Title: Combatting social isolation and increasing social participation of older adults through the use of technology: A systematic review of existing evidence

Abstract

Objectives: There are growing concerns that social isolation presents risks to older people's health and wellbeing. Thus, the objective of the review was to explore how technology is currently being utilised to combat social isolation and increase social participation, hence improving social outcomes for older people.

Methods: A systematic review of the literature was conducted across the social science and Human Computer Interaction databases.

Results: A total of 36 papers met the inclusion criteria and were analysed using a four-step process. Findings were threefold, suggesting that (1) technologies principally utilised social network services and touch screen technologies; (2) social outcomes are often ill-defined or not defined at all; (3) methodologies used to evaluate interventions were often limited and small-scale.

Conclusion: Results suggest a need for studies that examine new and innovative forms of technology, evaluated with rigorous methodologies, and drawing on clear definitions about how these technologies address social isolation/participation.

Keywords

Social Isolation, Social Participation, Technology

Introduction

Two of the most disruptive transformations facing developed countries in recent history have been the social and economic challenges related to a rapidly ageing population, and the advancements in Information and Communication Technologies (ICTs) (1–3). The combined impacts of these transformations have led to increasing interest in investigating how ICTs might support older adults and improve their health status by reducing the negative impacts of social isolation and loneliness, whilst promoting social participation.

There is a growing body of international evidence indicating that older people are particularly vulnerable to social isolation and loneliness, and that it has a negative impact on their lives (4–7). This literature highlights the associated risk factors for poor physical and mental health, serious illness and increased mortality (4–7). The evidence highlights the strong association between social networks, participation and health status (7).

At the same time, however, there is an identified absence of a clear and consistent definition of social isolation in the empirical literature (8–10). For example, social isolation and loneliness are often used interchangeably, but are actually separate though related social concepts (11). Social isolation can be seen as a more objective state whereas loneliness relates to how people perceive and experience the lack of interaction and is thus more difficult to measure (11). There is also ongoing debate as to how best to define the concept of social participation, with terms such as participation, social participation, social involvement and social needs being used interchangeably in the literature (12–14). However, despite all these conceptual slippages, clear connections can be drawn between the lack of opportunities to participate in social activities and deleterious impacts due to social isolation and loneliness (4,14). Thus, in this review, we will focus specifically on technological responses to addressing social isolation and building social participation of older people.

There have been a broad range of social programs designed to address the prevalence of social isolation among older people, with technological interventions proposed as one way to provide an effective response (1,11). Chief among the advantages of ICT in combating the challenges facing older adult populations is its ability to connect and reconnect people across large geographic distances and its support of both synchronous and asynchronous forms of communication (15). Due to the rapidity of technological advances, it is important to explore how specific ICTs are being leveraged to address social isolation, to identify gaps in the

literature, and to strengthen the quality of research in this rapidly evolving area. It is also vital that those considering research in the field are well appraised of cutting edge technologies and design approaches that offer new potential to address the challenges faced by older adults. The intent of this article is to address these issues.

Thus, the aim of this systematic review is to investigate how technology is being used to combat social isolation and increase social participation for older adults. While a number of recent reviews have explored interventions designed to address social isolation, including technological interventions (4,5, 10), a unique aspect of this review is that our inclusion criteria incorporates smaller design studies and prototype evaluations from the field of Human Computer Interaction (HCI), a body of literature often neglected in systematic reviews. This allows us to consider the latest techniques and technologies being applied in the field and recognises the pace at which cutting-edge technologies develop. These insights will benefit all those considering new research exploring the ways in which ICTs can contribute to the wellbeing of older adults.

Methods

Search strategy

A systematic search strategy was designed to address the key aim of the review which was to explore how technology was being used to combat social isolation and increase social participation for older adults. The search of the literature was undertaken in August 2016 utilising PRISMA guidelines (16). Relevant peer reviewed literature was obtained by searching five electronic search engines: Scopus, Compendex, Inspec, Association for Computing Machinery, and Web of Science.

Inclusion criteria

All included articles were peer reviewed and published in English between January 2000 and August 2016. Inclusion criteria, including the three key search terms, were as identified in Table 1. Technology referred to ICTs and could include devices (hardware), applications (software), and websites. The term older people was as used as in the literature, although generally identified as aged over 65 years. Both social isolation and social participation were included within the relevant key search term. Thus, papers included use of any technology targeted at older people and aimed at supporting social participation and/or reducing social isolation. Search exclusions are described in Table 2. Search exclusions were identified in

conjunction with a research librarian while reviewing the initial search results. As the focus of the review is an applied one, in other words, how technology can be utilised using interventions, only empirical research is included in the review, and both theoretical and descriptive studies were excluded.

Table 1: Search strategy Boolean operators and modifiers

Key search terms – Technology (Boolean Operators <i>OR</i> , <i>AND</i>)	Key search terms – Older Adult (Boolean Operator <i>OR</i> , <i>AND</i>)	Key search term – Social isolation/social participation
“Information and Communication Technology” <i>OR</i> ICT <i>OR</i> “Information Systems” <i>OR</i> “Human-Computer Interaction” <i>OR</i> HCI <i>AND</i>	Seniors <i>OR</i> Elderly <i>OR</i> “Older Adult” <i>OR</i> “Older People” <i>AND</i>	Social*

Table 2: Excluded search terms

Excluded search terms (Boolean Operator <i>AND</i> <i>NOT</i>)
“Organisation and Management” <i>OR</i> “Medical Information Systems” <i>OR</i> Adolescents <i>OR</i> Telemedicine <i>OR</i> “Young Adults” <i>OR</i>

Robot* *OR*

“Geographic Information System*” *OR*

GIS *OR*

“Information Management”

Study selection

Analysis was conducted in a four-step process given the large number of articles that emerged at Step 1. First, article titles and abstracts were screened electronically for search terms and exclusions. Second, duplicates were both removed automatically and manually screened by title and abstract independently by a review author (SB) in order to identify studies that broadly met the inclusion criteria. Thirdly, articles were assessed by review authors (SB, JW and FV). Finally, full text articles were retrieved for these, and data extraction undertaken using a customised template by review authors (SB, JRW, FB, BD, EO, JW and TH). For each study, data extraction and collation included: the type of technology being used; how authors defined social isolation or social participation; the methodology used; number of participants; brief summary of outcomes; as well as any additional observations. Any disagreements were resolved through further review and team discussion.

Data collection and synthesis

Articles were not restricted by study design or outcome measures. Articles thus include both qualitative and quantitative data, hence are not reported based on statistical data. They also include a range of outcomes measures. Primary outcomes from the study relate to the use of technologies to support social participation and/or reduce social isolation for older people. Secondary outcomes may also relate to subsequent improvement in health and / or wellbeing among participants.

Results

The initial search of information sources at Step 1 yielded an initial scan of 3123 articles from the databases, with the breakdown of results from each database presented in Table 3.

Figure 1 shows results from the four-step process. At Step 2, duplicate articles were eliminated, and abstracts were manually reviewed and evaluated according to inclusion criteria. The result was 890 articles, which were then reduced to 73 articles at Step 3. These were excluded on a number of grounds. First, some articles were not sufficiently related to the topic, for example, the search term “seniors” included results relating to high school seniors. Second, as noted earlier, articles were excluded on methodological grounds, with some descriptive or theoretical studies and not empirical research. Some also contained insufficient methodological detail, including short articles or extended abstracts. This reduced the numbers resulting at each step. At Step 4, the full text of these 73 articles were read by members of the review team using the customised template described above. Here, a further 37 articles were removed as, on closer examination, they did not meet the inclusion criteria. At the completion of this stage, 36 articles were identified for inclusion in the review process.

Table 3: Results from initial search of included databases

Electronic research database	Results
Scopus	749
Compendex	593
Inspec	385
ACM (full digital guide to computing literature)	1185
Web of science	211
Total	3123

Figure 1: Selection process for systematic review.

Table 4 provides a summary of key aspects of the 36 papers included in the review. Due to the number of relevant studies, the findings are combined in terms of common themes. Specific articles are identified by reference number. In this table, both the aims and key outcomes are also reported, as well as what social concepts are utilised as outcome measures. In Table 5, the methods utilised by each study are described.

Table 4: Summary of results.

Technology Focus	Ref.	Aim	Social concepts	Key Outcomes
Touch screen technology	(27)	To assess use of iPads with older adults using off-the-shelf applications.	Network society, disadvantaged populations, homelessness.	Facilitating interactions with support workers. Reconnecting with family. Reminiscing about life events.
	(28)	Evaluations of a bespoke touch-screen application.	Interactions with family members and friends.	Factors that impacted on the adoption of the devices and bespoke software.
	(32)			Usability issues with touch-screen devices.

	(25) (26)		Promoting physical activity. Encouraging the sharing of digital content with peers.	Challenges of working with older adults in a range of real world and institutional settings. Classifying older adults' communication styles. Sustainability of use over time. Privacy and personal identity issues. Promoting self-expression.
	(31) (29) (33)	Reflections on the design challenges and/or ethical implications of touch-screen based interventions with older adults	N/A	Consider the factors behind older adults choosing to withdraw from studies using ICTs. Communications styles and their impact on research. Disconnect between client needs and the needs of older users.
Social Network Service (SNS)	(45) (46) (47) (48) (49)	Evaluations of older adults' use of existing SNS	Explore the links between SNS use and quality of life (QoL) factors. Assess the impact of personality types on SNS use. Comparisons of younger and older SNS users. Assessments using psychometric scales.	No relationship between loneliness and SNS use, or non-use. Most effective for online communities to be designed to focus on facilitating information sharing. Importance of privacy for older SNS users. Ambivalence about whether Facebook provided a sense of community. Older adults describe themselves more formally than younger users on SNS. Older women more enthusiastic about SNS use. Senior newsgroups tend to be dominated by a small group of users.
	(19) (20) (17) (21) (22) (23) (24) (18)	Evaluations of bespoke SNS specifically tailored for older users	Compare social isolation and social engagement results. What do older users value in bespoke SNS services? SNS as a means of promoting contact with family and friends. Intergenerational interaction. Gaining information about local events.	Older adults favour extending social contact to include other technologies (telephone, VoIP ¹ , e-mail) in addition to SNS. SNS use in an aged care facility found to increase self-esteem and self-confidence. SNS use by Chinese older adults favoured formally organised leisure activities over self-organised for mobile SNS service. Concern over privacy prevented some older adults from using bespoke SNS. SNS posts with emotional content show higher social connections among members than factual posts. SNS can be used more for information gathering than social interaction.
Adaptation of use of existing technology platforms	(37) (50) (35)	Adapt video technology	A means of addressing social disconnectedness. Intergenerational interaction. Social participation in the information society to improve quality of life (QoL).	Users reported these systems helped to create a sense of social presence. However, participants preferred physical meetings and interactions. Users reported a sense of security when using the system, however, there were concerns about privacy.
	(51) (52) (34)	Integrate social functions into ambient assisted living technologies	Gaining information about local services and supports. Promoting social connectedness. Intergenerational interaction.	Testing various interaction methods showed a preference for touch-based interaction over speech. Innovative technologies included "Walky" an interactive walking frame that shares your walking data with friends. Encouraging para-social relationships between older adults and virtual agents.

¹ † Voice over Internet Protocol

				Potential role of ICTs in encouraging reminiscence and storytelling.
Use of games to encourage social participation	(43)	To assess potential benefits of exergames	Intergenerational interaction. Fun and pleasure.	Exergames perceived as being more rewarding for younger users than older. Sharing social game elements, such as comparing scores, beneficial for engaging older users.
ICT training analyses, and interview studies	(53)	Impacts of computer training	Does computer training have a positive impact on older adults' sense of social connectedness?	Results from the studies contradicted each other with one finding no correlation with enhanced social connection (46) and the other concluding that ICT use has the potential to enhance social networks (47).
	(54)			
	(55)			
	(56)	Interviews with older adults on attitudes to technology and social participation	Impact of internet use on perceived social isolation and loneliness. Older adults' preferences concerning social support.	Using the internet may be beneficial for decreasing loneliness and increasing social contact for older adults. Perceptions and use of ICTs are embedded in older adults' personal social and physical contexts.
	(57)			
	(58)			
	(36)			

Table 5: Study Types Included in the Review

Study Types	Number of Papers	Reference
Interview Based Qualitative Evaluation	16	(17,21,23,24,26,27,30,31,33,36,47,50,54,55,57,58)
Smaller Scale Design, Pilot and/or Prototype Evaluations	8	(25,29,32,34,35,37,43,52)
Surveys of Older Adults' use of ICTs	2	(48,49)
Mixed-Method Evaluation	3	(28,45,51)
Social Network Analysis	2	(18,19)
Quantitative Evaluation	5	(20,22,46,53,56)
Total	36	

Findings are thus presented in terms of three key themes – (1) the types of technologies that are used in extant studies (Table 4); (2) the social concepts that are utilised to discuss outcomes (Table 4); and (3) the methods incorporated in this body of empirical research (Table 5). These findings enable us both to provide a critique of existing literature and identify gaps in the evidence that merits further exploration.

The focus of technologies utilised in review studies

Of the 36 papers reviewed, the largest segment (13 papers) comprised research into older adults' use of social network services (SNS) (see Table 4). Of the papers included in this review, five were examinations of older adults' use of pre-existing commercial SNS such as Facebook and LinkedIn. The remaining eight papers evaluated older adults' use of bespoke SNS. These ranged from examinations of newsgroups and web portals (17–19), through to custom designed SNS that responded to the perceived needs of older users (20–24).

While there was a mix of studies examining either existing or custom-made approaches in relation to SNS, studies that focussed on touch-screen based interventions – the second most prevalent technology identified in the review – skewed heavily in favour of bespoke interfaces for older users (8 papers out of 9). Many of these software applications aimed to tap into and leverage the perceived advantages of the touch-screen format, such as the lack of a mouse or other pointing device, or a rigid desktop type hierarchical file system. Much of the software incorporated social features, such as the ability to share photographs or initiate videoconference features to promote social interaction, either with other older adults (25–27) or family members and friends (28–30). Three papers included here examined the experiences of the older adults using the touch-screen systems, the design implications, and some of the ethical challenges involved with this type of research (31–33).

The remainder of the papers examined either novel technologies that sat outside those noted above, or evaluations of the impact of ICT based training and support on older adults' social lives. Seven papers examined the adaptation of various existing technology platforms such as videoconferencing, ambient assistive living (AAL) devices or *exergames*, which aimed to engage older adults in social activities. These studies tended to examine very novel interaction techniques, for example 'Walky' the microblogging walking frame (34), or the

‘Seasons Wholeness’ immersive music and art experience (35), though this innovation often came at the expense of larger scale evaluations. The final category of papers, those interested in interviewing older adults about their experiences using ICTs or evaluating large scale data about internet and ICT usage, were valuable in framing the more technology focussed papers within broader concepts of social participation and social interaction.

Social concepts used to determine outcomes

Table 4 presents the range of social concepts utilised in the review literature. These varied considerably, with many failing to define clearly the social outcomes being addressed in their study, whether it related to redressing social isolation or increasing social participation. As outlined in Table 4, the social concepts were often poorly defined using broad terms such as ‘increasing communication’ or ‘improving access to information’. Twelve of the thirty-six papers in the review contained no definition of what was meant by social participation or social isolation at all. Only five papers offered an explicit definition that was based on a standardised measure or included a discussion of the debates about social outcomes.

Breadth of methodologies included

One of the defining characteristics of the systematic review was its embrace of a broad set of studies relating to older adults’ use of ICT for social participation. This was done in order to ensure that the review captured the ways in which a broader range of techniques and technologies are being used to discover how cutting-edge technology can impact on the wellbeing of older adults. An overview of the range of study types included in the review is summarised in Table 5.

The majority of studies included in the review employed qualitative methods to evaluate the impact of new technologies on older adults. These studies typically involved small samples between 8 and 43 participants and employed a range of qualitative methodologies including; ethnography, grounded theory, and action research. One study (36), was distinguished by its larger sample size (388 participants). The relatively high number of pilot or prototype evaluations included in the review reflected our goal to include papers that incorporate insights about novel uses of cutting edge technologies. The majority of the papers in this category comprised smaller participant numbers, often less than 10 (19, 21, 41, 43-45),

though two papers (29,37) reported on prototype design testing that involved larger participant numbers.

Discussion

This systematic review has identified 36 extant articles which have explored how technology has been used to date to combat social isolation and/or increase social participation for older adults. Whilst this is a relatively high number, an exploration of key themes addressed in this literature suggests both some key findings as well as important limitations in the body of evidence. The implications of these findings will be discussed under the three main areas presented in the findings above.

First, the technologies included in the review showed the dominance of research focussed on just two categories of ICT based interventions, touch-screens and SNS. We acknowledge that both touch-screen and SNS are logical foci for research in this field. A comprehensive review of tablet and smartphone usage by the Australian Communications and Media Authority (ACMA), released in 2016, found that “67 per cent of Australian Adults used a tablet computer at least once a day to go online” (38). Touch-screen technology has also proven to be popular among older people, such that a 2016 ACMA report on the digital lives of older Australians notes that tablet usage by older Australians was higher than by other adults (18 per cent, compared to 16 per cent) (39).

Similarly, the growth in SNS use over the past decade has risen exponentially, with Facebook the most obvious example of this trend, increasing from around 1 million monthly active users in 2004 to over 1.2 billion monthly by 2013 (40). Population based survey research in both Australia and the United States supports the view that while older sections of the population still lag behind other segments, social media use is increasingly becoming a part of older adults’ lives (39,41).

However, these findings also suggest that there is a need to broaden the focus of research efforts beyond the two dominant areas identified in the review. We hope that our inclusion of novel smaller scale prototype studies is a small step toward encouraging this effort.

Examples include the design and evaluation of “Walky” (34) an approach to embedding communication technology into everyday objects – in this case a walking frame – so as to

make vulnerable older adults' activities more visible in their local communities, and the 'Seasons Wholeness' immersive music and art experience (35). Several papers also reported the design of ICT-based games that would engage both children and older adults in fun shared activities (42,43). The inclusion of these studies helps to frame creative means by which ICTs can inspire older adults to engage in social activities beyond the narrow constraints of mass market consumer devices and services.

However, overall, the dominance of SNS and touch-screen techniques does highlight a gap in research that focuses on more innovative technologies. This includes emerging technologies such as virtual and augmented reality applications (VR/AR), or virtual assistants that make use of machine learning and artificial intelligence (AI).

The second key theme relates to use of social concepts in this body of evidence. As noted in Table 4, many reviewed studies fail to clearly define the social outcomes being addressed in their study, whether it relates to redressing social isolation or increasing social participation. Some make an assumption relating to improved social outcomes, while others do not discuss concepts being incorporated into their study. While we acknowledge that there is an ongoing debate in the research literature about the best definition for both social isolation and social participation, there is nonetheless a need to offer an explicit definition or acknowledge this conceptual debate in order to design an intervention with clearly definable outcomes (7). Thus, future studies need to provide a framework for what might be considered a successful intervention, either by including standardised measures, or by providing qualitative evidence of the success of an intervention in a given context.

Thirdly, methodologies incorporated into this body of research are broad and varied. Thus, while research into SNS use spans a range of research methods, including larger scale quantitative evaluations, to date, much of the research into older adults' use of touch-screen devices is still focused on more preliminary user testing and shorter field trials. There is thus a clear gap in the literature for larger scale studies aimed at evaluating the impact of mature touch-screen based interventions with older users in real world contexts over time.

Overall, these findings suggest that there is a need for more studies that both utilise new and emerging technologies, as well as evaluate their effectiveness in extended field studies and broader user evaluations. Technology use needs to be assessed in terms of how it works in the

routines and contexts of people's everyday lives, as use develops over time. It is only through in-depth analyses of technologies-in-use that researchers can gain a full understanding of their impact (44).

Conclusion

This paper reports a systematic review of literature from the social sciences as well as the field of Human Computer Interaction (HCI) in order to explore how technologies are being used to redress social isolation and promote social participation among older adults. The review identified 36 papers that addressed this topic, highlighting the importance of technology as one way to reduce social isolation in older populations. A unique aspect of the review was that it sought to include studies that aimed to provoke new conversations about the way ICTs can respond to the needs of older adults. Despite this, most of the reviewed articles involved using or adapting pre-existing systems drawing on touch-screen technology and SNS, with relatively few examples of new technologies. This suggests a gap in knowledge relating to the use of emerging technologies. Finally, current evidence is somewhat limited due to inadequacies in methodology, as well as insufficient attention to key social concepts. This makes it difficult to assess the effectiveness of specific technological interventions aimed at combating social isolation or increasing social participation for older adults.

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Author/s:

Baker, S;Warburton, J;Waycott, J;Batchelor, F;Thuong, H;Dow, B;Ozanne, E;Vetere, F

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