

Reducing Later Life Loneliness: A Systematic Literature Review of Loneliness Interventions

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Abstract—Later life loneliness is a social issue that is increasing alongside an upward global population trend. As a society, one way that we have responded to this social challenge is through developing non-pharmacological interventions such as befriending services, activity clubs, meet-ups, etc. Through a systematic literature review, this paper suggests that currently there is an underrepresentation of radical innovation, and underutilization of digital technologies in developing loneliness interventions for older adults. This paper examines intervention studies that were published in English language, within peer reviewed journals between January 2005 and December 2014 across 4 electronic databases. In addition to academic databases, interventions found in grey literature in the form of websites, blogs, and Twitter were also included in the overall review. This approach yielded 129 interventions that were included in the study. A systematic approach allowed the minimization of any bias dictating the selection of interventions to study. A coding strategy based on a pattern analysis approach was devised to be able to compare and contrast the loneliness interventions. Firstly, interventions were categorized on the basis of their objective to identify whether they were preventative, supportive, or remedial in nature. Secondly, depending on their scope, they were categorized as one-to-one, community-based, or group based. It was also ascertained whether interventions represented an improvement, an incremental innovation, a major advance or a radical departure, in comparison to the most basic form of a loneliness intervention. Finally, interventions were also assessed on the basis of the extent to which they utilized digital technologies. Individual visualizations representing the four levels of coding were created for each intervention, followed by an aggregated visual to facilitate analysis. To keep the inquiry within scope and to present a coherent view of the findings, the analysis was primarily concerned the level of innovation, and the use of digital technologies. This analysis highlights a weak but positive correlation between the level of innovation and the use of digital technologies in designing and deploying loneliness interventions, and also emphasizes how certain existing interventions could be tweaked to enable their migration from representing incremental innovation to radical innovation for example. This analysis also points out the value of including grey literature, especially from Twitter, in systematic literature reviews to get a contemporary view of latest work in the area under investigation.

Keywords—Loneliness, ageing, innovation, digital.

I. INTRODUCTION

Loneliness can affect individuals but has wider implications for the society as a whole. The interest in ‘loneliness’ as a topic for research has increased significantly since the 1970s [1]. Despite differing in opinion around the specific nature of loneliness, researchers generally consider

loneliness to represent a negative emotion, which is detrimental to general health and wellbeing [2], [3]. The notions that some degree of loneliness is necessary for society to function normally [4], and that it can be triggered due to a variety of causes [5] only adds to its complexity as a research problem.

It has long been understood that loneliness is closely associated with ageing and researchers have discussed the occurrence of loneliness and social isolation among older adults as early as the 1950s. More recent studies have revealed the prevalence of loneliness among people over the age of 80 years [6]. Demakakos et al. have also reported this age group’s ‘vulnerability’ to being lonely [7] and both social isolation and loneliness have been reported as two problems associated with old age [8], [9]. Wilkes opines that loneliness is in fact ‘the main problem’ associated with later years of life [10]. For instance, it has been reported that nearly half a million older Britons had no one to celebrate their Christmas with in 2009 [11]. Recent data from the English Longitudinal Study of Ageing (ELSA) show that 25% of respondents over the age of 52 reported feeling lonely sometimes and 9% said that they felt lonely often. 46% of such individuals who reported feeling lonely sometimes or often were aged 80 years and over [12].

Loneliness is known to be detrimental to physical health as it is perceived as an indicator of increased blood pressure [13], [17] and is known to increase susceptibility to other diseases and mental illness [14]-[21], [4]. Tiwari suggests that “loneliness may be pathognomic of depression in old age” [15, p. 320]. In medical terms, pathognomic means characteristic of a particular disease – in this case depression. However, the relation between age and loneliness is more complex than it appears on the surface. Researchers should watch out for making any stereotypical connections between the two, as doing so can contribute to a false perception of all older adults being unhappy and lonely [6].

The occurrence of loneliness among older adults has been found to vary in different surveys. This variation can be attributed to differences in cultures, countries, age-ranges and rural-urban differences, etc. [6], [16]. In a recent speech, UK Health secretary Jeremy Hunt urged the UK to seek inspiration and learn from Asian cultures where there was ‘more reverence and respect’ given to older people [17]. However, Neill-Hall, who represents Campaign to End Loneliness, does not believe that attitudes towards older persons have changed drastically in the UK. He suggests that an increase in ageing population simply means that there are many more older people who are isolated than before [18]. This surge in the ageing population is expected to apply socioeconomic

pressures on countries such as the UK, currently home to more than 11.6 million people over the age of 65 years [19]. Therefore, the rise in loneliness figures amongst older adults is an area of serious concern for policy makers [20], [21]. In the UK, National Health Services (NHS) are already showing early signs of facing this pressure. It has been reported that some older adults visit their General Practitioners (GPs) frequently as a way to address their loneliness, rather than for seeking medical advice. Castle Point Association of Voluntary Services Befriending Scheme (CAVS) refers to such older patients as 'frequent flyers' [22]. O'Connor calls later life loneliness 'a ticking time bomb' [23] and suggests that it has serious cost implications for the NHS. He argues that doctors have tendency of responding to patients initially manifesting loneliness-based depression by prescribing conventional antidepressants such as Prozac. He feels that this is "akin to placing a sticking plaster on a bleeding skin wound" [23].

Murphy refers to loneliness amongst older adults, as a "complex concept" [24, p. 22]. A closer look at Cattan et al.'s seminal work on 'preventing social isolation and loneliness among older people' [25] makes this point clearer. In their study, Cattan et al. systematically examined loneliness interventions that targeted older adults. Some interventions they studied were operationalized more than 30 years ago. This is a clear indication that for the past three decades we have been up against similar, if not the same issues.

This paper aims to extend the discussion that Cattan et al. initiated nearly a decade ago [25], by examining existing loneliness interventions with a design lens.

II. UNDERSTANDING LONELINESS INTERVENTIONS

Auslander and Litwin highlight the lack of a common conception as to what constitutes a network intervention. They define it as a "planned activity by a professional that aims to influence (i.e., to strengthen, modify, or redirect) the functioning of an existing informal network or to bring about the creation of a social network where one did not previously exist due to absence or inaccessibility" [26, p. 310]. The interest in loneliness interventions emanates from the notion that "loneliness is not an immutable trait but rather can be exacerbated or ameliorated by social interactions" [27]. The idea behind loneliness interventions is to ensure a balance between the actual and the desired levels of social contact. Thus loneliness interventions can be broadly categorized into those that prevent loneliness, provide support to those who suffer from it, or act as remedial services [28]. Reference [27] highlights the economic rationale for society's investment in loneliness interventions. They suggest that loneliness interventions are an effective way of reducing the high costs of managing problems associated with loneliness [28].

As a society, our response to mitigating loneliness has either taken form of psychosocial approaches or pharmacological interventions. For instance, because the indicators of loneliness tend to be very similar to those of depression [3], [23], the treatment prescribed for both of them can be similar too. Cacioppo et al. describe depression as an outcome of loneliness [29], whereas Burholt and Scharf argue

that because loneliness is a subjective feeling, depressive symptoms interfere with one's judgment of their desired level of social contact [30]. This means that depression can have a moderating effect on loneliness. Owing to their close association, symptoms of loneliness as well as depression are either treated pharmacologically using antidepressants or other medication, or by relying on non-medical methods such as through network interventions aimed at enhancing social contact. This research focused on such non-pharmacological approaches i.e. interventions that have been developed to regulate loneliness.

III. EXAMINING LONELINESS INTERVENTIONS

Windle et al. examined loneliness interventions in their exhaustive review and suggested that "Just as the range of wellbeing services is extensive, so too is the available literature examining how well they work" [28, p. 2]. The review of services (loneliness interventions) carried out for this study was not aimed at understanding how successful they are in alleviating or moderating loneliness. Instead, the efforts were directed at gathering an understanding of different types of loneliness interventions and to map the similarities and differences in our current attempts to solving the problem.

After reviewing these interventions, their key characteristics were logged onto a template. The template was specially designed using a pattern language approach [31]. Subsequently coding categories were developed and refined. Windle et al.'s comprehensive review of interventions to prevent loneliness and social isolation inspired coding categories based on the scope (one to one, group services, or wider community engagement), and the objective (preventative, remedial, or supportive) of the interventions [28]. Other coding categories looked to classify interventions based on the extent of their utilization of digital technologies, or the level of their innovativeness. These coding categories have been discussed below:

A. Scope of the Intervention

Within codes based on the scope of the intervention, the one to one category included interventions based on befriending services, mentoring and gatekeeping. Befriending can be defined as "an intervention that introduces the client to one or more individuals, whose main aim is to provide the client with additional social support through the development of an affirming, emotion-focused relationship over time" [32]. Mentoring on the other hand focusses on achieving agreed individual goals. If a social relationship emerges in doing so, it is incidental [28]. Finally, Wayfinders or Community Navigators are generally volunteers who help 'hard-to-reach' groups of people and provide them with support and guidance around their emotional, social or practical needs. They are the interface between the community and public services and enable signposting such groups to relevant support systems such as interventions [28]. On the other hand, interventions such as day center-type services (Lunch Clubs, Arts and Crafts sessions, etc.) and social group schemes looking to help people extend their social circles were categorized as group

services [33]. Furthermore, initiatives aimed at supporting individuals to increase their participation in existing activities (e.g. sport, use of libraries and museums) and those that encouraged people to utilize and participate in outreach programs and volunteer schemes, were classed as wider community engagement [28].

B. Objective of the Intervention

Another group of codes based on the objective of the interventions was also created. Interventions were categorized as being preventative, supportive or remedial based on whether they prevented someone from experiencing loneliness, looked to reduce their loneliness or only provided support to those users who experienced loneliness without causing a reduction in the levels of loneliness experienced by users [28].

C. Level of Innovation

Langrish et al.'s [34] four-level classification of innovation was used to develop coding categories that separated radical interventions from the ones that tend to operate within our 'existing ways of thinking and doing' [35]. Langrish et al. [34] use the changes made to a 'standard book' or 'a text book of the sort' that would be required to deliver a university lecture course about a 'technology' being examined, as a metaphor to demonstrate various levels of innovation. These levels of innovation have been discussed below:

- 1) Improvement: Reference [34] argues that when 'the standard book' of a product or service undergoing innovation is either completely unaltered or is only slightly different to its original form, it represents an improvement.
- 2) Incremental Innovation: When the innovation requires changes to an entire chapter or additions of a few paragraphs to the book, it is an incremental innovation.
- 3) Major Innovation: If an innovation renders several chapters of the standard book out of date or causes the addition of a new chapter or chapters to it, then it represents major innovation
- 4) Radical Innovation: Innovations that lead to a brand new technology may mean that 'the standard book' has to be completely conceptualized. Such profound changes represent 'radical breakthrough innovation' [34].

D. Utilization of Digital Technologies

Baxter- Reynolds' categorization of different elements of digital technologies was adapted to develop a coding strategy to determine the extent to which interventions utilized digital technologies. Baxter-Reynolds has attempted to categorize various elements of digital technology that explain how they can be used to improve businesses and organizations by 'going digital' [36]. According to him this can be done by focusing on five key areas, namely how going digital can help businesses capitalize on social networking phenomena (Social), the growth of mobile phone users (Mobile), research (Analytics and Big Data), the gradually increasing affordability of IT (Consumerization of IT), and the ability to access information anywhere, anytime (The Cloud).

IV. SEARCH STRATEGY

The search identified any intervention studies that were published in English language, within peer-reviewed journals between January 2005 and December 2014. Studies not published in English were excluded keeping in mind the limitation cited by Cattani et al. [25] in their review, that highlighted the inaccessibility of literature in languages other than English (to native English speakers) as an important limitation for comparative studies that are international in scope. In their review they found that majority of the publications identified in other languages "were neither intervention nor loneliness studies but rather examinations of related matters such as social support" [25, p. 58]. To be included in the study, the articles had to meet the following conditions:

- 1) The study was related to older people on some level - either in full, or in part.
- 2) The intervention either looked to prevent loneliness or social isolation or alleviate them in full or in part.
- 3) The study described interventions that promoted health and gave older people increased control over and improvement to their health.
- 4) The full research article/publication was available to read online using Lancaster University's institutional access.

Seeking inspiration from [25]'s selection of databases, electronic searches were conducted on Medline, PsychInfo, CINAHL and EMBASE. Interventions from grey literature such as websites, blogs, marketing material, etc. were also included in the review to offer balance to those identified within academic databases. This study also included interventions that the author came across while attending meetings and conferences during the study, and those found on *Twitter*.

Reference [25]'s search strategy was adapted in order to obtain maximum number of publications suitable for examination for the purpose of this study. To include all forms of interventions, the type of study (review, evaluation, overview, etc.) was not predetermined as was the case in [25]'s search strategy. A summary of the core and peripheral search terms has been provided in Table I. Note that '\$' sign indicates any suffix or none.

The searches were conducted in two steps. First all the core terms were investigated followed by searching all the peripheral terms. Although this resulted in some duplication of research articles, in terms of managing the process, it helped avoid any confusion while dealing with multiple sets of numerous search terms.

A. Shortlisting Interventions

The search terms yielded a total of 8298 articles out of which 7807 articles were excluded based on their titles. If the title clearly indicated that they did not meet the inclusion criteria set out earlier, then the article was discarded. For example, a paper titled "Psychosocial issues confronting young women with breast cancer" was found during the search, but was rejected as the title did not indicate any association with older adults or loneliness interventions. For

any studies where the title did not clearly indicate whether they met the inclusion criteria or not, reading the abstracts helped in screening the papers resulting in a total of 491 research articles. After eliminating duplication, 452 papers remained. Upon detailed examination of these papers, 57 papers were included in the study as the rest did not meet one or more of the conditions for inclusion. 3 out of the 57 papers that were examined in this study were themselves systematic literature reviews of loneliness interventions. After consulting the source papers mentioned within each of these 3 SLRs a total of 8 articles were found that met the screening criteria. These 8 studies were included in this review. Also, one of the articles mentioned 2 interventions that met the inclusion criteria therefore a total of 63 interventions were included in the study. Fig. 1 depicts the process of shortlisting interventions from research articles for examination using the systematic route.

TABLE I
ADAPTED KEYWORDS AND SEARCH TERMS

Population/ Target Group	Problem Area	Prevention/Promotion Topic	Intervention/ Method
Core search terms			
Older\$ Elder\$ Senior\$ Geriatric\$ Aged	Social isolation Isolation Loneliness Social	Social support Loss	Promot\$ Prevent\$ Support Self-help
Peripheral search terms			
Older age Carer Older person Caregiver Aging Ageing Old age	Mental health Suicide Psychosocial Depression	Access Ageism Housing Transport Mobil\$ Behaviour\$ Behavior\$ Fear Environment\$ Activ\$ Housebound Motivation Bereavement Physical disability	Educat\$ Policy Community development Community programme Strateg\$ Empower\$ Skill Screening Social activity Advice Community Inform\$ Welfare Benefits Rehabilit\$ Neighbourhood Neighborhood

B. Including Grey Literature

Although methodologically rigorous, a traditional SLR approach can potentially exclude interventions developed by practitioners who may not have “the same incentives as academics to publish in peer-reviewed journals” [37, p. 222]. Therefore, a further 133 loneliness interventions found in non-academic publication sites, i.e. in grey literature, were also included in this review, taking the total number of interventions examined to 196.

Since searching for grey literature is ‘challenging’ [37], it can also be difficult to articulate the exact process of identifying studies included in such a review. This can raise doubts about the replicability of the process which is detrimental to the credibility of research based on literature reviews. To minimize this ambiguity in identifying loneliness

interventions found outside the systematic review strategy, a three-pronged approach to reviewing grey literature was implemented. First, 33 case studies found on *Campaign To End Loneliness (CTEL)* website’s *Learning Network* webpage (2016) were examined and included in the study. A second set of grey loneliness interventions were identified from a review of social media. An investigation of 1000 tweets found on CTEL website’s Twitter handle yielded 147 shortlisted tweets potentially mentioning loneliness interventions, and were examined further. Upon removing duplication and applying the same screening criteria as the SLR to the interventions found within these tweets, 61 loneliness interventions were included in the study. A third and final set of loneliness interventions came from other sources such as reports, online articles, referrals, attending conferences, etc. that were all part of the overall research endeavor. A total of 39 such interventions from ‘other’ sources were included in the review.



Fig. 1 The process for shortlisting eligible interventions

V. CODING

In order to arrive at mutually exclusive categories and to assist coding, category-defining questions were developed. These have been discussed below:

A. One to One, Community or Group Based

Question: Does This Intervention Involve One to One Interaction of Personnel with the Older Adult?

If the answer to this question was yes, then it was considered to be either one to one or community based. If the

answer however, was no, then it was considered to be either group based or community based. Two subsequent questions determined the individual coding category.

If the answer to the first question was yes, then a second question was posed as: *Does the intervention engage the wider community in any way?* If the answer to this question was yes as well, then it was labelled a community based intervention, whereas if the answer to this question was no, then it was called a one to one intervention.

If the answer to the first question was no, then the second question was posed to this subset too as: *Does the intervention engage the wider community in any way?* If the answer to this question was yes, then it was categorized as a community based intervention, otherwise it was classed as a group based intervention.

B. Preventative, Supportive or Remedial

Question: Does This Intervention Specifically Address Someone Who Can Be Identified as 'Being Lonely' or 'Being Socially Isolated'?

If the answer to this question was no, then it was called a preventative service. However, if the answer to this question was yes, it was either considered a supportive or remedial strategy. A secondary question was used to differentiate between the two as: *Does this intervention attempt to eliminate specific effects of being lonely or being socially isolated?* If the answer to this question was yes, then it was considered to be a remedial one and if the answer was no then it was labeled as a supportive strategy.

C. Improvement, Incremental, Major or Radical Innovation

In order to ascertain whether an intervention represented an improvement, an incremental innovation, a major advance or a radical departure, in comparison to the most basic form of a loneliness intervention, each intervention was critically analyzed to glean out its working principle. Each working principle was constructed as a statement that represented the underlying approach of the intervention and was compared to a standard working principle akin to [34]'s metaphorical standard book. Based on the preliminary review of interventions, the following statement was considered to represent the most basic underlying approach or in other words, the standard working principle (SWP) for developing loneliness interventions: *SWP: "If someone is feeling lonely, get someone to talk to them."* This standard approach is best demonstrated by some befriending services wherein if an individual or their family seek help from a social service highlighting that the given person experiences loneliness, they are introduced to another person, usually a volunteer, who is responsible to converse with them and it is hoped that through these conversations, a friendship may emerge and that the individual seeking help finds some assistance in dealing with their loneliness.

Coding questions were developed to compare each individual working principle with the SWP to determine whether the interventions being reviewed represented an improvement, incremental innovation, major innovation or

radical innovation as follows:

Question: What Is the Working Principle of This Intervention?

All responses to this question were framed in terms of "If someone feels lonely, then..." or "If a person feels lonely, then..." in order to have consistency in responses. This helped in comparing the working principles.

Once the working principle was established, a subsequent question was asked as: *Does this working principle demonstrate a noticeable change or difference in comparison to the SWP?* If the answer to the question was yes, the intervention represented one of the three types of innovation, i.e. incremental, major, or radical. If the answer to this question was no, then it represented an improvement.

To distinguish radical innovation from incremental, and major, a follow up question was asked as: *Does this working principle demonstrate unconventional ways of thinking and doing things? For example, engaging previously unimagined stakeholders, looking at older adults as providers rather than recipients of help and support, creatively combining the problem of loneliness with another problem such that they address each other, addressing loneliness as a by-product of some other activity, etc.?* If the answer to this question was yes, the intervention was classed as being an example of radical innovation. If the answer to the question was no, it was considered to be either a major innovation or an incremental one. A final question was used to ascertain whether the intervention under scrutiny represented incremental innovation or major innovation: *Does this working principle represent more than a few (1 or 2) key differences in comparison to the SWP?*

If the answer to this question was yes, the intervention was considered to represent major innovation, and if the answer was no, it was classed as an example of incremental innovation.

1) Classification Example

To explain this in more detail let us consider the example of an intervention called *Eldershine*. This service brings together older adults who might experience loneliness or other psychosocial problems, to participate in mindfulness and meditation activities. The underlying core idea or working principle upon which *Eldershine* has been created relies on bringing together a group of people, and getting them to become 'at peace' with their experience of loneliness, or solitude. This is different to the SWP, which looks to provide help and support to lonely older adults via external sources such as befrienders. However, because its core approach of bringing people together around an activity is not 'radically' different from introducing them to potential befrienders or mentors who can guide them, *Eldershine* is classed as a major innovation. Table II shows how coding questions were used to examine *Eldershine*.

Similarly in order to determine the extent to which each intervention used digital technologies, Baxter-Reynolds' [36] 'Five Aspects of Digital' framework mentioned earlier, was

adapted to draft six coding questions. Based on ‘yes or no’ responses to the coding questions, each intervention was given a score out of 6 wherein a total score of 6 (yes responses) indicated a high utilization of digital technologies and a score of 0 suggested minimum reliance on digital elements. These coding questions have been provided below:

- Question 1: Does this intervention enrich/enhance the older adults’ social network in any way (digitally)?
- Question 2: Does this intervention utilize mobile technology in any way?
- Question 3: Does this intervention capture and/or utilize analysis of Big Data?
- Question 4: Does this intervention rely on consumerised IT (PCs, laptops, tablets, affordable handsets, etc.)?
- Question 5: Does this intervention rely on ‘The Cloud’?
- Question 6: Does this intervention have an online presence/access (websites, YouTube videos, etc. found through a simple Google search. Google Scholar citations to be ignored)?

TABLE II
USING THE CODING QUESTIONS TO DETERMINE THE LEVEL OF INNOVATION FOR ELDELSHINE

SWP	“If someone is feeling lonely, get someone to interact with them”. Eldershine	
Intervention Name	Eldershine	
1. What is the working principle of this Intervention?	If someone’s lonely, get them to focus on their inner self by practicing mindfulness and meditation.	
2. Does this working principle demonstrate a noticeable change or difference in comparison to the SWP?	Yes	No
	Incremental, Major or Radical	Improvement
2.1 Does this working principle demonstrate unconventional ways of thinking and doing things? For example, engaging previously unimagined stakeholders, looking at lonely older adults as providers rather than recipients of help and support, creatively combining the problem of loneliness with another problem such that they address each other, addressing loneliness as a by-product of some other activity, etc.?	Yes	No
	Incremental or Major	Radical
2.1.1 Does this working principle demonstrate more than a few (1 or 2) key differences from the SWP?	Yes	No
	Major	Incremental

VI. VISUALIZING

Using the coding approach described in Section V, each intervention was categorized on four different levels and individual visualizations were created for them. Based on their objective, interventions were classed as being either preventative, supportive, or remedial in nature represented by the colors red, orange, and green respectively in the visualizations.

Interventions were also categorized based on their scope as either being one-to-one denoted by the letter O, Group-based represented by letter G, and Community-based symbolized by

letter C in the visualizations.

The ‘digitalness’ i.e. utilization of digital technologies of an intervention was denoted by radial arcs where a full colored circle (red, orange, or green) represented a 6 out of 6 score on the digital questions presented above. A fully grey circle on the other hand, represented a 0 out of 6 score on the digital questions.

All the responses were then mapped on a scale of innovation ranging from improvements to radical innovation based on the coding questions discussed earlier to highlight their level of innovation (e.g. Table I). To demonstrate how interventions were visualized, *Eldershine* has been used as an example as shown in Fig. 2.

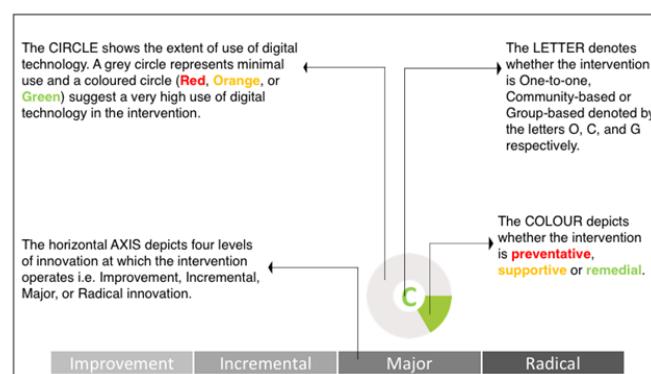


Fig. 2 Visualizing Eldershine intervention

Upon coding all interventions and creating such individual visualizations for each intervention, they were examined together to identify any patterns in our existing approach to mitigating loneliness as a society. The results and findings from this analysis have been discussed in the next section.

VII. MAIN OUTCOMES

After all interventions were shortlisted, they were coded and visualized using the data synthesis strategy discussed in Sections IV and V. Upon organizing data in this way (Fig. 3), it was found that majority (39%) of the interventions reviewed were based on one to one interactions between service providers and older adults. Community based approaches appeared to be a close second at 34%, followed by group based services representing 27% of the interventions reviewed. This indicated that personalized loneliness interventions were more popular than those that engaged a higher number of stakeholders.

In terms of the overall objective of the interventions, those that looked to correct the negative effects of experiencing loneliness, i.e. remedial services, accounted for 58% of the interventions reviewed while 24% of the interventions were found to be supportive in nature. The remaining 18% of the interventions that were examined were based on preventative methods indicating that as a society, more emphasis was laid on attempting to support or ‘cure’ loneliness, rather than attempting to prevent it from occurring in the first place.

Additionally, more than half (55%) of the interventions

examined took an incremental approach to mitigating loneliness amongst older adults. The remaining 45% of the interventions comprised of 16% improvements to the basic principle or SWP of introducing a lonely person to someone whom they can interact with, 14% major departures from this

principle, and 15% ideas that were radically different to this notion. This highlighted the disparity between society's existing ways of addressing loneliness, versus using novel ideas aimed at addressing loneliness experienced by older adults.



Fig. 3 Visualization showing all the interventions reviewed

In terms of utilizing digital technologies in developing and operationalizing loneliness interventions, it was found that nearly half (49%) of the interventions demonstrated the use of only 1 out of 6 of these aspects of digital technologies. Also, 6% of the interventions scored 3 or higher on the digital scale and the mean score of interventions on the digital scale was 1.37 out of 6. It was noticed that 72% of the interventions had some form of an online presence, either in the form of a webpage, or on online video-streaming websites such as YouTube. On the other hand, only 3% of the interventions utilized cloud computing.

A discussion of results from each of the coding categories in isolation has been given below to provide more specific insights regarding various characteristics of the interventions. To keep the discussion of results within the scope of this thesis, results have been presented for each of the innovation category, i.e. improvement, incremental innovation, major innovation, and radical innovation as can be seen at the bottom of Fig. 3 (from left to right).

A. Improvement

Out of the 32 interventions that were coded as improvements, 25 were one to one services, 3 were community based, and 4 were group based interventions. While conventional one to one befriending services such as

Dementia Friendship Scheme, Friends of the Elderly, Phone a Friend, etc. comprised the improvement category, other group and community based interventions such as *The Casserole Club, For Disability Mobility Bus (FDM), and The Enriched Opportunities Programme (EOP)* aimed to achieve similar goals to befriending services in a more communal setting. For example, *The Casserole Club* encouraged people living in the same community as older adults, to cook for them in order to help older adults who are not normally able to do so, eat healthy home-cooked food. This ‘communal’ act of cooking for neighbors brought people together and introduced older adults who might be experiencing loneliness, to someone that they can potentially befriend, and rely on, for help and support. Also, in terms of their overall objective, 25 improvement services were found to be remedial in nature, while 6 of these interventions were supportive, and the remaining 1 intervention was preventative. The remedial services within this category ranged from interventions aimed at fostering friendships between older adults and volunteers such as in *British Penpals* and *Good Company*, to services that offered guidance and support to older adults via volunteers who performed the role of *Active Mentors*. Other services such as the *Homelessness Intervention Programme*, which was aimed at preventing and addressing homelessness issues faced by older adults, were not specifically designed to alleviate

loneliness or social isolation. However, its evaluation demonstrates the supportive role that the intervention played in moderating the problem of loneliness experienced by older participants. The only preventative intervention within this category was a *Home Visit Programme* developed for older people with poor health status. As part of the home visit activity, nurses gathered data about loneliness experienced by older adults to assess their overall quality of life. The intervention did not aim to remedy loneliness or offer help and support to individuals experiencing it and only collected the information for research purposes, contributing to knowledge that can be used for developing preventative measures.

In terms of utilizing digital technologies, 10 interventions out of 32 did not show any signs of harnessing digital potential. For example, programs such as Cognitive Behavioral Therapy (CBT) or Interpersonal Psychotherapy (IPT), which were run as curative sessions, did not require the usage of digital technologies for their operation. Furthermore, 17 out of 32 interventions within this category displayed the use of only 1 aspect of digital technologies, mostly in the form of having some form of online presence, either as a website or a YouTube video. For instance, although Lifestyle Engagement Activity Program (LEAP) did not require the use of digital technologies for its operation, it had a YouTube video providing an overview of the intervention. Additionally, 3 interventions scored 2 on the digital scale, and out of the remaining two interventions, 1 intervention scored 3 and the other one scored 4 on the scale. The most 'digital' intervention in this category, with a score of 4 on the digital scale, was the *Community Network*, a social enterprise and a charity aimed at creating 'talking communities' by bringing people together on the phone as well as online.

B. Incremental Innovation

With 107 interventions being classed as incremental, this coding category contained the largest number of interventions out of the four levels of innovation coded for during this study. 27 out of these were one to one interventions, 44 were community based, and the remaining 36 interventions were group based. Due to the large number of interventions within this category, some level of heterogeneity was observed within each sub-category. For example, one to one incremental interventions ranged from services like a *Tai Chi Exercise Programme*, aimed at improving physical wellbeing of older adults but also at the same time having a positive effect on their perceived loneliness, to *Silverline*, which was a phone based helpline service for older adults that offered general information relevant to the older demographic. Similarly, community-wide interventions such as, *Community-based Early Psychiatric Interventional Strategy (CEPIS)* and *Time for Life (TfL)* varied widely in the way they dealt with loneliness amongst older adults. While CEPIS relied on community nurses monitoring the health and wellbeing of older adults in their area, TfL aimed to get older people involved in activities and clubs such as book reading, arts and crafts, coffee mornings, etc. to help them overcome their loneliness. Group based interventions in this category were

generally built around bringing people together over activities such as sports in *Sporting Memories* and *Walking Football*, or in arts and crafts in *Voyage*, which was a choir of older adults, and *Magic Me Arts*, an intergenerational arts project.

It was also noticed that 59 out of 107 incremental interventions were remedial in nature i.e. focused on correcting the negative effects of experiencing loneliness. 26 out of the remaining 48 interventions were supportive, and 22 were preventative in nature. Some interventions in the remedial category aimed to involve older adults in activities such as gardening, exercise, or eating together through interventions such as *Green Prescribing*, *Physical and Leisure Activity Programme*, and *Friendship Lunches* respectively, to introduce them to opportunities for socializing. Other remedial interventions looked to provide older adults with some form of support or guidance to help them overcome their loneliness such as the *Furzedown Project* which was a community transport scheme, or various social prescribing schemes such as the *Yorkshire and Humberside Social Prescribing Project* or *Rotherham Social Prescribing Scheme*. On the other hand, supportive incremental interventions comprised of ideas such as *The Rural Coffee Caravan Information Project* which provided an opportunity to socialize over food and beverages, while disseminating information that might be relevant to rural and isolated communities, or *Springboard*, an intervention that liaised with Fire and Rescue Services (FRS) to organize home visits by staff members to local older residents offering them help, support, and guidance based on an assessment of their needs. Additionally, apart from general wellbeing initiatives and social clubs for older adults such as the *Rochdale Circle*, or *Brendoncare Clubs*, preventative interventions also comprised of services that encouraged older adults to make lifestyle adjustments in response to their growing age to avoid scenarios where they may find themselves isolated or lonely in future. For example, *Spring Retirees Activity Centre (RAC)* was a retirement home that focused on keeping its residents active, by engaging them in activities of learning and leisure.

23 out of 107 incremental interventions displayed no signs of utilizing digital technologies. Again, interventions such as *Psychosocial Group Rehabilitation* and *Peer Counselling Programme* appeared to be curative in nature and did not rely on digital technologies for operation. On the other hand, although interventions such as *Buddy Hub* or *Know My Neighbour* did not require digital technologies to run, they had websites acting as gateways to access resulting in a score of 1 on the digital scale. It is interesting to note that interventions such as *Life Time Warrington* that scored 2, and *Silver Robin*, scoring 3 appeared to be similar in that they both offered help and support to older adults interested in learning how to use computers. The key difference between the two interventions was that *Life Time Warrington* aimed to connect older people to services, such as gardening, household repair, and maintenance work, etc. whereas *Silver Robin* was a web-based networking platform for older adults to share digital space with like-minded older adults, thereby scoring an extra point over *Life Time Warrington* for enhancing older users' social network digitally. Finally, 2 interventions that scored 4 on the

digital scale (the highest for this category) were *Finding Your Funny*, a University level course that teaches stand-up comedy to older adults, and *Counselling Directory*, which was an online repository of services relevant for older adults such as therapists, care homes, and other facilities.

C. Major Innovation

28 interventions were classified as being representative of major innovation and this category had the lowest number of entries. Half of these interventions, i.e. 14, were one to one interventions, while there were 7 interventions each in the community based as well as group based category. The one to one interventions representing major innovation were services such as *Sideboard* and *Esc@pe*. Instead of directly offering digital services to older adults who may not be as technologically savvy, *Sideboard* offered them access via their family members or friends, i.e. their 'supporters' who are more comfortable with handling digital technologies. Within community based services, interventions such as *DropBy*, a web-based service which aimed to build a community (online) of people over the age of 60 years, can be contrasted with *Time to Shine*, which worked towards strengthening community networks within Leeds, a northern English city, to help older people feel more included and less isolated. Although both interventions were community based initiatives, they took very different approaches to addressing the problem. The group based interventions had a strong educational theme as interventions in this category were dominated by the ones aimed at teaching older adults how to acquire new skills such as using the Internet in the *ANU Wellbeing Study*, or learning academic subjects of their choice at *The Open Universities for Senior Citizens (Universidade Aberta para a Terceira Idade i.e. UnATI)*.

Remedial services continued to be the dominant type within this level of innovation as well. 15 out of 28 interventions were identified as remedial services, while the supportive ones accounted for 8. The remaining 5 interventions were coded as being preventative in nature. Interventions such as *Mindings* and a couple of *Videoconferencing Programmes* that used digital technologies to connect older adults to their friends and family were classed as remedial services within major innovation. Other interventions such as *Assisting Carers using Telematics Interventions to meet Older Persons' Needs (ACTION)* that connected carers to their older patients using digital technology were coded as being supportive in nature. The *Second Half Centre*, an intervention that offered a range of services such as computer classes, arts gatherings, exercise sessions, etc. to older adults constituted the preventative category as it did not specifically aim to alleviate loneliness or offered support to someone experiencing it.

It was noticed that a higher proportion of interventions scored 2 or more on the digital scale than the previous two categories of improvement and incremental innovation. For example, only 3 out of 28 interventions scored a 0 on the digital scale and only 2 interventions scored 1. Also, 8 interventions each scored 2 and 3 on the digital scale. Interventions such as the *Third Age University Programme*

scored 2, and *Vital Aging-M* that focused on multimedia and e-learning to promote 'active ageing' amongst older adults scored 3. *Pepper*, an interactive robot designed to have conversations with its users scored 4. One intervention, by the name of *Seniornet*, scored 6 out of 6 and demonstrated a very high utilisation of digital technologies. *Seniornet* was an intervention that provided education for and access to computer technologies to older adults. An exploration of *Seniornet's* website suggested that it allowed users to network with each other, offered email services, gathered data from users' Facebook and Twitter accounts, etc. thereby exploring various possibilities of digital technology.

D. Radical Innovation

10 out of the 29 radical interventions were found to be one to one in nature, 13 were community based, and 6 interventions were classed as being group based. Although this category only had 29 interventions, this grouping displayed a lot of variation. For example, one to one radical interventions included services such as *Homeshare Oxford* and *PARO*, which were drastically different in how they address loneliness, and at the same time this category also contained interventions such as *Chat Mats*. While *Homeshare Oxford* paired older adults with younger tenants, *PARO* was a robotic Seal designed to bring the known benefits of animal therapy to care environments. *Chat Mats* on the other hand, were coffee mats designed to be used in cafés and restaurants that indicated whether someone is open to having a conversation with strangers or not at that moment in time. It did not target older adults directly but tried to usher in a behavioral change within the community such that older people could feel comfortable and confident about approaching strangers for conversation, if they felt lonely or isolated in a public place. Similarly, community based initiatives included a volunteering programme for older adults, and *Culture Champions* that allowed older adults to contribute to the society, as opposed to being perceived as someone who does not have much to offer to the society anymore. Also, radical community based interventions such as *The Man on The Moon* Christmas advertisement, *Breaking the Spell of Loneliness* music album, and *The Age of Loneliness* television documentary were not solely targeted at individuals experiencing loneliness. They were designed to engage the wider community in a discussion about this prevalent social problem by using creative arts. Group based interventions in this category were equally creative, with interventions such as *Bristol LinkAge Flashmob*, an impromptu street dance performance organised and delivered by older people to challenge the stereotypical perception of older adults in the community, to *Old School*, where older adults were paired with younger schoolchildren to offer mentorship and guidance to the younger generation.

As was the case with improvement, incremental, and major innovation categories, remedial services were the dominant type within radical interventions as well. Nearly half the radical interventions, i.e. 15 interventions in total were remedial, while 6 interventions were supportive in nature. The remaining 8 interventions were categorized as being

preventative in nature. Remedial interventions such as *Furry Tales* aimed to bring the known benefits of animal-assisted therapy to older adults experiencing loneliness, and *Friends of the Elderly (Christmas Gift Guide)* targeted the wider community by suggesting suitable Christmas gifts that can be bought for older adults experiencing loneliness during the festive season. On the one hand, supportive interventions included the *REPRINTS (Research of Productivity by Intergenerational Sympathy)* study which paired senior volunteers with public elementary schoolchildren. By pairing them in such a way, older adults were involved in reading picture books to children. On the other hand, interventions such as *Spice Time Credits* also played a supportive role in managing loneliness amongst older adults by promoting a culture of sharing and volunteering within a community. *Spice Time Credits* is a time-banking initiative that uses time as a currency such that participating members can earn or spend their time-credits by participating in a variety of community activities. Preventative radical interventions included large scale movements such as *Men in Sheds (Better Shed than Dead)* that allowed older men to offer support with various DIY (do-it-yourself) jobs in the community that they live in, and the more local initiatives such as *The Good Gym* an intervention that pairs keen runners with older adults.

In terms of utilisation of digital technologies, 1 intervention scored 6 and another intervention scored 4 on the digital scale. With 4 interventions scoring 2 on the digital scale, it was the second most popular score. 18 radical interventions scored 1, and 2 interventions scored 0. One of the 2 interventions that scored 0 on the scale was *Silver Stories* that allowed young children from an infant school to read a short story or a poem to an older adult experiencing loneliness. Face-to-face interventions, such as *Age UK County Durham's Come Eat Together* project, got older adults together to eat, cook, and even grow food for themselves as well as others via a website. Similarly, *Writing Back Leeds*, which paired older adults with students from the University of Leeds in a letter writing project, also utilised digital technologies in the form of having a website, and therefore both the interventions scored 1 on the scale. It is interesting to note that two interventions scored 3 and 6 each on the digital scale, but were similar in their approach. For instance, both *Speaking Exchange* which scored 3, and *School in the Cloud* which scored 6 mitigated loneliness by pairing older adults in the education of younger students via videoconferencing. Another intervention scoring highly on the digital scale was *Breaking the spell of loneliness* which is a music album available to download online that aims to highlight the issue of loneliness as a serious health problem on the global platform by using music.

VIII. ANALYSIS

The analysis was primarily concerned with data gathered around the level of innovation, and the use of digital technologies, as can be seen from the presentation of the results above. Also, a weak, but positive correlation was seen between the level of innovation and the use of digital technologies in designing and implementing loneliness

interventions. The analysis also highlights the possible migration of interventions from one category into another in terms of their levels of innovation. Furthermore, this analysis also highlights the value of extending the systematic literature review to include interventions found in grey literature with a view to get a contemporary picture of latest developments in this area.

The analysis of patterns emerging from the data demonstrates that an exhaustive review of contemporary loneliness interventions can uncover insights that may be useful to designers interested in developing such services. For instance, a visual scan of Fig. 1 establishes that there is an underrepresentation of radical-digital loneliness interventions in this area. This provides evidence and a rationale for the design community to 'invest' more resources in experimenting with radical-digital interventions, either in pursuit of design-knowledge, or to rule out their suitability in mitigating later life loneliness. It is noteworthy that this review also identified an underrepresentation of major innovation in developing loneliness interventions. This further strengthens the call to move away from conventional interventions and highlights the need to experiment with those that are substantially different to the standard way of mitigating later-life loneliness. In addition, when the elements of 'radical' and 'digital' were examined collectively, it was found that only 15% of the overall interventions were classed as radical, and out of these 29 radical interventions, only 5 interventions (17%) scored 3 or more on the digital scale. Also, at 1.37 (out of 6), the overall mean digital score of all the 196 interventions also indicated an underrepresentation of digital technologies in this area. Although conceiving, and implementing radical interventions may not prove to be "straightforward" since it requires out of the box thinking [38], introducing certain elements of digital technology, such as having a website, or an online video, could be relatively easy to achieve and could possibly expand the reach of loneliness interventions, or change the way in which they primarily operate. This is an important observation because a weak but positive correlation between the utilization of digital technologies and the level of innovation was found when the interventions were analyzed (Table III).

TABLE III
 CORRELATION BETWEEN DIGITAL SCORES AND THE LEVEL OF INNOVATION

		Level of Innovation	Digital Score
Spearman's rho (r _s)	Level of innovation	Correlation coefficient	1.000
		Sig. (2-tailed)	.311**
		N	196
	Digital Score	Correlation coefficient	.311**
		Sig. (2-tailed)	1.000
		N	196

** . Correlation is significant at the 0.01 level (2-tailed).

A. Exploring the Relationship between Radical Innovation and Digital Technologies

Although faint, this positive correlation between digital

scores and the level of innovation (Table III) indicates that the use of digital technologies can potentially help interventions in climbing up the innovation ladder from improvement to radical categories. An indication of this somewhat weak correlation can be found by taking a closer look at the ‘major’ innovation category in Fig. 1 and comparing it to ‘improvement’ and ‘incremental’ groupings in the same figure. It appears that a larger percentage (nearly 50%) of the interventions within this category scored 3 or higher on the digital scale in comparison to the other two, suggesting that

utilizing various aspects of digital technologies can possibly help interventions in steering away from the dominant incremental innovation approach, thereby allowing the exploration of other types of interventions. However, it is important to note that further research is required in this area to establish the true nature of this relationship between the level of innovation and the use of digital technologies in developing loneliness interventions because this correlation, although positive, does not imply causation.

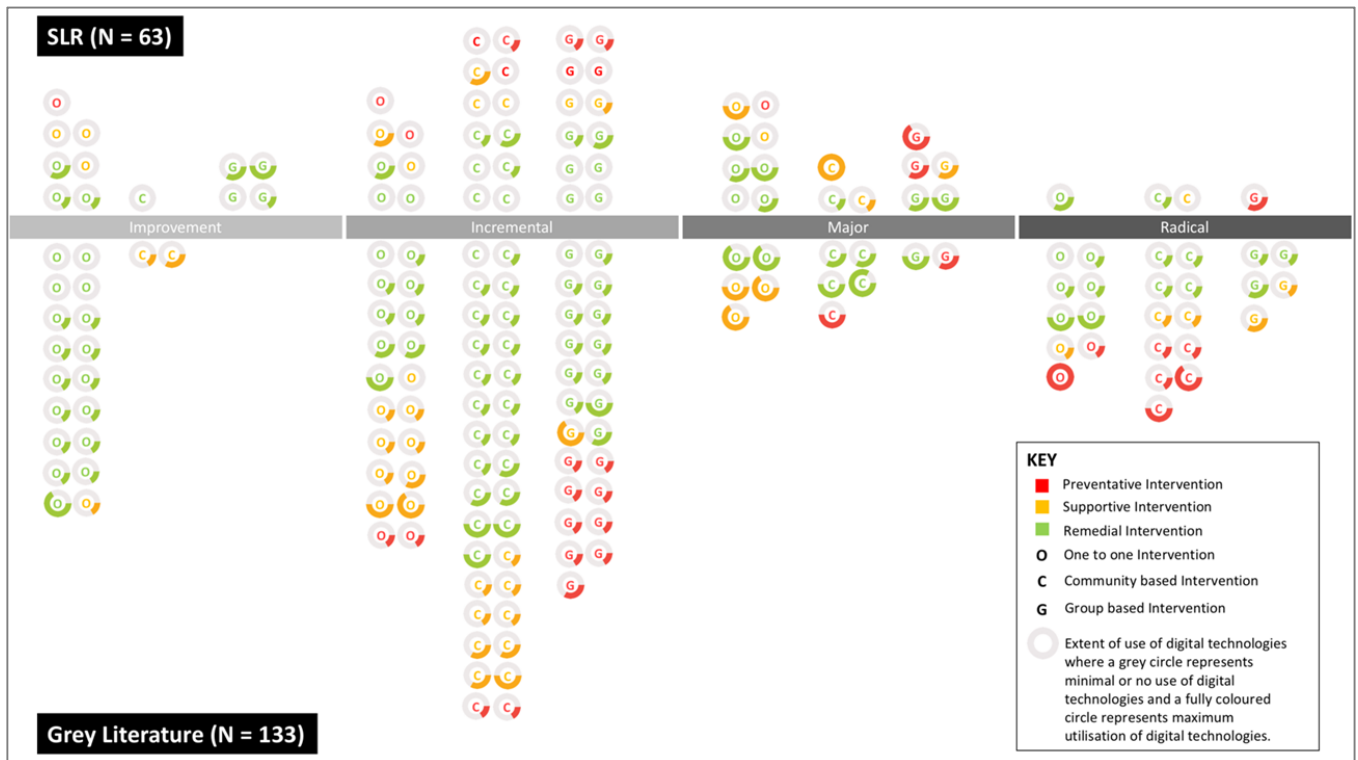


Fig. 4 Interventions found using the SLR versus grey literature

B. Enabling Migration of Loneliness Interventions

Upon examining the details of how interventions operated, it was found that some of them had the potential to migrate from one category to the other by making small adjustments to their modus operandi. For example, in terms of how they operate, it was found that *Writing Back Leeds*, a radical intervention was not that different from *British Penpals*, which was an improvement. Both these projects established contact between two parties through letter writing. The crucial distinction that placed them on the two extremes of the innovation scale (from improvements to radical), was the notion that through *Writing Back Leeds* older participants offered support to students in Leeds who were in many cases, themselves experiencing isolation having moved to a new city for higher education. Often older adults’ local knowledge about Leeds anchored conversations between the two parties. *British Penpals* on the other hand, sought volunteers who were willing to befriend older adults over letter writing. Perhaps by making small adjustments to their intervention wherein older

adults could offer some form of support to another party who could potentially benefit from it, *British Penpals* could undergo a ‘radical’ transformation.

Similarly, in terms of exploiting the digital potential, interventions that were highly comparable in terms of the way they operated, displayed variation in the extent to which they utilized digital technologies. For example, *Speaking Exchange* and *School in the Cloud* were both radical interventions that paired students to mentors via videoconferencing. While *Speaking Exchange* paired students in Brazil with older adults in a care home in the USA, *School in the Cloud* did not have any age restrictions in terms of the non-student end of participation. Anybody could volunteer to be a ‘granny’ (mentor) although they reported a high participation of older adults in their intervention as grannies. This meant that the utilization of digital technologies was higher in *School in the Cloud* due to the inclusion of younger mentors, who could be potentially more technologically savvy than their older counterparts. Also, the key differences in their digital scores

can be attributed to their individual scopes. While *Speaking Exchange's* website suggested that they were in their 'trial period' at the time of this study, *School in the Cloud* had been an ongoing project with several years of experience and research leading up to its present form. Therefore, *Speaking Exchange* utilized digital technologies not only to operate the intervention, but also to gather data that would improve their services and boost their already global scale further. This comparison suggests that interventions can have a diverse set of needs, and thus can utilize digital technologies to varying degrees depending on their aims and objectives.

C. Extending Systematic Literature Reviews

Methodologically speaking, extending the SLR beyond conventional peer-reviewed academic publications, and into the 'grey' literature, yielded some noteworthy insights. For instance, examination of grey literature resulted in nearly double the amount of interventions found in the academic sources. Also, out of 7807 publications found by searching 4 different academic databases, only 63 interventions met the inclusion criteria (Fig. 4), whereas on the other hand, an examination of the latest 1000 tweets from just one Twitter handle (@endlonelinessuk) resulted in 61 interventions that were included in the study. This significant difference in rejection rates makes a case for including grey literature in studies based on systematic review of literature. However, in order to limit ambiguity and haphazardness of data, researchers investigating grey literature should ensure that they choose their sources judiciously, and ensure that their step-by-step approach to identifying literature (in this case interventions) is recorded and expressed clearly so that it can be replicated by other researchers if required. For example, in this study the examination of known and publicly retrievable sources of data (CTEL website, and Twitter) allows for the application of the same research strategy by multiple researchers in case future researchers would be interested in replicating the study.

D. Highlighting the Disparity between Scholarly and Grey Literature

Another notable insight that emerged from comparing interventions found within academic publications with the ones found in grey literature was that the majority (86%) of the radical interventions included in this study were found in the grey literature. The observation that the only radical intervention scoring 6/6 on the digital scale, i.e. *School in the Cloud*, was identified through an examination of grey literature, highlights the importance of going beyond academic outputs when carrying out systematic literature reviews. This exercise also highlighted how certain interventions that were not published in academic journals could still potentially reach a vast audience including academics through digital technologies. For instance, the @endloneliness Twitter handle for CTEL had more than 14,500 'followers' on Twitter (as of 26 September 2017). Therefore, any interventions broadcast on @endloneliness Twitter account could be seen, appreciated, and digitally 'shared' by users who followed CTEL's Twitter

activity. Similarly, the *Man on the Moon* Christmas advertisement found in grey literature had been viewed more than 75,000 times on YouTube (as of 26 September 2017). Thus, grey literature helped in identifying novel interventions such as *Men in Sheds*, *Bristol LinkAge Flashmob*, *Friends of the Elderly* (Christmas gift guide), *The Age of Loneliness Documentary*, etc. that did not have an academic research angle associated with them, and their inclusion provided a better idea of diversity within the radical innovation category.

Finally, when the interventions found in grey literature were examined separately, it was found that at 13% of the total interventions found in grey literature, radical interventions outnumbered the 'major' category by 7%. This is different to the SLR approach where radical interventions only accounted for 6% of the total and contained the least number of interventions out of the four categories. Therefore, by ignoring some of these 'innovative' loneliness interventions, scholarly literature overlooked the ground-reality of the solution space.

These findings further strengthen the case for including grey literature in such comprehensive reviews not only to provide a more 'contemporary' and balanced perspective to the overall study, but also to be inclusive, and consequently more representative of developments in the area.

IX. CONCLUSION

Although radical-digital loneliness interventions are underrepresented, their deficiency cannot be considered directly or indirectly responsible for the persistence of loneliness and/or social isolation amongst older adults despite decades' worth of efforts devoted to alleviating them. Due to their low numbers in this area, much is yet to be known about the strengths and weaknesses of such interventions and this research represents an early exploration of this insight. An investigation of contemporary information (from the examination of grey literature) during this study however, indicated that the representation of radical ideas and digital technologies in loneliness interventions is on the rise. This offers an interesting opportunity for further research and experimentation in the area to understand the viability and sustainability of radical-digital loneliness interventions. More research into the 'weak but positive' correlation [1] between radical innovation and the use of digital technologies in designing and implementing loneliness interventions that was found during this research, can establish a better understanding of this relationship. Such knowledge can then help stakeholders in making informed choices about dedicating their resources to either radical innovation, or digital technology, or both.

REFERENCES

- [1] N. Savikko, *Loneliness of older people and elements of an intervention for its alleviation*, Turku, Finland, University of Turku, 2008.
- [2] J. J. Lynch, *The broken heart: The medical consequences of loneliness*, New York: Basic Books, 1977.
- [3] I. Stuart-Hamilton, *The psychology of ageing: An introduction*, Jessica Kingsley Publishers, 2012.
- [4] J. Ferreira-Alves, P. Magalhães, L. Viola and R. Simoes, "Loneliness in middle and old age: Demographics, perceived health, and social

- satisfaction as predictors," *Archives of gerontology and geriatrics*, pp. 613-623, 2014.
- [5] L. Doman and A. Le Roux, "The causes of loneliness and the factors that contribute towards it: a literature review," *Tydskrif Vir Geesteswetenskappe*, pp. 216-228, 2010.
- [6] K. Kaasa, "Loneliness in old age: Psychosocial and health predictors," *Norsk epidemiologi*, 1998.
- [7] P. Demakakos, S. Nunn and J. Nazroo, "10. Loneliness, relative deprivation and life satisfaction," *Retirement, health and relationships of the older population in England*, p. 297, 2006.
- [8] J. H. Sheldon, "The Social Medicine of Old Age. Report of an Enquiry in Wolverhampton," *The Social Medicine of Old Age. Report of an Enquiry in Wolverhampton*, 1948.
- [9] P. A. Dykstra, "Older adult loneliness: myths and realities," *European journal of ageing*, pp. 91-100, 2009.
- [10] R. Wilkes, "General philosophy and attitude to ageing," *Soc Work Today*, pp. 14-6, 1978.
- [11] P. Daoust, "The joys of solitude, Health & Wellbeing," 2010.
- [12] J. Beaumont, "Measuring National Well-being - Older people and loneliness," Office for National Statistics, UK, 2013.
- [13] L. C. Hawkey, C. M. Masi, J. D. Berry and J. T. Cacioppo, "Loneliness is a unique predictor of age-related differences in systolic blood pressure," *Psychology and aging*, p. 152, 2006.
- [14] A. Dean and N. Lin, "The stress-buffering role of social support: Problems and prospects for systematic investigation," *The Journal of Nervous and Mental Disease*, pp. 403-417, 1977.
- [15] S. C. Tiwari, "Loneliness: A disease?," *Indian journal of psychiatry*, p. 320, 2013.
- [16] D. A. Jones, C. R. Victor and N. J. Vetter, "The problem of loneliness in the elderly in the community: characteristics of those who are lonely and the factors related to loneliness," *The Journal of the Royal College of General Practitioners*, pp. 136-139, 1985.
- [17] P. Butler, *Jeremy Hunt: UK should adopt Asian culture of caring for the elderly*, The Guardian, 2013.
- [18] BBC News, "Loneliness 'on the rise among elderly'," 3 May 2014. (Online). Available: <http://www.bbc.co.uk/news/uk-politics-27247418>.
- [19] Age UK, "Later Life in the United Kingdom," 2016.
- [20] J. Bingham, "Record numbers reach retirement age as baby boomers turn 65," 25 September 2012. (Online). Available: <https://www.telegraph.co.uk/finance/personalfinance/pensions/9563647/Record-numbers-reach-retirement-age-as-baby-boomers-turn-65.html>.
- [21] S. Marsh, "Fourteen ways councils can help combat loneliness," 14 April 2014. (Online). Available: <https://www.theguardian.com/local-government-network/2014/apr/14/fourteen-ways-councils-can-help-combat-loneliness>.
- [22] Campaign to End Loneliness website, "Loneliness and isolation: Guidance for Local Authorities and Commissioners," 2013. (Online). Available: <https://campaigntoendloneliness.org/guidance/>.
- [23] J. O'Connor, "Age-related loneliness is a ticking time bomb waiting to explode," 2014. (Online). Available: http://insidetime.co.uk/articleview.asp?a=1773&c=agerelated_loneliness_is_a_ticking_time_bomb_waiting_to_explode.
- [24] F. Murphy, "Loneliness: a challenge for nurses caring for older people," *Nursing older people*, pp. 22-25, 2006.
- [25] M. Cattan, M. White, J. Bond and A. Learmouth, "Preventing social isolation and loneliness among older people: a systematic review of health promotion interventions," *Ageing and society*, pp. 41-67, 2005.
- [26] G. K. Auslander and H. Litwin, "The parameters of network intervention: A social work application," *The Social Service Review*, pp. 305-318, 1987.
- [27] C. M. Masi, H.-Y. Chen, L. C. Hawkey and J. T. Cacioppo, "A meta-analysis of interventions to reduce loneliness," *Personality and Social Psychology Review*, pp. 219-266, 2011.
- [28] K. Windle, J. Francis and C. Coomber, "Preventing loneliness and social isolation: interventions and outcomes," London: Social Care Institute for Excellence, pp. 1-16, 2011.
- [29] J. T. Cacioppo, M. E. Hughes, L. J. Waite, L. C. Hawkey and R. A. Thisted, "Loneliness as a specific risk factor for depressive symptoms: cross-sectional and longitudinal analyses," *Psychology and aging*, p. 140, 2006.
- [30] V. Burholt and T. Scharf, "Poor health and loneliness in later life: the role of depressive symptoms, social resources, and rural environments," *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, pp. 311-324, 2014.
- [31] C. Alexander, S. Ishikawa and M. Silverstein, "Pattern languages," *Center for Environmental Structure*, 1977.
- [32] N. Mead, H. Lester, C. Chew-Graham, L. Gask and P. Bower, "Effects of befriending on depressive symptoms and distress: systematic review and meta-analysis," *The British Journal of Psychiatry*, pp. 96-101, 2010.
- [33] Age UK, "Safeguarding the Convoy. A call to action from the Campaign to End Loneliness," Age UK, 2011.
- [34] J. Langrish, M. Gibbons, W. G. Evans and F. R. Jevons, *Wealth from knowledge: Studies of innovation in industry*, Springer, 1972.
- [35] D. A. Norman and R. Verganti, "Incremental and Radical Innovation: Design Research vs. Technology and Meaning Change," *Design Issues*, pp. 78-96, 2012.
- [36] M. Baxter-Reynolds, "Everyone is 'going digital' but just what does that mean?," 23 April 2014. (Online). Available: <https://www.zdnet.com/article/everyone-is-going-digital-but-just-what-does-that-mean/>.
- [37] Q. Mahood, D. Van Eerd and E. Irvin, "Searching for grey literature for systematic reviews: challenges and benefits," *Research synthesis methods*, pp. 221-234, 2014.
- [38] Hage, J., *Restoring the innovative Edge: Driving the evolution of science and technology*. 2011: Stanford University Press.