007; Mellor et al. 2008; Shapira et al. 2007; Slegers et al. 2008; White et al. 1999; White et al. 2002; Woodward et al. 2011). These projects have typically used a randomized controlled trial design with pre- and post-measures of loneliness, and findings have been mixed. Shapira et al. (2007) provided twenty-two nursing home and day care centre attendees with computers and training (e.g. in email and online forums). Between the group training sessions, participants were encouraged to use a communal computer room in their own time. After fifteen weeks, participants showed a significant decrease in scores on the UCLA Loneliness Scale, compared to controls. Fokemma and Knipscheer (2007) provided fifteen home-bound elders with one-to-one tuition and a computer with internet connection for three years. They observed a significant reduction in 'emotional' loneliness measured using the De Jong-Gierveld Loneliness Scale. The intervention enabled participants to stay in touch with social contacts despite poor health, and increased self-confidence in general, leading to more social activities outside the home.

These studies, however, are open to confounding. In particular, improvements in loneliness may be due to one-to-one and group training sessions rather than the ICT intervention itself. White et al. (1999) found that immediately following a computer training period, the intervention group showed a significant decrease in loneliness, but after five months this significant effect had disappeared. Slegers et al. (2008) isolated this effect by providing a comparison group with training, but no computer or internet access. They found no significant difference with regard to mood, quality of life or loneliness between the intervention or comparison groups.

Many trials of ICTs in loneliness had high withdrawal rates (13 per cent to 60 per cent). Reasons included illness, hospitalization, limited time, unwillingness to learn, difficulty using the technology and lack of perceived need for the technology (Cody et al. 1999; Fokemma and Knipscheer 2007; Mellor et al. 2008; Shapira et al. 2007; Slegers et al. 2008; White et al. 1999). Many potential participants were excluded from the studies for practical reasons, such as sensory, physical and cognitive impairment, as well as insufficient space in the home for the technology.

The inconclusive evidence emerging from these studies, and the barriers to taking part, suggest a need for new ICT solutions. One study conducted twenty years ago sought to modify existing technology. Czaja et al (1993) redesigned a 'POMS' (Plain Old Message System) specifically to encourage social interaction among older people with no experience with computers. The technology consisted of a 'simplified' communication system with a text editor, display, keyboard, modem and printer. The design was specialized for message communication. It was always 'on', and there were no log-on procedures, disk operations or file access. To begin, the user pressed any key. The screen would then display a single line of text with the word 'To?' The user typed the name of another participant, and the system dialled automatically. The user then pressed a key boldly labelled 'Return' on the keyboard. They could then write the message. When the message was completed, the user would press a boldly labelled 'Send' key. When the message arrived it was printed automatically. The system was placed in the homes of thirty-six women aged 55 to 95 who had minimal or no prior experience with computers. It was reported that they used the system with little difficulty, enjoyed using it and felt that it facilitated social interaction and a chance to meet new people. However, use fell significantly over the course of the trial, signifying that the early positive findings were partly due to novelty effect. Other reasons for disengagement included being too busy, limited functionality and boredom.

In 2009, the EU Ambient Assisted Living (AAL) Joint Programme invested 60.9 million euros into twenty-three different projects that focused specifically on developing 'ICT based solutions for advancement

of social interaction of elderly'. Various approaches were taken, including virtual community networks accessible through computers or televisions (e.g. 'Co-LIVING' and 'ELDER-SPACES'), 3D virtual environments where the older user's 'avatar' can meet with other users' avatars (e.g. '3rD-Life'), computer games (e.g. 'SILVERGAME') and robotic devices that support webcam communication through mounted screens (e.g. 'ExCITE') (www.aal-europe.eu/call-2/).

Notwithstanding these and other rapid technological advancements in internet-based, mobile and robotic systems, it is important that design is driven by an understanding of older users' daily lives and needs. As was demonstrated in the early work by Czaja et al. (1993), design must go beyond generic usability features and initial attitudes towards the technology. For prolonged use, it must fit around users' daily lives and meet their social needs. The cultural gap between young designers and older adults is particularly wide when developing ICTs intended to facilitate social interaction. Gerontology literature has shown various changes in social behaviours, roles and relationships over the life course (Rook 1987; Carstensen et al. 2003; Schwarz et al. 2005). This highlights the need to include older people in the design process to ensure that the technology meets their needs and wishes.

Designing with Older Users

'Co-design' is a participatory design approach that brings designers and users together to develop new technologies and services. It aims to ensure that design is grounded in the lived experience of users and that users are fully engaged in the design process (Hartwood et al. 2008). This section looks at some of the methods used to understand the lived experience of older users, and methods of engaging them in the design of ICT to enhance social interaction.

Exploring Social Connection 'in the Wild'

Ethnographic research techniques (e.g. visiting people in their homes, semi-structured and narrative interviews, observations and field notes) can be employed to learn how older people approach their relationships and how they deal with loneliness and isolation. However, pursuing ethnographic research within domestic and private settings raises practical and ethical challenges. 'Cultural probe' methods offer a relatively unobtrusive way of exploring social and domestic routines (Wherton et al. 2012). Cultural probes are open-ended and evocative activities for participants to pursue

in their own time to help narrate and depict their lives to researchers and technology designers. They employ everyday artefacts, such as digital cameras, audio-recorders, diaries and notebooks to allow participants to record and capture everyday activities to help gain insight into how technology might be embedded within people's lives.

The cultural probe method supports ethnographic data collection by promoting dialogue between researcher and participant, allowing participants to reflect on their lives and relationships, and recall events and subjective experiences (Boehner et al. 2007; Graham et al. 2007; Graham and Rouncefield 2008; Wherton et al. 2012). Visual materials also offer a means for 'cognitive offloading', helping to communicate complex aspects of daily living, such as social network structures and relevant places, objects and routines that promote positive social and mental wellbeing. This helps researchers to gain insight into the lived experience of older people, their social relationships and how they deal with loneliness, and to consider how ICTs should be designed to address real needs.

Cultural probes were initially developed by Gaver et al. (1999), who used a range of materials for participants to record their daily lives in order to inspire creative responses among a design team. The cultural probe packages included local and world maps, postcards, a disposable camera, a photo album and a diary. These were given to participants to use and return after a period of time. For example, cameras included suggestions for photographs written on the back (e.g. 'what you will wear today', 'something desirable' and 'something boring'). The materials were left with the older participants to return fragmentary data over time. Responses were used in an open-ended way to inspire design ideas.

This approach has subsequently been used in different ways with different affordances in order to gather information about people's social relationships and routines. The probe tools were used in combination with other ethnographic methods (e.g. interviews, observations and 'home tours') to help establish dialogue between researcher and participant and facilitate qualitative data collection. Riche and Mackay (2010) used cultural probes to understand the supportive role of social networks and the way in which technology could help the elderly stay in touch with family, friends and neighbours. Findings revealed themes to be considered in the design of ICT, including 'PeerCare', in which the role of reciprocal support behaviour (e.g. check-up calls and exchanging house keys for emergencies) played an important part in their social relationships; 'Awareness, rhythms and routines', in which daily routines and behaviour patterns played an important part of helping elders remain aware of each other (e.g. if neighbours had not left the house, if curtains were drawn), as well as knowing each other's routines (e.g. knowing when to contact each other and when

to expect a call or visit); and privacy, in which there was a trade-off between a desire to maintain their privacy but also the need to disclose, such as providing sensitive information (e.g. about their health) in exchange for peace of mind.

Similarly, Pedell et al. (2010) focused on the role of domestic technologies in addressing social isolation. Participants were asked to take at least one photograph per day and write what it meant to them with regard to social interaction. The diary included cued phrases (e.g. 'Today I feel lonely because...' or 'Every day I...') to prompt entries. These probes helped to capture personal and subjective events *in situ* and foreground these for the interview. For example, a widow with no family relations commented that other members 'can bore you silly with their tales about children and grandchildren'. Photos and diary entries also highlighted how the use of artefacts within the home supported reminiscence and triggered memories of meaningful past relationships.

The cultural probe method was used as part of the ATHENE (Assistive Technologies for Health Living in Elders: Needs Assessment by Ethnography) project, which explored the healthcare and social care needs of older people with different health conditions, ethnic backgrounds and family settings (Greenhalgh et al. 2013). A range of materials, including a digital camera, diary, lists (e.g. likes, dislikes, concerns), body outline (to draw/write areas of pain, discomfort or decline), and 'relationship maps' (to indicate important people, places and objects) were given to participants for one week between home visit interviews. The visual representations helped the researchers follow discussions regarding social support networks and how they related to participants' health and social wellbeing. One participant, for example, recorded various locations for face-to-face interaction. This included visits to the local shop, even if she did not need to buy anything. She also included the 'front door' as an important place to greet and chat with people passing by. A major fear she had was moving into sheltered accommodation, where she would not have her own front door or access to local shops as places for opportunistic social interaction (Wherton et al. 2012).

Collectively, these studies highlight the fact that older users may not be as 'homebound' as designers typically assume, and that even those with multiple impairments value opportunistic and flexible interactions outside the home. Relationships often involve a degree of reciprocity (e.g. checking-in on each other), common ground (shared knowledge or experience) and insight into each other's routine behaviours (e.g. knowing when to call, when to expect a call). However, they also raise concerns around privacy and intrusion (not wanting to intrude, but also not being disrupted by others). Understanding the social routine and relationships of older people

can inform the design of ICTs to support social interaction, so that they meet users' needs and fit within existing settings and behaviours.

Including Older People in Design

Focus groups and workshops are an effective way of directly engaging older people in the design of ICT, but they pose practical challenges such as fatigue and boredom, as well challenges for researchers to keep a focus on the design topic (Lindsay et al. 2012). Users may also lack the technical knowledge or confidence to offer design input or express their opinions (Eisma et al. 2004).

A number of techniques have been developed to support involvement of older people in the co-design process. Visual materials and hands-on activities may help trigger ideas and focus attention on essential parts of the design. Scenarios and storyboards can help to communicate how a novel technology might be used and cue general discussion about the idea. Storyboards can depict (in cartoon-strip format) a narrative of the technology being used. The story is presented in a series of frames to include the character(s)/setting, their problem, the solution, and the consequences of using it. Once the facilitator has presented the storyboard, participants are invited to comment on the scenario. This approach is not intended for detailed evaluation of technical features and user interface designs, but can promote a general discussion about how the technology might fit (or not) within daily lives, and raise important issues or concerns related to social connection, such as privacy and security, social obligation, fitting social interactions into daily routines and need for common ground between users (Wherton and Prendergast 2009). Newell et al. (2006) suggested the use of live 'interactive theatre' with professional actors as a means of communicating user scenarios. Short five-minute plays were scripted to enact ways in which users might behave in the context of novel applications. The use of humour and dramatic tensions were found to be enjoyable and engaging for older adults and designers, facilitating creative discussions about the technology.

Sketching and cards prompts may elicit discussion and talk through design ideas with other members of the group (Beck et al. 2008; Rice and Carmichael 2011; Rice et al. 2012). For example, Rice and Carmichael (2011) sought to elicit ideas of what would be required to design a 'social TV' (social interactive applications through digital television) for older people. Participants were first presented with prompt cards representing each interactive step to initiate a call through the TV, and asked to write or sketch design ideas for each step. This helped participants externalize design ideas and share them with the group. For example, they raised

concerns about privacy and intrusiveness, particularly with regard to video calls. They proposed familiar metaphors for icons that represent availability to talk, and options to hold a video call so that they could prepare themselves before talking to the other person. Following this activity, participants were then given cardboard cut-outs of graphical components that could be included on the user interface of the call applications. They were asked to select and re-assemble the interface components themselves. This triggered ideas about how to simplify the interface design, organize tools (e.g. address book), eliminate redundancies in the design and include more meaningful icons. The versatility of the cardboard cut-outs also meant that individuals could revert back to change or swap them over at any stage during discussions.

When preparing workshop structure and materials, it is important to consider a wide range of age-related impairments and health problems, including loss of vision, hearing, memory and physical mobility. Furthermore, the need to create a friendly atmosphere, in which participants feel free to mutually inspire each other through collaboration, should not be overlooked (Lindley 2012).

User involvement is required throughout the design of a technology prototype. At successive design iterations, users can request more specific and detailed modification. This helps to achieve a balance between maintaining simplicity and adding functionality (Dewsbury et al. 2007).

Pilot Studies in the Home

Garattini et al. (2012) explored the use of 'Building Bridges', a prototype communication device designed to encourage social interaction among older people at risk of loneliness. The device was inspired by the wide use of telephone befriending schemes and primarily intended to support interaction between strangers. With the involvement of potential users, the design aimed to help overcome intrusion, privacy and need for common ground (Wherton and Prendergast 2009; Prendergast, Somerville and Wherton 2012). The device consisted of a 12-inch touch screen with phone handset and speakers. The software used VoIP (Voice over Internet Protocol) with a user interface to allow older users to access four features. The main feature was 'Broadcast and Chat', in which users could listen/watch regular audio/video broadcasts (e.g. news, documentaries, health lectures and music) at scheduled times throughout the day and join a 'group chat' afterwards by lifting the phone handset. During the group chat, the screen displayed icons and first names to indicate who had entered/left the conference call. Hence, the broadcast was designed to create opportunities to meet new

people and offer some common ground (topic of the broadcast) to facilitate the conversations. Additionally, participants could initiate one-to-one or group calls, send one-to-one or group messages, and enter an audio chat room that could be entered at any time during the day or night.

The device was deployed in the home of nineteen older adults for ten weeks. Participants could talk during post-broadcasts chats, or communicate at any point using the call, messaging and chat room features. If they did not wish to be contacted, they could switch their device off, and their icon status would indicate that they were unavailable.

Home visit interviews and logging of usage (feature, time, frequency and duration) provided insight into how the device was used over the course of the pilot. Although frequency of calls dropped over time, the duration of conversations increased. The logs also revealed aspects of the solution that were most effective in facilitating interaction. For example, educational broadcasts, particularly those about managing health (e.g. 'helping your memory' and 'coping with falls'), led to more frequent and longer post-broadcast chats than other broadcast genres, such as news programmes, documentaries (e.g. history) and entertainment (e.g. music and comedy). However, participants varied in their use of the system. In particular, those who scored high for 'social' loneliness, according to the De Jong Loneliness Scale, became lead users and advocates of the platform, attempting to focus social interaction and encourage usage among other members. However, those who scored high for 'emotional' loneliness were generally more ambivalent.

The opportunistic nature of the broadcasts and post-broadcast chats helped to overcome some of the concerns of intrusion and a need for common ground. One woman commented that she was 'too shy to make a call and so would talk to people after the broadcasts'. One man likened it to the 'lamp post on the corner of the street and three of four [people] chatting'.

Over time, the pilot revealed changes to system requirements. Concerns about intrusion and privacy led to requests to remove video call functionality within the device. However, as users became familiar with each other, they wanted to share information (e.g. interests, where they lived) as well as the ability to see each other via a webcam. Many felt that they had reached a limit, that they could develop a friendship through the device and wanted to meet each other face-to-face. Some perceived this to be a limitation, while others adapted their use of the device to meet this need, using the messaging feature to set up meetings with those they found things in common with (e.g. went to the same school or similar profession) and sent out group messages to arrange scheduled events (e.g. walk in the park). It

therefore became a tool to prompt social interaction outdoors, as opposed to merely communicating from home.

Lindley (2012) deployed a novel communication device across three households within a family network. The case study was part of a wider field trial with a prototype device, 'Wayve'. The prototype consisted of a touch screen display that allowed sending and receiving of written messages. Messages could be created through handwriting or drawing with coloured pen-strokes, entering text using an onscreen keyboard, or by taking photos using a camera in the top right corner. The device was designed to allow messages to be quickly scribbled and sent from home. The case study focused on an extended family of a couple, their two sons and two grandchildren. Home visit interviews and remote logging of system usage was carried out for a period of eighty-nine days.

The authors found that the grandparents spent more time and energy in sending messages to other family members. The flexibility of the device allowed them to invest effort into their communication to achieve the degree of personalization that they desired (e.g. digital photos of meal ingredients and cooking, trips out during the day). At the same time, the asynchronous nature of the communication made it easier for the grandparents to work around the busy schedule of one son and the unusual working patterns of the other. Sharing photos and allowing people to comment upon mundane aspects of daily life created a sense of closeness, which could not be achieved through telephone or mobile phone communication. The grandparents valued the device for a number of other reasons beyond sharing everyday activities. They used 'social touch' messages (e.g. 'night all') as a way of creating a sense of social presence or awareness across households. The flexibility of the device allowed them to engage with teenage grandchildren quite differently. Sending 'silly pictures' and playing word games (e.g. hangman) appeared to be the most effective way to establish direct contact with them. Importantly, the Wayve device did not replace other communication practices, such as telephone or face-to-face contact. In fact, it prompted and helped to co-ordinate these forms of communication. The grandfather took ownership of the device, and became responsible for creating and sending messages. The grandmother had a supportive and coordinating role, viewing the images and using the device to establish when the sons were available to talk on the phone.

These pilot studies illustrate the need to observe how technologies are used in real contexts to inform the design. In both cases, the device became as much of a prompt or facilitator to other forms of contact (e.g. telephone, face-to-face, events) as a mode of social interaction. This highlights the fact that technologies cannot be viewed in isolation, but must be considered within the broader context of existing social routines and practices and the

way in which technologies can support them. These devices, for example, could be embedded within the volunteer befriending schemes previously discussed, rather than presented as an alternative solution to loneliness.

Observing variations in levels of engagement and the use of specific design features highlights areas for further development. For example, with the 'Building Bridges' device, educational broadcasts appeared most effective in facilitating conversation between strangers. This suggests that informative or educational content, which is perceived as beneficial in itself, acts as an effective channel for encouraging social interaction.

These pilots revealed different needs and expectations among users with regard to social interaction, reflecting individual differences in needs, expectations, social roles and communication styles. This presents a challenge for designing ICTs for social connection, as the system is made up of the user, the technology and numerous other users whose profiles are unknown at the time of design or installation. Insights into how older people adapt their use of technologies in real social contexts, to better suit their needs, is an important part of the design process.

Conclusion

The ageing of the population in many countries is fuelling interest in ICTs to support independence and delivery of health and social services to the home. With advances in internet and mobile technologies, there has also been growing interest in supporting social connectivity and alleviating loneliness. Older people experience loneliness in diverse and complex ways, which are, in turn, the product of a range of factors. If ICT-based interventions are to address loneliness, then their design must be informed by an understanding of older users' roles and relationships across different social contexts. In order to achieve this, older people need to be directly involved in their design and development.

There is a growing research literature showing how older people can be involved in co-design. Different elicitation methods can provide insight into older people's social routines and relationships, and engage them in design. The literature highlights a diverse set of requirements, including reciprocity (being able to offer help as well as receive it), education, reminiscence, common ground, opportunistic interaction, concerns of disrupting others or becoming a burden, maintaining a sense of privacy and fitting social activities around daily routines. The social importance of mundane, everyday tasks (e.g. trip to local shop) must also be considered when developing ICT-based interventions as this could impact on existing social encounters. Understanding how users feel constrained by technologies, or exploit

flexibility within them, provides valuable insights into how solutions can be improved to better support social interaction. Through co-design workshops, older people can directly inform how these issues are addressed and, for example, help maintain a balance between simplicity and building in sufficient functionality for meaningful social interactions.

However, we must be careful not to assume that co-design workshops alone hold the key to understanding older people's needs and that engagement can be concluded at this point. Studies emphasize how people continue to adapt – and adapt to – technological innovations over time (Williams et al. 2005). Users respond differently to new technologies and utilize them in different ways that may not have been considered at the design stage. The challenge, then, is to devise ways to progress from co-design with older people to co-deployment: the mutual shaping of technologies 'in-use'. Particularly for technological interventions intended to enhance social interaction, it should not be too difficult for providers of technology and services to older people to use these same technologies to put in place mechanisms to continue supporting older people as they seek to explore what they are capable of, learn how to use them effectively and adapt them to meet their specific needs. The ATHENE project has revealed how older people and their formal and informal carers (e.g. family, friends, neighbours) take the initiative in customizing technologies and adapting routines to fill the gap between the limitations of a priori design and the lived realities of ageing in place (Procter et al. forthcoming). These findings highlight the fact that older people, their carers, service providers and technology designers must be able to work together to shape technologies and services over time. Therefore, in order to develop social connection technologies that fit the lives of older users, and address the complex problem of loneliness, it is important that designers have the capacity to track the use of such technologies and feed these insights back into the design.

References

- Beck, E., M. Obrist, R. Bernhaupt and M. Tscheligi. 2008. 'Instant card technique: how and why to apply in user-centered design', in J. Simonson, T. Robertson and D. Hakken (eds), *Proceedings of the Participatory Design Conference 2008*. New York: Association for Computing Machinery, pp. 162–65.
- Boehner K., J. Vertesi, P. Sengers and P. Dourish. 2007. 'How HCI interprets the probes', in *Proceedings of CHI'07: 28 April – 3 May 2007*. San Jose, CA, pp. 1077–86.
- Cacioppo, J.T., L.C. Hawkey, E. Crawford, J.M. Ernst, M.H. Burleson, R.B. Kowalewski and G.G. Berntson. 2002. 'Loneliness and health: potential mechanisms', *Psychosomatic Medicine* 64: 407–17.

- Cacioppo, J.T., M.E. Hughes, L.J. Waite, L.C. Hawkey and T. Thisted. 2006. 'Loneliness as a specific risk factor for depressive symptoms in older adults: cross-sectional and longitudinal analyses', *Psychology and Aging* 21: 140–51.
- Carstensen, L.L., H.H. Fung and S.T. Charles. 2003. 'Socioemotional selectivity theory and the regulation of emotion in the second half of life', *Motivation and Emotion* 27(2): 103–23.
- Cattan, M., M. White, J. Bond and A. Learmouth. 2005. 'Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions', *Ageing and Society*. 25: 41–67.
- Cattan M., N. Kime, A.M. Bagnall. 2011. 'The use of telephone befriending in low level support for socially isolated older people – an evaluation', *Health and Social Care in the Community* 19(2): 198–206.
- Cody, M., D. Dunn, S. Hoppin and P. Wendt. 1999. 'Silver surfers: training and evaluating internet use among older adult learners', *Communication Education* 48(4): 269–86.
- Czaja, S.J., J.H. Guerrier, S.N. Nair and T.K. Landauer. 1993. 'Computer communication as an aid to independence for older adults', *Behaviour and Information Technology* 12(4): 197–207.
- De Jong Gierveld, J. and T. Van Tilburg. 2006. 'A 6-item scale for overall, emotional and social loneliness: confirmatory tests on survey data', *Research on Aging* 28(5): 582–98.
- Dewsbury, G., M. Rouncefield, I. Sommerville, O. Victor and P. Bagnall. 2007. 'Designing technology with older people', *Universal Access in the Information Society* 6: 207–17.
- Dickens, A.P., S.H. Richards, C.J. Greaves and J.L. Campbell. 2011. 'Interventions targeting social isolation in older people: a systematic review', *BMC Public Health* 11: 647.
- Dutton, W.H. and G. Blank. 2011. *Next generation users: the internet in Britain*. Oxford Internet Survey. Oxford: Oxford Internet Institute, University of Oxford.
- Eisma R., A. Dickinson, J. Goodman, A. Syme, L. Tiwari and A. Newell. 2004. 'Early user involvement in the development of information technology-related products for older people', *Universal Access in the Information Society* 3(2): 131–40.
- Fees, B.S., P. Martin and L.W. Poon. 1999. 'A model of loneliness in older adults', *Journal of Gerontology: Psychological Sciences* 54(B): 231–39.
- Fokkema, T. and K. Knipscheer. 2007. 'Escape loneliness by going digital: a quantitative and qualitative evaluation of a Dutch experiment in using ECT to overcome loneliness among older adults', *Ageing & Mental Health* 11(5): 496–504.
- Garattini, C., J. Wherton and D. Prendergast. 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): 211–22.
- Gaver, W., A. Dunne and E. Pacenti. 1999. 'Design: cultural probes', *Interactions* 6: 21–29.
- Golden, J., R.M. Conroy, I. Bruce, A. Denihan, E. Greene, M. Kirby and B.A. Lawlor. 2009. 'Loneliness, social support networks, mood and wellbeing in community-dwelling elderly', *International Journal of Geriatric Psychiatry* 24: 694–700.
- Graham, C., M. Rouncefield, M. Gibbs, F. Vetere and C. Cheverst. 2007. 'How probes work', in *Proceedings of OZCHI 2007*, Adelaide, Australia, pp. 29–37.

- Graham, C. and M. Rouncefield. 2008. 'Probes and participation', in *Proceedings of Participatory Design Conference*, Bloomington, IN.
- Greenhalgh, T., J. Wherton, P. Sugarhood, S. Hinder, R. Procter and R. Stones. 2013. 'What matters to older people with assisted living needs? A phenomenological analysis of the use and non-use of telehealth and telecare', *Social Science and Medicine* 93: 84–94.
- Hartke, R.J. and R.B. King. 2003. 'Telephone group intervention for older stroke caregivers', *Topics in Stroke Rehabilitation* 9(4): 65–81.
- Hartwood, M., R. Procter, M. Rouncefield, R. Slack and A. Voss. 2008. 'Co-realisation: evolving IT artefacts by design', in M. Ackerman, T. Erickson, C. Halverson and W. Kellogg (eds), *Resources, co-evolution and artefacts*. Berlin: Springer, pp. 59–94.
- Hawkey, L.C. and J.T. Cacioppo. 2003. 'Loneliness and pathways to disease', *Brain, Behaviour and Immunity* 17: 98–105.
- Hawkey, L.C., C.M. Masi, J.D. Berry and J.T. Cacioppo. 2006. 'Loneliness is a unique predictor of age-related differences in systolic blood pressure', *Psychology and Aging* 21: 52–164.
- Heller, K., M.G. Thompson, P.E. Trueba, J.R. Hogg and I. Vlachos-Weber. 1991. 'Peer support telephone dyads for elderly women: was this the wrong intervention?', *American Journal of Community Psychology* 19(1): 53–74.
- Lauder, W., K. Mummery, M. Jones and C. Caperchione. 2006. 'A comparison of health behaviours in lonely and non-lonely populations', *Psychology, Health & Medicine* 11: 233–45.
- Lindley, S. 2012. 'Shades of lightweight supporting cross-generational communication through home messaging', *Universal Access in the Information Society* 11(1): 31–43.
- Lindsay, S., D. Jackson, G. Schofield and P. Olivier. 2012. *Engaging older people using participatory design*. Austin, Texas: CHI.
- McHugh, J. and B. Lawlor. 2012. 'Perceived stress mediates the relationship between emotional loneliness and sleep quality over time in older adults', *British Journal of Health Psychology*, 18(3): 546–55.
- McHugh, J. Wherton, D. Prendergast and B. Lawlor. 2012. 'Teleconferencing as a source of social support for older spousal caregivers' initial explorations and recommendations for future research', *American Journal of Alzheimer's Disease and Other Dementias* 27(6): 381–87.
- Mellor, D., L. Firth and K. Moore. 2008. 'Can the internet improve the well-being of the elderly?', *Ageing International* 32: 25–42.
- Monk, A.F. and D.J. Reed. 2007. *Telephone conferences for fun: experimentation in people's homes*. Chennai, India: HOIT, Springer.
- Newell, A.F., A. Carmichael, M. Morgan and A. Dickinson. 2006. 'The use of theatre in requirements gathering and usability studies', *Interacting with Computers* 18: 996–1011.
- Ofcom. 2012. Communications Market Report, Ofcom London, http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/CMR_UK_2012.pdf
- Office for National Statistics. 2012. Internet Access Quarterly Update, Q3 2012, http://www.ons.gov.uk/ons/dcp171778_286665.pdf

- Pedell S., F. Vetere, L. Kulik, E. Ozanne and A. Gruner. 2010. 'Social isolation of older people: the role of domestic technologies', in *Proceedings of OZCHI*. Brisbane, Australia: ACM Press, pp. 164–67.
- Penninx, B.W., T. van Tilburg, D.M. Kriegsman, A.J. Boeke, D.J. Deeg and J.T. van Eijk. 1999. 'Social network, social support, and loneliness in older persons with different chronic diseases', *Journal of Aging and Health* 11: 151–68.
- Phillipson, C. 2007. 'The "elected" and the "excluded": sociological perspectives on the experience of place and community in old age', *Ageing and Society* 27: 321–42.
- Pinquart, M. and S. Sorensen. 2001. 'Influences on loneliness in older adults: a meta-analysis', *Basic and Applied Social Psychology* 23(4): 245–66.
- Prendergast, D., C. Somerville and J. Wherton. 2012. 'Connecting communities: the role of design ethnography in developing social care technologies for isolated older adults', in J.C. Augusto, M. Huch, A. Kameas, J. Maitland, P. McCullagh, J. Roberts, A. Sixsmith and R. Wichert (eds), *Handbook of ambient assisted living: technology for healthcare, rehabilitation and well-being*. Amsterdam: IOS Press, pp. 791–804.
- Procter, R., T. Greenhalgh, J. Wherton, P. Sugarhood, M. Rouncefield and S. Hinder. 'The day-to-day co-production of ageing in place', *Journal of Computer Supported Cooperative Work*, 23: 245–67.
- Rice, M. and A. Carmichael. 2011. 'Factors facilitating or impeding older adults' creative contributions in the collaborative design of a novel DTV-based application', *Universal Access in the Information Society* doi 10.1007/s10209-011-0262-8.
- Rice, M., Y.L. Cheong, J. Ng, P.H. Chua and Y. Theng. 2012. 'Co-creating games through intergenerational design workshops', *Proceedings of the Designing Interactive Systems Conference 2012*. New York: ACM Press, pp. 368–77.
- Riche Y. and W. Mackay 2010. 'Peer care: supporting awareness of rhythms and routines for better aging in place', *Journal of Computer Supported Cooperative Work* 19: 73–104.
- Rook, K.S. 1987. 'Reciprocity of social exchange and social satisfaction among older women', *Journal of Personality and Social Psychology* 52(1): 145–54.
- Russell, D., L.A. Peplau and C.E. Cutrona. 1980. 'The revised UCLA Loneliness Scale: concurrent and discriminate validity evidence', *Journal of Personality and Social Psychology* 39: 472–80.
- Scharf, T. and J. De Jong Gierveld. 2008. 'Loneliness in urban neighbourhoods: an Anglo-Dutch comparison', *European Journal of Ageing* 5: 103–15.
- Schnittger, R., J. Wherton, D. Prendergast and B.A. Lawlor. 2012. 'Risk factors and mediating pathways of loneliness and social support in community dwelling older adults', *Aging and Mental Health* 16(3): 335–46.
- Schwarz, B., G. Trommsdorff, I. Albert and B. Mayer. 2005. 'Adult parent-child relationships: relationship quality, support, and reciprocity', *Applied Psychology: An International Review* 54(3): 396–417.
- Shapira, N., A. Barak and I. Gal. 2007. 'Promoting older adults' well-being through internet training and use', *Aging & Mental Health* 11(5): 477–84.
- Slegers, K., M.P.J. van Boxtel and J. Jolles. 2008. 'Effects of computer training and internet usage on the well-being and quality of life of older adults: a randomized, controlled study', *Journal of Gerontology, Psychological Sciences* 63B(3): 176–84.

- Step toe, A., N. Owen, S.R. Kunz-Ebrecht and L. Brydon. 2004. 'Loneliness and neuroendocrine, cardiovascular, and inflammatory stress responses in middle-aged men and women', *Psychoneuroendocrinology* 29: 593–611.
- Tijhuis, M.A.R., J. De Jong-Gierveld, E.J.M. Feskens and D. Kromhout. 1999 'Changes in and factors related to loneliness in older men: the Zutphen Elderly Study', *Age and Ageing* 28(5): 491–95.
- Tilvis, R.S., M.H. Kahonen-Vare, J. Jolkkonen, J. Valvanne, K.H. Pitkala and T.E. Strandberg. 2004. 'Predictors of cognitive decline and mortality of aged people over a 10-year period', *Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 59: 268–74.
- Victor, C.R., C.R. Bowling and J. Bond. 2002. *Loneliness, social isolation and living alone in later life*. ESRC Report.
- Victor, C., S. Scambler, A. Bowling and J. Bond. 2005. 'The prevalence of, and risk factors for, loneliness in later life: a survey of older people in Great Britain', *Ageing & Society* 25(3): 357–75.
- Weiss, R.S. 1973. *Loneliness: the experience of emotional and social isolation*. Cambridge, MA: MIT Press.
- Wherton, J.P. and D.K. Prendergast. 2009. 'Building bridges: involving older adults in the design of communication technology to support peer-to-peer social engagement', in A. Holzinger and K. Miesenberger (eds), *HCI and usability for e-inclusion*. Berlin: Springer-Verlag, pp. 111–34.
- Wherton, J.P., P. Sugarhood, R. Procter, M. Rouncefield, G. Dewsbury, S. Hinder and T. Greenhalgh. 2012. 'Designing assisted living technologies "in the wild": preliminary experiences with cultural probe methodology', *BMC Medical Research Methodology*, 12: 188.
- White, H., E. McConnell, E. Clipp, L. Bynum, C. Teague, L. Navas, S. Craven and H. Halbrecht. 1999. 'Surfing the net in later life: a review of the literature and pilot study of computer use and quality of life', *Journal of Applied Gerontology* 18: 358–78.
- White, H., E. McConnell, E. Clipp, L.G. Branch, R. Sloane, C. Pieper and T.L. Box. 2002. 'A randomized controlled trial of the psychosocial impact of providing internet training and access to older adults', *Ageing & Mental Health* 6(3): 213–21.
- Williams, R., J. Stewart and R. Slack. 2005. *Social learning in technological innovation: experimenting with information and communication technologies*. Cheltenham: Edward Elgar.
- Wilson, R.S., K.R. Krueger, S.E. Arnold, J.A. Schneider, J.F. Kelly, L.L. Barnes and D.A. Bennett. 2007. 'Loneliness and risk of Alzheimer disease', *Archives of General Psychiatry* 64: 234–40.
- Woodward, A.T., P.P. Freddolino, C.M. Blaschke-Thompson, D. Wishart, L. Bakk, R. Kobayashi and C. Tupper. 2011. 'Technology and aging project: training outcomes and efficacy from a randomized field trial', *Ageing International* 36: 46–65.
- Young, J.E. 1982. 'Loneliness, depression and cognitive therapy: theory and application', in L.A. Peplau and D. Perlman (eds), *Loneliness: a sourcebook of current theory, research and therapy*. New York: John Wiley, pp. 379–406.