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What do we know about the relationship between Internet mediated interaction and social isolation and loneliness in later life?

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Keywords:	loneliness, internet, social relationships, later life, social isolation, mediated social interaction

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3 What do we know about the relationship between Internet-mediated interaction and social
4 isolation and loneliness in later life?
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10 **Abstract**

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13 Social isolation and loneliness are recognised social, health and wellbeing problems that
14 particularly affect later life. They have been the subject of many recent studies. Studies
15 examining the role of the Internet in addressing these problems have increased. However, it
16 is still unknown whether Internet-mediated social interaction has a role in mitigating social
17 isolation and/or loneliness or not. To address this gap, this study reviews previous research
18 that investigates the relationship between Internet use for communication and social
19 isolation and loneliness. It reviews the empirical literature published since 2000 and
20 expands on previous literature reviews by including a variety of research designs and
21 disciplines. Despite the recent growth of studies there is still little evidence to demonstrate
22 Internet effects on social isolation and loneliness. It is concluded that future research
23 programmes aimed at reducing them by the use of the Internet should include more robust
24 methodological and theoretical frameworks, employ longitudinal research designs and
25 provide a more nuanced description of both the social phenomena (social isolation and
26 loneliness) and Internet-mediated social interaction.
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39 **Keywords:** social isolation, loneliness, Internet, social relationships, later life
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1. Introduction

Social isolation and loneliness are recognised social and public health problems that particularly affect people in later life. Although the problems are not limited to this life stage, the special conditions – both structural factors and life events – that contribute to them tend to increase as age advances. Lelkes (2013) reports that, in Europe, one out of six people over 65 are isolated, with this number increasing among those over 80, at which age one person out of five reports not having any friends, having very limited social interaction and feeling lonely. Previous studies provide strong evidence of social isolation and loneliness' harmful effects on health and wellbeing. Yet, the relationship also works in the opposite direction: health and mental problems lead to an increased risk of suffering social isolation and loneliness (e.g. Fokkema and Knipscheer 2007). The literature has clearly identified a relationship between loneliness and social isolation and health (e.g. Holt-Lunstad et al. 2015, Miyawaki 2015). To the contrary, social interaction and social support are related to improvements in health and wellbeing (Berkman et al. 2000; Victor et al. 2000).

In western societies, there has been interest in studying the role of the Internet in reducing this problem. Internet – with social media (SM) as the specific tools developed to sustain social relationships and communicate within social networks (SN)- plays an essential role in supporting daily life. It is logical, then, to think that they might provide opportunities for communication with kin and others that can be of great value in later life. There have been optimistic claims about the potential of technologies and the Internet to enhance personal relationships and mitigate social isolation and loneliness in later life. However, their actual effects (and affects) are still not fully recognised.

Since 2000, several reviews analysing the effectiveness of different types of interventions aiming to mitigate social isolation or loneliness in later life have been published (Findlay 2003; Cattan et al. 2005; Dickinson and Gregor 2006; Dickens et al. 2011; Hagan et al. 2014). However, they have found contradictory results. One of the limits of these previous reviews is that they are not restricted to Internet-based studies and included several types of interventions aiming at reducing social isolation and/or loneliness, and they do not disentangle social isolation and loneliness. Within these reviews, six interventions using the Internet were found to have a positive effect on social isolation and/or loneliness (Ito et al.

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3 1999; Swindell 2001; Fokkema and Knipscheer, 2007; Tsai and Tsai 2011; Sum et al. 2009;
4 Wright, 2000). On the contrary, five were found to have no influence or no significant effect
5 (Meyer et al., 2011; Slegers et al., 2008; Straka and Clark, 2000; White et al. 1999; White et
6 al. 2002). These highlights that there is still the need to understand the Internet's effect on
7 social isolation's various dimensions – such as social relationships and social support – as
8 well as on loneliness. Also, these reviews did not include other research designs beyond
9 interventions (except for Sum et al. 2009 and Meyer et al. 2011). Some of them did not
10 include a mechanism to control whether the reduction in social isolation or loneliness was
11 due to the intervention itself –which in most of the cases included training that involved
12 personal contact with the trainer/carer – or to the use of the Internet. Moreover, previous
13 reviews have been generally limited to clinical – psychological, nursing, geriatric – research,
14 disregarding all the research conducted in other social science areas (such as
15 communication, community and social informatics, and sociology). There is a growing body
16 of literature that studies social isolation and loneliness from different research disciplines
17 which needs to be considered too. The need to include other strands of research is also
18 supported by the “dearth of evidence” highlighted in previous reviews (Findlay 2003; Cattan
19 et al. 2005).

20 Today we are immersed in the digital society, the Internet is embedded in our everyday lives
21 and people in later life are increasingly using digital communication technology to interact
22 with others. As society and technology develop, it is needed to explore more complex
23 methods of communication, contact and support as both a response to social isolation and
24 loneliness and as a way of gaining further knowledge about their role. This deserves a
25 broader review focused on Internet technologies, serving as a starting point for creating
26 more inclusive societies that engage and empower people in later life and that, in turn,
27 promote wellbeing and health. This paper aims to start addressing this gap by reviewing
28 recent literature to further understand the relationship between Internet use as a
29 communication means and social isolation and loneliness, including its effects on social
30 relationships in later life.

31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 **2. Method**

54 We conducted a literature review of studies on Internet use in later life published between
55 2000 and 2015. To identify the studies, we searched on Pubmed, PsycInfo, PsycArticles, IEEE
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3 Explore, ISI Web of Knowledge, Wiley Online Library, International Communication
4 Association, and Google Scholar using a combination of the following keywords for the
5 targeted population: aging, aged, ageing, elderly, elderlies, old, older adults, oldest-to-old,
6 seniors and later life. For the content search, we used Internet, social media, social
7 platform, social networking sites, and Web 2.0. Thirdly, we used the following terms for the
8 issue: social isolation, isolation, loneliness, social support, social capital and social
9 relationships. The search was conducted successively using the mentioned databases and
10 search terms. We also identified studies from reference lists in retrieved articles,
11 unpublished dissertations and conference abstracts. After removing all duplicated papers,
12 the remaining were reviewed by two researchers (NC and RBM). The final number of
13 studies reviewed was 42. The final study selection criteria were all manuscripts about later
14 life (in full or in part) and Internet use for communication with others (broadly defined and
15 including social media) and published in English. We selected any study regardless of its
16 methods and social science discipline. The papers that did not meet all these criteria were
17 excluded and we finally reviewed 25 papers. No further attempt to limit the number of
18 studies on quality grounds was undertaken, given the manageable number of papers.
19 After the studies were selected, they were categorized by two researchers according to the
20 following factors:
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- 33 • Method
- 34 • Measurement or focus
- 35 ○ Loneliness
- 36 ○ Social relationships and social isolation
- 37 • Effect
- 38 ○ Positive
- 39 ○ No effect or negative
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44 When lack of consensus, it was resolved via discussion before the appraisal of each paper.
45 The focus on loneliness or social relations and social isolation was a challenge due to its
46 complexity. The distinction between social isolation and loneliness –although introduced
47 below, it is not explored in full here due to the complexity of the terms and also to the
48 complexity of their relationship (de Jong Gierveld, et al. 2016)– is used for the remainder of
49 the paper. However, it is necessary to recognise that social isolation and loneliness,
50 although different, are intertwined and closely related. This review uses this distinction as a
51 way of disentangling the effects of the Internet and includes studies examining its effect on
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3 both loneliness and social relationships in later life –their deprivation or enhancement in
4 form of social support, social relationships, and so on.
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10 **3. Social isolation, loneliness and social relationships**

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13 Loneliness and social isolation are very complex concepts which have been defined
14 differently in studies about later life and have often been treated as synonymous. Recently,
15 social isolation has been recognised as being different from loneliness, and several authors
16 have called for the phenomena to be treated separately (e.g. Masi et al. 2011; Victor et al.
17 2009). It is recognised that somebody can feel loneliness even having lots of social
18 relationships or the other way around. Consequently, social isolation and loneliness do not
19 always go hand-in-hand. Social isolation relates to the lack of integration of individuals –
20 and groups – into the wider social context and to the deprivation of social contacts or social
21 relationships (Biordi and Nicholson 2009). In this sense, social isolation is usually treated as
22 a measurable variable that accounts for the social relationships (social networks) or
23 perceived support somebody gets from social relationships (social support and social
24 capital), or their lack thereof. While studying social isolation four main concepts have been
25 examined –living status, being alone, loneliness and social participation–, and for each,
26 there are related issues of theory, definition and measurement. There are also different
27 types of isolation (related to living conditions and social engagement, involvement and
28 participation). Social isolation broadly refers to having or not a network of kin and non-kin
29 relationships and to the size and characteristics of this network –and related to social capital
30 too.¹ A commonality of much of this research is the understanding that social engagement
31 is a key determinant of quality of life at any age, but especially relevant in later life due to
32 the reduction of social space.
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47 Although a causal relationship cannot be unequivocally established, social isolation is
48 sometimes associated with the concept of loneliness. According to an already classic
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52 ¹ Social capital does not have a clear, uncontested meaning (Adler and Kwon 2002), however most of
53 the definitions agree on defining social capital as the potential benefits derived from social
54 relationships.
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3 conceptualisation, loneliness is the 'discrepancy between one's desired and achieved levels
4 of social relations' (Peplau and Perlman 1982:32). Loneliness is an unwelcome perceived
5 feeling of social isolation in any of its types. It is an experienced discrepancy between the
6 kind of personal relationships the individuals have and the kind of relationships they would
7 like to have (Sermat 1978). Loneliness, then, is understood as the subjective complement to
8 social isolation or as the opposite of "social support" – a negatively perceived absence or
9 lack of company (Grenade and Boldy 2008)- and it is related with the quality of the
10 relationships somebody has. Loneliness is sometimes also conceptualised under the term
11 'perceived social isolation' (Cacioppo et al. 2009), and also named emotional isolation
12 (Ditommaso et al. 2004).

20
21 There are different types of loneliness as well (related to life course issues, the persistence
22 of loneliness feelings, and to the size and quality of the social network). Moreover, there are
23 several determinant factors affecting loneliness such as age –as one grows older the
24 likelihood of loneliness increases (O'Lunaigh and Lawlor 2008, Pinguart and Sörensen
25 2001); gender (Dahlberg et al. 2015); education and income (De Jong Gierveld and Dykstra
26 2012); demographics such as country of birth (Dykstra 2009; Tilburg et al. 2004) or being an
27 immigrant (Victor, Burholt and Martin 2012), health and personal characteristics.

33
34 As explained before, research sometimes treats social isolation and loneliness as synonyms.
35 The next sections try to unpack the effects of the Internet on both separately as
36 summarised in table 1.

39
40 <table 1>

41 42 **4.1. Loneliness and Internet**

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44 When observing the relationship between loneliness and Internet use, literature has found
45 that frequency of Internet use has been associated with loneliness (e.g. Kraut et al. 1998).
46 An alternative association has been sustained as well, proposing that those who are already
47 lonely tend to use the Internet more frequently (Tokunaga and Rains 2010). Research
48 focusing on the Internet effects in later life loneliness is scarcer.

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53 There is a group of studies employing cross-sectional research designs which found Internet
54 use beneficial in reducing loneliness (Sum et al. 2008; Lelkes 2013; Heo et al. 2015; Tsai and
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3 Tsai 2011; Blazun et al. 2012). With a clearer conceptualisation of loneliness, Lelkes (2013)
4 reported a positive relationship between Internet use and loneliness. Loneliness was less
5 frequently reported among those (aged 65 or over) using the Internet. Moreover, people
6 who regularly used the Internet for personal use were less likely to feel lonely. Heo et al.
7 (2015) study pointed to the importance of social support as a mediator of the relationship
8 between Internet use and loneliness. When social support and loneliness were incorporated
9 into the model, the relationship between the two decreased by mitigating the negative
10 effect of loneliness on wellbeing. Hence, the findings of this study suggest that loneliness
11 and social support/social relationships could not be disentangled and investigated
12 separately, as one impacts the other. However, both Lelkes (2013) and Heo et al. (2015)
13 utilised a single measure of Internet usage, based on frequency instead of kinds of activity,
14 and we already know that using the Internet for communicating and using it for browsing
15 are very different kinds of activities which may have very different effects on loneliness.
16 Conversely, there are five survey studies that did not find any positive relationship between
17 Internet usage and loneliness (White et al. 2002; Carperter and Buday 2007; Sum et al.
18 2008; Bell et al. 2013; Hutto et al. 2015). Within this group, Sum et al. (2008) conducted a
19 survey studying the use of the Internet in later life. They measured loneliness using the
20 Social and Emotional Loneliness Scale (SELSA), which implies the conceptualisation of
21 emotional loneliness as social and emotional loneliness² and includes three subscales:
22 family, romantic and social loneliness. The research also analysed different types of
23 activities carried out over the Internet – as a communication tool, for information,
24 entertainment, commercial purposes and for finding new people – and found interesting
25 relationships that point towards the need for a more nuanced approach in the
26 conceptualisation of Internet usage. Participants in this research reported low levels of
27 loneliness overall. Yet, greater use of the Internet to make new contacts was associated
28 with a higher level of emotional loneliness. This study started to delve into the different
29 activities carried out on the Internet and their effect on different forms of loneliness.
30 However, in the study, the different forms of loneliness were not clearly conceptualised
31 distinguishing loneliness and social isolation. Bell et al. and Hutto et al. research projects
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54 ² Emotional loneliness would be what we define here as loneliness and social loneliness would be
55 equivalent to social isolation.
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3 employed the revised UCLA Loneliness Scale (Russell et al. 1980). Bell et al. (2013)
4 specifically investigated the effect of Facebook use on loneliness. The relationship between
5 Facebook use and loneliness in a highly-functional sample was not significant. This sample
6 was small (N=141) for a quantitative study and appeared, on the whole, not to be very
7 lonely. Hutto et al. (2015) also focused their study on Facebook's impact on loneliness. This
8 study used the same data as the previous one but with more detailed analyses (Bell et al.
9 2013). They also found no significant difference in loneliness scores between Facebook
10 users and non-users. But, interestingly, they found that perceived loneliness decreased with
11 age and this association was stronger for Facebook users.
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19 These studies continue to fail to provide solid evidence about the specificities of the
20 relationship between loneliness and Internet usage. In addition, they still leave us with the
21 question of whether the effects of Internet usage on the different perceptions of loneliness
22 are due to the use of the Internet itself or whether, on the contrary, how lonely one feels
23 affects the use they make of the Internet. Causality cannot be determined. Indeed, the
24 contribution of these studies lies in the fact that they have started to reveal that there is a
25 complex relationship between the Internet and loneliness in later life. The complexity of
26 studying loneliness is compounded by the complexity of studying the use of the Internet.
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34 A series of quasi-experimental designs deal with the causality issue. There are a series of
35 studies which found a significant reduction in loneliness (Shapira et al., 2007; Fokkema and
36 Knipscheer 2007). Cotten et al. (2013) used the revised UCLA Loneliness Scale in an
37 intervention designed to investigate the effects of the Internet on perceived loneliness
38 among seniors living in assisted and independent living communities. They reported that an
39 increase in the frequency of going online was associated with a significant decrease in
40 loneliness scores. Ballantyne et al. (2010) also reported a decrease in feelings of temporal
41 loneliness¹ through the use of SM sites. The sample was very small to generalise results and
42 the positive claims seem too optimistic and technologically determined; furthermore, they
43 did not account for the intervention effect, which might be large as the intervention implied
44 one-to-one sessions. However, this study starts to pay attention to how loneliness is
45 understood in relation to Internet connectivity.
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54 Interventions reporting no effects can also be found in the recent literature (Carpenter and
55 Buday 2007; Slegers 2008; Woodward et al. 2011). These studies compared the loneliness
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3 reported by computer and Internet users and non-users, and they found that the
4 differences were not significant.
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6 One of the major problems we have found in this strand of research on loneliness is that it
7 does not include any in-depth qualitative analysis (except for Ballantyne et al. 2010) that
8 provides an understanding of the mechanism of loneliness and Internet use in later life.
9 Another problem relates to the variety in the conceptualisation of loneliness which makes
10 the studies no comparable. Furthermore, overall research results are still conflicting.
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16 **4.2 Social relationships online**

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20 When exploring the deprivation of social contacts or social relationships, a logical step is to
21 look at its positive side as well (Anderson 1998) and pay attention at whether the Internet
22 can be a means of forming social relationships in later life – the formation of SNs and social
23 support- as a way to look for further evidence. Concepts such as SNs, social support and
24 social capital appear frequently in recent literature on the Internet and later life. Previous
25 studies found that people in later life are more likely to use the Internet to sustain or
26 strengthen existing social relationships – mainly with family and friends – and to enhance
27 social support (e.g. Xie 2007; Cotten et al. 2012). “Social relationships online” refers to
28 literature tackling any form of social relationships online, including social support, social
29 capital or SN formation. These three aspects of social relationships appear to be interwoven
30 in many cases.
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39 Several studies have highlighted that the prospect of sustaining social relationships with
40 family members is one of the main motivators for starting to use the Internet in later life
41 (Harley et al. 2009; Prieto and Leahy 2012). Indeed, the most common use in later life is
42 staying in touch with others (Carperter and Buday 2007; Sum et al. 2008; Nahm and Resnick
43 2001; Climo 2001), mainly with family and friends (Bell et al. 2013) and to a lesser extent
44 with community groups or exclusively online friends.
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49 When looking at social networks and the Internet, one of the main issues emerging is the
50 connectivity effect on the size of the network of friends and contacts. Strong associations
51 have been found between age and online SN size. When comparing older (above 60) with
52 younger (13 to 19) people, older people were found to have fewer friends or online contacts
53 on MySpace than younger users (Pfeil et al. 2009). Siriaraya and Siang Ang (2012) also found
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3 similar results when comparing the online SNs of people between 55 and 74 and people
4 between 18 and 22 in a multi-user virtual environment. Similar studies have been carried
5 out regarding Facebook SN size (Hutto et al. 2015). These studies concluded that, despite
6 having a smaller number of social ties than younger users, older users have higher levels of
7 interaction and reciprocity between each of their ties, which seems to indicate stronger
8 relationships. Zaphiris and Sarwar (2006) found that the SN of older users in a Usenet
9 newsgroup was smaller and less connected than that of younger users and also contained a
10 higher number of isolated actors. However, the senior newsgroup was more interactive
11 than the younger one and displayed a stable and consistent environment with a high level of
12 activity.

13
14 So far, it seems that older people are more interested in developing strong online
15 relationships than displaying large SNs mainly formed by weak ties. This also seems to
16 suggest that they are more interested in the quality of the relationships than the quantity,
17 which in turn is one of the distinguishing factors between loneliness and social isolation.
18 Although these studies suggest that the Internet allows for the formation of satisfactory SNs
19 and describe their characteristics, they do not offer many insights into what it means for
20 social relationships and eventually for social support and social capital. To further explore its
21 impact on social relationships more broadly, we need to look at the online relationships'
22 effect on social support.

23
24 Internet use has been associated with higher level of satisfaction with the amount of
25 contact with family and friends (Bradley and Poppen 2003; Sum et al. 2009; Cotten et al.
26 2013; Bell et al. 2013). Computer users have more extensive SNs, with better access to
27 assistance, and they report being more satisfied with their social circumstances (Carperter
28 and Buday 2007; Heo et al. 2015). Results revealed that more frequent use of the Internet
29 as a communication tool was associated with a lower level of social isolation (Sum et al.
30 2008). Lelkes (2013) found that those who use the Internet regularly (but not every day)
31 have a greater chance of having a close friend and meeting up with someone regularly, and
32 this effect is greater for those who use the Internet every day. Again, the causal direction
33 cannot be determined, neither the specific effects of the Internet. With the data offered, it
34 is not possible to know whether having larger SNs fosters Internet use for communication or
35 if it is the Internet use that sustains the development of larger SNs.

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37 Intervention studies deal with the directionality issue. An intervention for housebound
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3 people over 60 found a significant increase in communication with family and friends and
4 better communication with community services and governmental agencies after
5
6 introducing the Internet (Bradley and Poppen 2003). Caution in interpreting these results is
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8 needed because the sample was small (8 out of 20 were over 60) for a quantitative study
9
10 and the research design weak (lack of theoretical framework and lack of control by
11
12 intervention effect). Although also employing a weak research design, the study conducted
13
14 by Blažun et al. (2012), which pointed towards the Internet's positive effects in terms of
15
16 social support, was interesting in that it suggested that sociocultural background could
17
18 impact on the effectiveness of the Internet in social support.

19
20 Similarly, several qualitative studies (Shapira et al. 2007; Fokkema and Knipscheer 2007;
21
22 Winstead et al. 2012) found that participants reported an enhanced connection with their
23
24 SN and consequently seemed to benefit from social capital to a greater degree. Blit-Cohen
25
26 and Litwin's (2004) non-intervention study also achieved similar findings. Ballantyne et al.
27
28 (2010) went even further, suggesting that using the Internet not only facilitates maintaining
29
30 and strengthening social relationships but also fosters regular face-to-face meetings. An
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32 intervention study (Cornejo et al. 2013) that analysed two whole families' social interactions
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34 on a specifically designed SM also suggests that this site benefit older people by enriching
35
36 their offline interactions.

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38 Another study (Slegers et al. 2008) – employing a larger sample and a quasi-experimental
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40 research design – did not report any significant differences in the level of social support
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42 after the Internet intervention. Along the same lines, Woodward et al. (2011) did not find
43
44 any significant differences in the size of the SN, the frequency of contact and the perceived
45
46 social support when comparing Internet users and non-users. Tsai & Tsai (2011) also did not
47
48 find any significant differences in terms of social support, and Cotten et al. (2013) did not
49
50 find any significant effect on the perceived levels of social isolation but did detect positive
51
52 effects regarding social relationships. These contradictory findings could be due to a weak
53
54 conceptualisation of social isolation or misleading survey questions.

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56 To date, the results are contradictory. On the one hand, it seems that older people miss out
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58 on the benefits of having great online social capital due to having a smaller group of
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60 friends/contacts, then being affected by social isolation, but, on the other hand, greater
interaction and higher reciprocity are suggestive of greater (in quality terms) social capital
and this affects loneliness. The quality of their SNs and social relationships seems to be

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2
3 more strongly associated with loneliness than quantity –social isolation. Some evidence also
4 suggests that Internet use might provide social support, but, at the same time, the
5
6 frequency of use is associated with weak relationships or a lack thereof. The online social
7
8 capital theory assumes that greater social capital is always better for individuals and for
9
10 society, but this may not be the case in later life.

11 12 13 **CONCLUSIONS**

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16 Results from previous studies are still inconclusive regarding the Internet's effect on
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18 loneliness and social isolation –including social relationships and its different dimensions.
19
20 Although the literature on social relationships has shed some light on disentangling the
21
22 effects of the Internet on social isolation there is not enough understanding of the
23
24 processes and mechanism through which mediated social interaction is effective.
25
26 The limits of current research come from several foundations. First, research needs to
27
28 employ more rigorous research designs. In quasi-experimental research designs, training
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30 effects must be disentangled from Internet effects. There is need of pragmatic and pluralist
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32 methodological approaches combining qualitative and quantitative methods. There is also
33
34 lack of longitudinal qualitative studies (such as ethnographies) able to provide a more
35
36 nuanced account of the Internet's effects –and affects- and account for life events. Second,
37
38 more finely graded and coherent measurements are needed, not only in relation to social
39
40 isolation and loneliness but also regarding Internet use. In this sense, the tendency, for
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42 example, is to treat time on the Internet as a unique dimension, but time spent on the
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44 Internet currently varies greatly and one can spend large amounts of time online not
45
46 engaging in any social activity

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48 On the one hand, the studies reviewed used a variety of measurements to account for
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50 loneliness and social isolation, making them difficult to compare and thus build upon
51
52 research findings. Some studies ignore the relationship between loneliness and life events
53
54 and consider loneliness as a variable that can be easily controlled. There is not much
55
56 research being done regarding social backgrounds (including living conditions), neither
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58 considering other social, cultural and economic factors, and how these factors affect
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60 Internet-mediated social relationships. On the other hand, the majority of the studies
61
62 reviewed treat the Internet and the services available for personal communication as

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3 neutral, when they are not, indeed their meanings are socially constructed as well.

4 Technologies are collectively produced, interacted and “co-shaped” and without knowing
5
6 more about these co-shaping processes is difficult to draw meaningful conclusions.

7
8 Finally, the lack of theoretical frameworks is also an issue for most of the studies reviewed.

9
10 As stated previously, the situation has changed considerably in recent years due to the
11
12 increase in digital technology adoption in later life. Internet use is most of the times studied
13
14 from the adoption perspective or with ageist stereotypical assumptions, but nowadays
15
16 more and more people are already using the Internet in later life and can no longer be
17
18 considered non-adopters or laggards.

19
20 Research on social isolation, loneliness and later life also needs to start using digital data
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22 from SM and engaging in digital sociology research and STS studies. As far as we know,
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24 there are few studies making use of digital social science approaches and taking advantage
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26 of the availability of digital data.
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5 ¹ Defined as loneliness perceived in a specific moment, i.e. in the evening.
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Quality in Ageing and Older Adults

Table 1: Studies on Internet, loneliness and social relationships in later life

Authors	Aim	Method & sample	Measurements		Technology	Results
			Loneliness	Social relationships		
Wright (2000)	To study the ways in which individuals use CMC for social support.	On-line questionnaire Sample: Users of SeniorNet. (N=136) Age (M=61 SD=6.5) from 55 to 87 84 female 52 male		Social support questionnaire (Sarason, Sarason, Shearin, & Pierce, 1987) comparing internet and non-internet relationships. <ul style="list-style-type: none">• Number of supportive relationships• Support Network Satisfaction• Number of companionship (Rook, 1987).• Companionship Scale satisfaction (Rook, 1987).	Internet, CMC	Older adults engage in companionship relationships on the Internet significantly more than supportive relationships. Satisfying supportive relationships on-line are associated with frequency of use. For those individuals who spend a great deal of time on the Internet, there is potential for relatively strong relationships to form.
White, et al. (2002)	To assess the psychosocial (loneliness) impact of providing Internet access to older adults over a five-month period.	Intervention: Randomized-controlled trial. Internet training Intervention group: 48 (71% females) Control= 45 (82% females) Congregate housing and nursing facilities Questionnaire: (pre and post test)	UCLA (Huges et al. 2004)	Number of confidants	Internet	Although there was a trend toward decreased loneliness and depression in intervention subjects compared to controls, there were no statistically significant changes from baseline to the end of trial between groups. Among Internet users (n = 29) in the intervention group there were trends toward less loneliness and more confidants than among intervention recipients who were not regular users (n = 19) of this technology. However, this is not statistically supported.
Bradley and Poppen (2003)	To assess the decrease isolation among older people who were home-bounded.	Intervention: Install computer and the internet, training and support with volunteers Questionnaire (pre and post test -a year after) Self-Progress reports Sample: home-bounded people and caregivers N= 20 (only 8 +60) No information about gender		Questions relating to amount of contact with others. Level of communication and participant satisfaction with the amount of contact they had with others.	Internet, email CHIPs online community	Significant positive differences between baseline measurement and post internet installation, especially regarding contact with others and their satisfaction with contacts.
Blit-Cohen & Litwin (2004)	The study the degree to which computer-mediated communication increases the social capital of older adults.	Interviews Sample: 10 computer users and 10 non-users Low to moderate income Israeli adults Mainly females (lack of specific data). No details of exact age.		Social capital	Computer-mediated communication	Participants enhanced connections with their group and with their social network.

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Zaphiris and Sarwar (2006)	To establish similarities and differences in the ways of interacting among the participants of two newsgroups (teenagers and seniors).	Social Network Analysis (SNA) comparing a teenagers group and a senior group.		SNA measures (Nodes, ties, range, centrality, degree, closeness, etc.)		They found that the SN of older users in a Usenet newsgroup was smaller and less connected than that of younger users and also contained a higher number of isolated actors
Carpenter & Buday (2007)	To study patterns of computer use among older people.	Questionnaire Sample: computer (N=115) and non-computer users (N=209) living in a retirement community Age: M= 75 SD=6.7 Computer users Males 43 Females 72	Geriatric Depression Scale (Leshner & Berryhill, 1994) including one question about loneliness	OARS Social Resources Rating Scale Total Score (Fillenbaum, 1988). Questions (e.g., frequency of social contacts, presence of a confidant, subjective perception of available assistance	Internet and computer	No significant differences between computer users and non-users in terms of loneliness. Computer users have more extensive social networks, with more access to assistance, and are more satisfied with their social circumstances. But the direction of causality cannot be determined with this cross-sectional data.
Fokkema & Knipscheer (2007)	To decrease loneliness among chronically ill and physically handicapped older adults through introducing them to the use of an electronic communication facility.	Intervention: 3 years of PC and Internet connection, training at the beginning. Sample Intervention group= 12 (11 women), living alone, few possibilities to leave home, no pre-internet experience, > 60 Control group = virtual Age M=66 Questionnaires (pre, post and post test -two years after) In-depth interviews with four participants	Emotional loneliness - six negatively formulated items express feelings of isolation and of missing an attachment relationship. (Jong Gierveld and Kamphuis, 1985)	Social loneliness - five positively formulated items express feelings of social embeddedness (Jong Gierveld and Kamphuis, 1985)	Internet and computer	Both the participants and the control persons experienced a reduction in loneliness (both measurements) over time. The reduction was only significant for the intervention participants. The changes in loneliness were significantly greater among the participants compared to the control persons. The effect of the experiment was only significant regarding emotional loneliness and among the highest educated. No significant effect in social loneliness. Qualitative findings - the intervention was found to alleviate feelings of loneliness by offering people a network of contacts. E-mail was found to facilitate social contact.
Shapira, et al (2007)	To test the psychological impact of learning how to use computers and the Internet in old age, hypothesizing that such activities would contribute to seniors' well-being and personal sense of empowerment.	Intervention: course in day-care centers for the elderly or resided in nursing homes. Experimental group (N=22) Control group (N=26) Measures (pre- and post-intervention four months later. Individual semi-structured interviews Age = 70-93 Males = 9 (E) – 9(C) Females = 13 (E) – 17 (C)	Revised UCLA loneliness scale (UCLA) (Russell et al. 1980)	Emerging in the qualitative interviews	Internet browsing, email, participating in forums and virtual communities.	Improvement in UCLALS score from pre to post (statistically significant). Lower levels of loneliness. Qualitative results: It found social benefits of using online communication; they experienced the social benefits of enhanced interpersonal communication.

1 2 3 4 5 6 7 8 9 10 11 12 13	Slegers, et al. (2008)	To study the improvement of quality of life.	Intervention: One control group (N=45 non-interest in learning computers and Internet); Experimental (N=191 – interested to learn internet; from those N=123 received computer and training, N= 68 did not receive training) Age= 64 -75 Male-females = not specified	Loneliness questionnaire (De Jong-Gierveld & Kamphuis, 1986)	Nature and frequency of participants' social networks. 1. Number of people the participants can rely on for help and with whom they share private matters (Stevens, Kaplan, Ponds, Diederiks, & Jolles, 1999). 2. Number of people the participants can rely on for help but with whom they do not discuss private matters. 3&4 frequency of contact with 1 & 2.	Computers and the internet	More complex and robust research design trying to avoid / test training and interest effects. No positive effects in any of both measures.
14 15 16 17 18 19 20 21	Sum, et al (2008) (2009)	To survey changes in older adults' social relationships and explore how Internet affects their sense of community.	Survey in Australia N= 222 (62% female) Over 55	Loneliness was measured by a 15-item Social and Emotional Loneliness Scale (SELSA) (Ditommaso et al 2004) with social, family, and romantic loneliness subscales.	Shklovski and Krauts'13 Internet Breadth Scale with five subscales: including finding new people and communication. Impact of the internet on social activities. Contact with family and friends	Internet	Using the Internet for communication with relatives and friends was specifically associated with lower levels social loneliness. Using the Internet for communication with unknown people was associated with greater levels of family loneliness. Time spent on the Internet was a predictor for social loneliness. The more hours spent on the Internet, the higher degree of social loneliness. Second study (2009) also confirmed that Internet used was associated with higher satisfaction with contacts with family and friends.
22 23 24 25 26 27 28 29 30	Pfeil, et al. (2009)	To identify and analyse any age differences in the way people represent themselves on MySpace and build and maintain social capital in this setting.	Content analysis Initial Sample: 50 teenagers (13-19) and 50 older users (>60) / 50% males in both groups. The crawler collected the profile data of these users and the profile data of all their friends, resulting in around 6000 MySpace user's profiles being crawled.		Social network size in social media sites	MySpace	The social capital of older people on MySpace is smaller in size but more heterogeneous concerning the age distribution of friends. The fact that older people have a much smaller size of friends suggests that they miss out on the benefits of a great social capital [online]. Older people seem to lack the basis of a large pool of friends and also do not engage much in further activities (comment on others profiles) in order to maintain their social capital. Older women receive significantly more comments than older men.
31 32 33 34 35 36 37	Ballantyne, et al. (2010)	A pilot project that implemented an internet social networking intervention and evaluated the effect it had on older people's experience of temporal loneliness.	Intervention: one-to-one Sample: 4 older people 65-85 3 males 1 female Home living In-depth interviews (entry and exit) and reflective journals (field notes)	Five interrelated dimensions of loneliness: Private, relational, readjustment, temporal (Stanley et al. 2010)	Connectedness	Internet and SNS	The utilisation of a SNS has the potential to reduce loneliness in older people. Positive effects of SNS on temporal loneliness (especially in the evening) and connectedness.
38 39 40 41 42 43 44 45 46 47	Meyer, et al. (2011)	To determine the degree of isolation among rural nursing home residents, their perception of	Surveys 33 nursing home residents age >65 years 16 friends and family	Loneliness was measured by Geriatric Depression Scale (GDS).	Nine-item instrument that examined social contact and interaction.	Webcams	This study demonstrates a willingness toward the use of webcams for residents and their friends and families. The study did not find a statistically significant relationship between loneliness and the willingness to use of webcam.

	communication with family members who live too far away to visit regularly, and the interest and perception of telecommunication through webcams.	members living far away.				
Woodward, et al (2011)	To examine whether training provided to adults age 60+ would increase the use of information and communication technologies (ICTs), such as email and SNS and the Internet, and influence participants' social support and mental health.	Intervention Experimental group (N=45), control group (N=38) Six month-training program Data were collected from both groups at baseline, 3 months, 6 months, and 9 months (3 months after the end of the training). Age +60 72% female 32% lived alone	Loneliness questionnaire (De Jong-Gierveld & Kamphuis, 1986)	Perceived social support from friends Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet et al. 1988)	Email, Instant Message and Skype	No significant difference in the use of IM, email and Skype. In terms of social support outcomes, there was no significant difference between the experimental and control groups in the number of people in their social network or in frequency of contact with their network Perceived greater social support from friends. This was driven by a difference in perceived support from friends; however, there was no significant difference in this variable over time (may be due to the program itself). No significant difference between experimental and control in terms of loneliness.
Tsai & Tsai (2011)	To evaluate the long-term effectiveness of a videoconference intervention in improving nursing home residents' social support, loneliness, and depressive status over 1 year.	Intervention: 5 minutes/week teleconference guided in nursing homes. Access to the internet. Sample (N=90) Experimental (N=40; females=22) Control (N=50; females=30) +60 Questionnaires at baseline, 3, 6, 9 and 12 months.	Revised UCLA (Russell et al. 1980)	Social support was measured by the Social Support Behaviors Scale (Hsiung 1999) with three subscales: social support network, quantity of social support, and satisfaction with social support.	Windows Live Messenger or Skype	This study demonstrated that the videoconference intervention alleviated elderly nursing home residents' perceived loneliness at 3, 6, and 12 months after the intervention. Positive effects of support over time. No significant differences between experimental and control group regarding informational social support.
Blazun, et al. (2012)	To study how an ICT learning intervention supported the development of their ICT skills and how it affected their behavior regarding social interaction. To explore the extent to which, after a computer intervention, older people were able to exploit ICT to improve their social inclusion,	Intervention: 3-week computer training courses Sample (N=58; Finland and Slovenia; 22.42 % drop off; 39.3% male) + 57 Pre and post-test – questionnaire (3 weeks after the training)	Self-reported feeling of loneliness (the operationalization of this variable is not clearly explained)	Composite variable called loneliness (but according our conceptualisation it should be social relationships): <ul style="list-style-type: none"> number of existing friends, possibilities of making new friendships on-line frequency of Internet use frequency of sending e-mails. 	Email and Skype	Level of loneliness decreased significantly after ICT course. However, the design is too weak to report significant positive effects (correlation analysis and unclear conceptualisation of variables)

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	and consequently reduce their loneliness.					
Lelkes (2013)	To explore the impact of internet use in old age on social isolation.	European Social Survey (ESS2010) 11000 people over 65	Feeling lonely	<ul style="list-style-type: none"> Lack of a close friend Meeting socially less than once a month 	Internet	Social isolation is lower among internet users aged 65 or over in the three dimensions explored: loneliness, lack of close friend and meeting socially. Those who use the internet regularly have a lower chance of being isolated, more so for those who use the internet every day, controlling for personal characteristics such as income, marital status, gender and health condition
Prieto and Leahy (2012)	To examines how older people use online social networks and the factors which influence this use.	Online survey Sample: 28 people >61 (17 out of 28 using SNS). No background data. Weak design, small sample, weak descriptive analysis.		Perceived benefits of using SNS and negative impacts	SNS	The main benefit expressed by older users was to improve communication with family and friends (46.7%). No negative impacts reported.
Siriaraya & Siang Ang (2012)	To investigate the characteristics and activity patterns (social networks and gift giving behaviour) of older users within a 3D online multi-user virtual environment (IMVU).	Content analysis Web crawler to collect information from profiles. Sample: pre-senior (55-64), senior (65-75). Total 2551 profiles older users (after filtering and cleaning). M=61.15 (SD=5.02) 59% female. 2445 younger users (18-22) to allow comparison. M= 19.3 (SD=1.04) 64.8% Female		Online gift giving behaviour (based on the number of virtual gifts each user gave and received) and the nature of user's social networks (focusing on the number of buddies and visitors).	IMVU	Despite having a smaller number of social ties than the typical younger user, older users have higher levels of interaction between each of these ties which seem to indicate stronger relationship. Joining groups to connect to users with similar physical world interests or users who live in a similar region. Older people also seem to be able to make good use of the gift-giving mechanism. What is especially surprising is the considerable number of older people using this platform to look for romantic relationships.
Winstead, et al. (2012)	To study whether ICTs can mitigate the effects of social and spatial barriers.	Intervention. Training to use ICT. Qualitative study. Sample: 43 (79.1 % females) Age: M= 83 (SD=1.4) Living in assisted and independent communities		Social interactions and social ties	Email, web searches, SNSs, Youtube & Hulu	ICTs have the ability to maintain and enhance social networks as well as provide a greater sense of connection to the world at large.
Cornejo, et al. (2012) (2013)	To explore how the use of an ubiquitous system, Tlatoque, is able to adapt and move the SNS's social capital outside the desktop in to a domestic setting to support older adults' offline interactions with their family.	Intervention: 21 weeks of using customised Tlatoque Sample: two households (N=30 including extended family members, older people 2 females, over 85, living with their families. Extended family		Offline social interactions (2013)	Tlatoque (Facebook)	Positive effect in offline family interactions Small study technology focused

		members living in Mexico but also abroad) Digital footprints, interviews and focus group				
Cotten, et al. (2013)	To study how Internet use affects perceived social isolation and loneliness of older adults in assisted and independent living communities	Intervention (8 weeks of training) Experimental (N=79) (two control groups – placebo (72) and no treatment (54)) This study only One wave of data (N=205; female= 82.4%) age M=82.8 SD=7.7 Independent (103) and assisted (102) living.	3 items- UCLA Loneliness Scale (Huges et al. 2004)	Social isolation: • not having a close companion, • not having enough friends • not seeing enough of the people you feel close to.	Email and Facebook	An increase in the frequency of going online was associated with a significant decrease in loneliness scores. Using the internet was not associated with perceived social isolation. Going online was associated with an increase in agreement with internet social interaction indicators.
Bell et al (2013)	To study how and why older adults use (or not) Facebook.	Online survey Sample = 142 Age (M=72 SD= 11, range 52-92 of those 59 Facebook users) Female = 66.9%	Revised UCLA Loneliness Scale (Russell et al. 1980)	Social Satisfaction Scale PROMIS (Bode et al, 2010)	Facebook	There was not a significant difference in loneliness between Facebook users and non-users for this sample. Older adult Facebook users scored higher on measures of social satisfaction than non-users. FB is primary used to stay connected with family.
Hutto et al (2015)	To understand the foundations underlying social media technology usage by older adults.	Online survey Sample = 141 respondents living in their own homes. >50 – M= 71.17 years (SD = 10.69; range = 51–91) female 95 , male 46 The mean age of Facebook (FB) users was 66.09 years (SD = 9.03) and that of non-Facebook users was 74.72 years (SD = 10.36). *Same data than Bell et al (2013)	Revised UCLA Loneliness Scale (Russell et al. 1980)	Social role satisfaction. Social roles and activities (PROMIS)	Facebook	No significant difference in loneliness between users and non-users. Older-old users have smaller social networks in FB (significant). Frequency of direct communication on FB and frequency of passive consumption on FB are related with lower loneliness levels (significant).
Heo et al (2015)	To develop an integrative research model in order to determine the nature of the relationships among Internet use, loneliness, social support, life satisfaction, and psychological wellbeing.	Survey data (from 2008 U.S. Health and Retirement Study -HRS) Sample= 5,203 respondents Age = range 65-105 (M=77.87, SD=8.6); 59% female	Loneliness Scale (Huges et al. 2004)	Social support (Schuster et al 1990)	Internet use	Internet use can positively influence the lives of older adults by providing social support. This study demonstrates the importance of social support as a mediator of the relationship among Internet use and loneliness.

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Quality in Ageing and Older Adults