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Abstract

With the rise of online social networking, social relationships are increasingly developed and maintained in a digital domain. Drawing conclusions about the impact of the digital world on loneliness is difficult because there are contradictory findings, and cross-sectional studies dominate the literature, making causation difficult to establish. In this review, we present our theoretical model and propose that there is a bidirectional and dynamic relationship between loneliness and social internet use. When the internet is used as a way-station on the route to enhancing existing relationships and forging new social connections it is a useful tool for reducing loneliness. But when social technologies are used to escape the social world and withdraw from the "social pain" of interaction, feelings of loneliness are increased. We propose that loneliness is also a determinant of how people interact with the digital world. Lonely people express a preference for using the internet for social interaction and are more likely to use the internet in a way that displaces time spent in offline social activities. This suggests that lonely people may need support with their social internet use so that they employ it in a way that enhances existing friendships and/or to forge new ones.

Loneliness is a prevalent psychosocial malady in modern society. Over a quarter of UK adults report sometimes being lonely, and 6% of those report being lonely all or most of the time (Victor & Yang, 2012). In the 2002 Health and Retirement Survey, 19.3% of U.S. adults over 65 years old reported feeling lonely for much of the previous week (Theeke, 2009). Loneliness has been demonstrated to be on the increase in modern society (Victor, Scambler, Bowling, & Bond, 2005; Victor & Yang, 2012) and concerns that using new online technologies are contributing to rising loneliness have been raised in both popular literature (Marche, 2012) and within the internet research field (Kraut et al., 1998; Nie & Hillygus, 2002; Stepanikova et al., 2010). But there are a number of difficulties with drawing conclusions from the existing literature. First, the literature is dominated by cross-sectional research making an examination of the direction of causation difficult. Second, there are contradictory findings in this mostly cross-sectional evidence. In this review, we critically examine the extant literature to evaluate whether social internet use *contributes to* the increase in loneliness in modern society by outlining reasons for the contradictory findings. We also use literature from loneliness research to examine particular characteristics of lonely people in relation to social communication and provide evidence to show that the experience of loneliness also influences the way people use social technologies.

The two dominating perspectives in this area are used as a framework to discuss the evidence: the displacement and the stimulation hypothesis. The *displacement hypothesis* specifies that loneliness is associated with social internet use because people displace offline relationships and activities with online ones (Kraut et al., 1998; Nie, 2001; Nie, Hillygus, & Erbring, 2002). The *stimulation hypothesis*, in contrast, specifies that social technologies can be useful in reducing loneliness by enhancing existing relationships and offering opportunities to form new ones (Gross,

2004; Valkenberg & Peter, 2007a). We propose that these two hypotheses are not mutually exclusive and that social technologies can be used in both ways.

In this review, we introduce a theoretical model that proposes that the relationship between loneliness and social internet use is bidirectional and dynamic. This model proposes that social internet use is associated with high loneliness when used in a way that displaces offline interactions with online activities. But when used to forge new friendships and enhance existing ones, social internet use can lead to reductions in loneliness. However, loneliness is also a determinant of how people interact with social technologies. The aversive state of loneliness is associated with interpretative biases and withdrawal behavior that influence the way that lonely people employ social technologies, indicating that they are more likely to use social technologies in a way that displaces offline friendships and communications.

In order to address the literature in a systematic way, we order the review around the elements of our theoretical model. First, we present the argument that there is a bidirectional relationship between loneliness and social internet use. We examine the literature that looks at the association between loneliness and social internet use that has often been used as evidence to indicate that new social technologies are contributing to rising loneliness in modern society. We highlight the trends in the data, discussing reasons for differences, and outline the need for longitudinal designs to examine causality. In this section we discuss the literature in age groups because age moderates the relationship between loneliness and social internet use. We also examine the differences in results which are dependent on measures because different usage of the internet has different impacts on loneliness. We then move on to present our argument that there is also a dynamic relationship between loneliness and social internet use. We discuss the characteristics of lonely people that impact on the way that they communicate with others and

examine evidence that shows that loneliness determines the way people interact with social technologies. The characteristics of lonely people's behavior, both online and offline, are examined and we highlight similarities and differences. We then outline our theoretical model of the interactions between loneliness and social technologies. We conclude our review by suggesting future directions for research that examines loneliness and social internet use.

Throughout the article we define "social internet use" as using the internet in a way that permits synchronous or asynchronous online social interactions with others and we define "social technologies" as those online resources which allow users to connect with other members of their social network for the express purpose of social interaction. For example, by our definition, email, social networking sites, and video-messengers are considered social technologies, but online gaming sites (where users' socialization is secondary to their game play) are not. We acknowledge that social internet use is not a unitary concept, but encompasses a variety of different mediums and note, throughout the review, that different mediums and internet usage may have rather different psychosocial outcomes for users.

Is Social Internet Use Contributing to the Rising Loneliness in Modern Society?

It has been suggested that social technologies replace the intimacy of human relationships with superficial communication, leaving people lacking intimate and quality interactions with others, thus increasing loneliness (Turkle, 2013). The displacement hypothesis proposes that social technologies contribute to increases in loneliness because time spent online displaces time spent in face-to-face interactions with others (Kraut et al., 1998; Nie, 2001; Nie et al., 2002). Indeed, prominent early work on the relationship between social internet use and loneliness

concluded that time spent online was associated with high loneliness. In a widely cited study, the internet was brought into the homes of Pittsburgh families during the mid-1990s (Kraut et al, 1998). The internet was a novel and new technology at the time: in 1995, only 14% of adults reported using the internet and only approximately 5.25% of the US population reported going online from home (Pew Research Center, 1995). Follow-up analyses after the families possessed internet in their homes for two years revealed that spending more time online was associated with increases in loneliness (Kraut et al., 1998). Since this early research, there have been a number of studies that have demonstrated an association between social internet use and loneliness. Prominent studies examining this association are summarized in Table 1. These studies are often used to suggest that social internet use increases loneliness and may be responsible for contributing to the rise in loneliness in modern society.

A Bidirectional Relationship: Social Internet Use Increases Loneliness by Replacing Offline Relationships but also Reduces Loneliness by Enhancing Existing Relationships

An examination of these studies shows that there is not a simple relationship between social internet use and loneliness. There may be specific uses of social technologies that are positively associated with loneliness, but there is also usage of social technologies that are negatively associated with loneliness. In addition, evidence suggests there are differences in the relationship between loneliness and social internet that may be dependent on age. Childhood and early adolescence studies typically show no associations between social internet use and loneliness. In late adolescence and adulthood, there are contradictory findings (sometimes loneliness is associated with social internet use but not always) and in older people social internet use is often

associated with lower loneliness. Age differences in the associations between loneliness and social internet use are contrasted in Figure 1. Studies are limited that contrast social internet use across different age groups, but cross-sectional evidence indicates there are age-dependent differences in the way social internet is used; therefore, we have examined the literature separately by age groups in order to explore reasons for these differences. Future research should examine more closely the reasons and/or mechanisms that may be the cause of these differences in use of social internet at different ages.

Childhood and Early Adolescence

There are few studies with children and early adolescents, but these studies do not typically show associations between social internet use and loneliness. Research shows children typically use social technologies to communicate with existing friends online rather than to forge new friendships (Gross, 2004). Although generally an association between loneliness and social internet use is not found in this age group, a few studies have shown that when children/early adolescents report their online interactions or friendships as their only mechanism for social support this is associated with loneliness (Gross, Juvonen, & Gable, 2002; Subrahmaryam & Lin, 2007). The evidence indicates that children do not generally use social technologies in a way that displaces their offline friendships or interactions, but use it in a way to communicate with their existing friends. However, if they do use social technologies in a way that replaces their offline social interactions, this usage is associated with high loneliness in this age group.

Late Adolescence and Adulthood

In studies with late adolescent and young adult/adult populations (typically studies are with undergraduate students) positive associations between loneliness and social internet use are commonly, although not exclusively, found (see Table 1). In contrast to childhood and early adolescence, when social internet use is predominately with existing friends, research shows that in late adolescence and adulthood there is a move to communicate online with both friends and strangers (Thayer & Ray, 2006).

One of the factors that influences whether social internet use is associated positively or negatively with loneliness in this age group is the measurement that is used (see Figure 1). Some studies focus on specific aspects of social internet, such as using social networking sites, and others use more generalized measures of time spent online. When time spent online and total internet use are measured this is associated positively with loneliness (Lemieux, Lajoie, & Trainor, 2013; Matsuba, 2006; Skues, Williams, & Wise, 2012), but when time spent online chatting or number of Facebook friends are used this is negatively associated with loneliness (Carden & Rettew, 2006; Lemieux et al., 2013; Skues et al., 2012). This indicates that whether a positive or negative association is found between loneliness and social internet use is dependent on the specific use of social technologies.

An interesting finding relating to a specific social internet use is the results found when different measures are used to examine the impact of Facebook use on loneliness. When frequency of Facebook use or time spent on Facebook is measured it is associated with higher loneliness (Lou et al., 2012), but when number of Facebook friends is measured, this is typically associated with lower loneliness (Lemieux et al., 2013; Lou et al., 2012; Skues et al., 2012). A possible reason for this difference in the results is that there are large overlaps in people's offline and online

friendship groups (Wang & Wellman, 2010), so having large numbers of friends on Facebook is associated with having large social networks offline. Where there are great overlaps with offline and online friendships, going online may not be an isolating experience for people, but used as a way of keeping in contact with friends when they are not present. Adolescents use instant messaging primarily to interact with their offline friends (Valkenberg and Peter, 2007a; Reich, Subrahmanyam, & Espinoza, 2012; Subrahmanyam, Reich, Waechter & Espinoza, 2008) and undergraduates use social networking sites primarily to keep in touch with or learn more about people with whom they have existing offline social relationships (Kross et al., 2013; Lampe, Ellison, & Steinfield, 2006).

Another reason for the difference in the results is that typically cross-sectional designs have been used and changes in loneliness over time are not measured. Posting status updates on Facebook leads to reductions in feelings of loneliness over the course of a week regardless of whether status updates receive a response (Deters & Mehl, 2013) and public social exchanges (but not private ones) on Facebook predict later reductions in loneliness (Burke, 2011). It may be that the very act of sharing is a way to feel as though one is connecting with others. But posting status updates on Facebook may also increase future social interactions: when our friends know more about what is going on in our lives, they may be more likely to use that information to reconnect. Despite reductions in loneliness with posting statuses, recent evidence indicates that these may only provide a temporary uplift from social difficulties for people. For example, although posting status updates on social networks, may reduce feelings of loneliness throughout a week (Deters & Mehl, 2013), they also decrease feelings of closeness to individual members of one's social network over a three-month period (Burke & Kraut, 2014).

It may not just be the specific type of social technology used that impacts on loneliness; the motivation for social internet use may also be important. Different motivations for using the internet are associated with different online behaviors (such as using different features of a social networking site; Matook, Cummings, & Bala, 2015; Smock, Ellison, Lampe, & Wohn, 2011) and with different loneliness outcomes. Motivations to use Facebook to make new friends reduces loneliness over time, in contrast, motivations to compensate for poor social skills leads to increases in loneliness (Teppers et al. 2012). These findings indicate that what is important for determining whether social internet use will increase or decrease feelings of loneliness is *how* a person uses the internet. However, research in this area has typically examined frequency and type of usage of social technologies, rather than motivations for social internet use, so it will be important that future studies examine motivations alongside usage in order to obtain a fuller understanding of the relationship between loneliness and social internet use.

Older Adults

In older adults there are fewer studies, but evidence, albeit limited, indicates that social technologies may be particularly helpful in reducing loneliness in elderly populations (see Figure 2). Studies show similar inconsistencies across measurements used, but in contrast to younger cohorts, time spent online is sometimes associated with lower loneliness in elderly populations (Cotton, Anderson, & McCullough, 2013; Erickson & Johnson, 2011). In particular, when social technologies are used specifically for communication with others, it is associated with lower loneliness in elderly populations (Erikson & Johnson, 2011; Sum, Mathews, Hughes, & Campbell, 2008), whereas this usage of social technologies in younger populations is associated with higher

loneliness (Matsuba, 2006). However, similarly to younger cohorts, when social technologies are used for information or entertainment this usage is associated with higher loneliness in older cohorts (Erikson & Johnson, 2011).

The introduction of social technologies has been found to be an effective intervention in reducing loneliness in elderly populations (for a review see Choi, Kong, & Jung, 2012) and among the elderly, brief interventions such as videoconferencing with friends and family (Tsai & Tsai, 2011) or simply learning to use social technologies (Cotton et al., 2013; Fokkema & Knipscheer, 2007; Shapira, Barak, & Gal, 2007) have been successful in reducing feelings of loneliness. It could be argued that the reductions in loneliness associated with the intervention could be the result of face-to-face interactions with trainers, rather than the intervention per se, but studies show that the reduced loneliness persists up to 36 months after the introduction of the social technologies when interactions with the trainer are no longer present (Fokkema & Knipscheer, 2007; Slegers, van Boxtel, & Jolles, 2008). This difference between time spent using social internet in elderly and young populations might be because loneliness is more closely linked to social isolation in older cohorts (Luhmman & Hawkley, 2016; Qualter et al., 2015) and social technologies may reduce loneliness by targeting objective social isolation in this population.

There are some studies that have shown that social internet use is associated with lower loneliness when it is linked to social isolation in younger cohorts. Access to online support groups and forums and to resources regarding issues that might arise from dealing with a chronic illness is associated with higher feelings of social support and lower feelings of loneliness in those who are experiencing a chronic illness (Weinert, Cudney, & Hill, 2008). The extent to which these successful interventions would generalize to other populations known to experience loneliness,

but who are not objectively socially isolated (e.g. students transitioning to college), is a question worth empirical examination.

Loneliness and Internet Addiction

Additional evidence that has been put forward to support the displacement hypothesis is the association between problematic internet use (e.g. addiction or compulsive internet use) and loneliness (Caplan, 2007; Casale & Fioravanti, 2011; Ceyhan & Ceyhan, 2008; Hardie & Tee, 2007; Kim, LaRose, & Peng, 2009; Matsuba, 2006). This evidence, summarized in Table 2, shows a consistent positive association between loneliness and problematic internet use and/or internet addiction irrespective of age. Internet addicts are preoccupied by thoughts of the internet and exhibit excessive use of social technology (often for longer than planned). They use the internet as a way to escape from the problems of everyday life, and exhibit signs of withdrawal such as depression and irritation when they try to reduce or discontinue their use. Clinicians report that internet addiction can result in lost opportunities for jobs, education, and career, and in damaged relationships (Beard & Wolf, 2001; Block, 2008; Shapira et al., 2003). It seems apparent, then, that people who experience problematic internet use or internet addiction displace their offline communications and relationships with online ones. Using the internet in this manner is positively associated with loneliness, yet because the evidence is almost entirely cross-sectional, the direction of the relationship remains to be established. Although longitudinal evidence is limited, one such study indicates that internet addiction predicts increases in loneliness over time (Yao & Zhong, 2014).

We have examined the literature so far and have shown that age moderates the relationship between loneliness and social internet use and although evidence at first glance supports the displacement hypothesis, a thorough examination of the literature shows that there is a bidirectional relationship between loneliness and social internet use, particularly in late adolescents and adults. Despite a lack of longitudinal work in this area, one way to assess the potential direction of the relation is to model the overlapping variance between the two. One study which has modeled the variance using structural equation modeling, showed that lonely people use the internet more than their less lonely peers, rather than internet use contributing to changes in loneliness (Amichai-Hamburger & Ben-Artzi, 2003). However, further work is necessary to draw conclusions and a further examination of these relationships in different ages is necessary because age is an important moderator of the relationship between loneliness and social internet use.

One of the fundamental tenets of the displacement hypothesis is that online interactions displace offline social interactions; however, the evidence discussed here indicates that this is not always the case; there is often a vast overlapping between the online and offline social worlds (Amichai-Hamburger & Hayat, 2011; Jacobson & Forste, 2011; Katz, Rice, & Aspden, 2001; Peter, Valkenburg, & Schouten, 2005; Valkenburg & Peter, 2007a;). Contrary to the displacement hypothesis, this evidence suggests that new technologies can offer an opportunity to enrich one's face-to-face social world. Social technologies, then, can be used in a way that stimulate existing relationships, not just in a way that displaces offline relationships. Indeed when the two hypotheses have been directly compared, in a large scale sample, adolescents were shown to use the internet in a way that stimulated their existing friendships (using instant messaging to communicate with offline friends) and that the quality of their friendships explained the positive impact of their social internet use on their well-being (Valkenberg & Peter, 2007b). However,

there is evidence that this is not a consistent finding across different cohorts and ages. This relationship was not found in a study which sampled a larger age range (18-63 years): those who had larger social networks online did not have similarly large social networks offline suggesting that offline and online friendships do not always overlap (Pollet, Roberts, & Dunbar, 2011).

But is there further evidence to support that social technologies can be used in a way that stimulates social interaction and enhances relationships? The stimulation hypothesis makes two propositions: 1) existing relationships will be enhanced by social technologies, and 2) social technologies offer new opportunities to form friendships. First, the use of social networking sites has been shown to strengthen ties with others and increase social connections (Burke & Kraut, 2014; Sheldon et al., 2011). More frequent social internet use is associated with higher quality face-to-face relationships (Valkenburg & Peter, 2009). However, this effect of enhancing existing relationships is limited. Evidence suggests that offline interactions explain some of the variance between social internet use and high relationship quality, indicating that experiences in the face-to-face domain impact on the quality of the online experience (Valkenburg & Peter, 2009). Face-to-face interactions facilitate greater feelings of social belonging than online interactions (Sacco & Ismail, 2014) and longitudinal work suggests that social support provided online contributes less to psychological well-being than social support provided in a face-to-face context (Trepte, Dienlin, & Reinecke, 2014). Thus, online social interactions enhance relationship quality, but only when used in combination with offline social interactions. This appears to contradict with evidence in elderly populations discussed earlier where loneliness is reduced by maintaining existing relationships via online communications only (i.e. through the introduction of social technologies). One reason for this may be that the causes of loneliness are different in older populations (Qualter et al., 2015). But it is difficult to address this because there are no

measurements of whether online and offline interactions overlap in computer intervention studies with elderly populations. It could be entirely possible that the same is true for elderly populations and that face-to-face interactions should be combined with online communication to facilitate reductions in loneliness.

Second, there is evidence to indicate that social technologies offer people a mechanism to forge new friendships and romantic relationships. Marriages between individuals whomet online and moved their relationship to a face-to-face domain are more satisfying than marriages between couples who began offline (Cacioppo, Cacioppo, Gonzaga, Ogburn, & VanderWeele, 2013), and friendships that begin online and move to a face-to-face domain are comparable in quality to friendships that began offline (Antheunis, Valkenberg, & Peter, 2012). We argue that the beneficial effects of forming relationships online are contingent upon eventually bringing these online relationships to a face-to-face domain (i.e. making these friendships "migratory relationships"; relationships that start online but then move to an offline domain, Stafford, 2005). Online relationships that fail to transition to offline settings are lower in quality and closeness than those relationships that successfully transition offline (Antheunis et al., 2012; Coget et al., 2002; Cummings, Butler, & Kraut, 2002; Mesch & Talmud, 2007, 2006; Parks & Roberts, 1998). Thus, the evidence indicates that people can use social technologies in a way that stimulates existing and new friendships, but what is important is that the online world is an extension of the offline world, rather than replacing it.

Loneliness as a Potential Determinant of Social Internet Use

We have highlighted that loneliness has a bidirectional relationship with social internet use. So far we have proposed that when social technologies are used in a way to stimulate social connections, this use is associated with lower loneliness, but when used in a way to escape the offline social world, it displaces more satisfying and stimulating social connections offline and is then in turn, associated with higher loneliness. In this section we propose that there is also a dynamic relationship: loneliness is a determinant of how people interact with and use social technologies. The characteristics of lonely people influence their social preferences and whether they are likely to employ social technologies in a way that promotes reductions in loneliness.

When experiencing loneliness, people show a distinct psychological and behavioral profile that influences the way that they interpret and interact with their social world (Cacioppo & Hawkley, 2009; Cacioppo & Patrick, 2008; Qualter et al., 2015). Cross sectional studies examining offline social behavior and cognition show that lonely people are hyperviligant to social threat (Bangee, Harris, Bridges, Rotenberg, & Qualter, 2014;Cacioppo, Balogh, & Cacioppo, 2015; Cacioppo, Bangee, Balogh, Cardenas-Iniguez, Qualter, & Cacioppo, 2015; Vanhalst, Gibb, & Prinstein, 2015), withdraw from social contexts (Watson & Nesdale, 2012) and, when in social situations, behave in a passive way by giving their partner less attention than non-lonely people (Jones, Hobbs, & Hockenbury, 1982). In addition, lonely people find social stimuli less rewarding (Cacioppo, Norris, Decety, Monteleone, & Nusbaum, 2008) and are less likely to experience 'uplifts' from social encounters (Cacioppo & Hawkley, 2005).

An important open question is whether lonely people also behave in a negative and withdrawn way in their interactions online, as they do offline. But first, there are some important reasons why the ways in which lonely people, in particular, interact with social technologies should be examined. There is evidence that people experiencing high loneliness, in particular, are making

use of these new and growing social technologies. Loneliness is associated with a preference for communicating online relative to face-to-face communication (Caplan, 2003; Kim et al., 2009; Morahan-Martin and Schumacher, 2003) and those high in loneliness find the anonymity of the internet (Morahan-Martin & Schumacher, 2003) and the opportunities to experiment with their identity gratifying (Leung, 2011). They also feel more in control of their online interactions and feel that they have a broader range of topics that they can discuss online than offline (Valkenberg & Peter, 2007a). Lonelier people also feel that they can be more themselves in online social interactions than they can be offline (Lee, Noh, and Koo, 2013; McKenna, Green, & Gleason, 2002; Morahan-Martin & Schumacher, 2003).

Further, there is evidence to indicate that lonely people may be particularly vulnerable to cyberbullying and that cyberbullying leads to increases in loneliness. Cyberbullying has been defined as as "an aggressive, intentional act carried out by a group or individual, using electronic forms of contact, repeatedly and over time against a victim who cannot easily defend him or herself" (Smith et al., 2008, p376). Cyberbullying is a serious circumstance that often leads to depression and suicide ideation among its victims (e.g. Hinduja & Patchin 2010; Wang, Nansel, & Iannotti, 2011). Although this is a relatively new area of research, there have been a number of longitudinal studies. Evidence shows that loneliness has been associated with cyberbullying in two ways: 1) victimization via cyberbullying is associated with increases in loneliness (Olenik-Shemesh, 2012; Schultze-Krumbholz, Jäkel, Schultze', & Scheithauer, 2012) and 2) loneliness is a risk factor for becoming a victim of cyberbullying (Brighi, Guarini, Melotti, Galli, & Genta, 2012; Wachs, 2012). Hence, lonely people are at increased risk of experiencing cyberbullying, but also the experience of being cyberbullied can lead to increases in loneliness over time. There is also some evidence that loneliness is not only linked to cybervictimization but also to the

perpetuation of victimization of others (Eden, Heinman, & Olenik-Shemesh, 2014). This is consistent with research in offline environments that shows that, although generally lonely children behave in a passive and withdrawn way, some lonely children behave in a hostile and aggressive way towards others (Crick & Grotpeter, 1995; Qualter et al., 2013; Qualter & Munn, 2005).

To return to the question of whether lonely people behave differently than non-lonely people online; given the bidirectional relationship that we have highlighted, an important consideration is whether lonely people utilize social technologies in a way that displaces offline interactions or in a way that stimulates existing relationships or promotes opportunities to forge new ones. The examination of lurking behaviors (using social technologies in a passive way by observing others but not interacting with them) offers a mechanism to address whether lonely people behave in a passive and withdrawn way online. Using social technologies in this way will not provide opportunities to stimulate existing relationships or form new friendships because there is limited or no social interaction with others. High levels of loneliness are indeed associated with engaging in passive lurking behaviors way online (Burke, Marlow, & Lento, 2010; Guo et al., 2014; Jin, 2013).

Also, there is evidence to suggest that those higher in loneliness displace offline friendships with online ones because they report that they have more friends online and that their online friends understand them better than their offline ones. They also report that going online makes it easier to make friends (Morahan-Martin & Schumacher, 2003) and loneliness is also associated with fewer offline interactions with friends made online, indicating less overlapping online and offline social networks (Jin, 2013; Van den Heuvel, Van den Eijnden, van Rooj, & van de Mheen, 2012). Furthermore, maintaining virtual friendships (that is, friendships with people that one has not met face-to-face) is associated with higher levels of loneliness than maintaining multi-modal

relationships (i.e., relationships that started online and transitioned to an offline environment or relationships that started offline but also include online interactions, Sharabi & Margalit, 2011; Van den Heuvel et al., 2012). Thus, those higher in loneliness are likely to form new friendships online (Morahan-Martin & Schumacher, 2003), but evidence demonstrates that they will tend to continue to conduct interactions with these new friends online only, which will have an important impact on the quality and satisfaction of these relationships (Jin, 2013; Morahan-Martin & Schumacher, 2003; Van den Heuvel et al., 2012).

Thus, current evidence indicates that lonelier people engage with social technology in a different way than less lonely people do. Similar to their behavior in the offline world, lonelier people tend to be more passive in their interactions online. Importantly lonelier people find it easier to express themselves online and have a preference for communicating online using social technologies and thus, are more likely to replace offline interactions with online ones than less lonely people. As the evidence indicates that people who are lonelier are more likely to use social internet in a way that displaces offline communications their loneliness levels are not likely to reduce when using social technologies.

Theoretical Model: A Bidirectional and Dynamic Relationship between Social Internet Use and Loneliness

Throughout this review we have proposed that there is a bidirectional and dynamic relationship between loneliness and social internet use. When social technologies are used in a way that displaces offline interactions with online interactions and/or activities it is associated with increases in loneliness. In contrast, when social technologies are used to forge new friendships

and enhance existing ones, social internet use can lead to reductions in loneliness, but only when there is an overlapping of the offline and online social worlds. The relationship between loneliness and social internet use is also a dynamic one because loneliness has also been shown to be a determinant of how people interact with social technologies. Loneliness is associated with a preference to use social technologies in a way that displaces offline friendships and communications. Taken together, these findings suggest that support is needed to encourage people who have experienced loneliness for a while to use the internet in a way that stimulates their existing relationships or enables formation of new relationships. Where that is made possible, social internet could be a useful vehicle for promoting reductions in feelings of loneliness.

Future Directions

Throughout this article we have proposed that the extant loneliness and social internet research is lacking longitudinal work to examine whether lonely people use the internet more or whether social internet use contributes to loneliness. Longitudinal studies that tackle this will be an important contribution to the field in the future.

Social Internet Use Measurements

Attending to details that reveal people's motivations and specific online behaviors will enrich the literature on loneliness and social internet use because these factors influence whether social internet use is associated positively or negatively with loneliness. The importance of examining outcomes of different social technology mediums and motivations for social internet

use can be demonstrated by using the example of research examining loneliness and Facebook use. Research in this area evolved through a series of stages in which a fuller understanding of the relationships between loneliness and Facebook use developed as more specific uses and motivations were examined. In early research, crude measures of Facebook use (e.g., time spent on Facebook) were used and small positive associations were found. Spending more time on Facebook was shown to be associated with greater loneliness, but this was only a small effect (e.g. Song et al., 2014). Researchers then distinguished between different types of Facebook use and between an active and passive use (i.e. lurking) of Facebook and found that specific uses of Facebook were associated with greater loneliness (Frison & Eggermont, 2015). Finally researchers distinguished between different motivations for using social internet and orientations towards relationships behind the more active uses of Facebook and found that specific motivations and relationship orientations impacted on either reductions or increases in loneliness (Matook et al., 2015; Teppers et al., 2014). This demonstrates that to fully understand the link between social internet use and loneliness, we must examine specific uses and motivations because the relationship is not a simple one: the way in which people interact with social technologies and the reasons for doing so impact on the likelihood of reductions or increases in loneliness.

Future research should also be mindful of the role that the historical framework and the changing technological landscape play in our experience of loneliness and our social internet behaviors (c.f., Ellison and Boyd, 2013). The introduction of new technologies, while an exciting opportunity for new research, puts old research at the risk of becoming obsolete if the adoption of new technologies diminishes online behaviors that were previously a topic of study. Similarly, researchers should also note to which online communication mediums their results generalize. The communication medium of interest (e.g. social networking sites, video-messengers, instant

messengers, etc.), the platform (e.g. Facebook, Myspace, Twitter), and the individual's specific online behaviors (e.g. the target of one's interaction, the features that one utilizes, one's motivations for doing so) all influence the predictions that can be made regarding social internet use and loneliness.

Another important direction for research is to examine the full landscape of social interaction because research to date has generally examined online behavior separately from offline behavior. An examination of the online social landscape is incomplete without an adequate mapping of the offline landscape in which it is situated. With the widespread use of cell phones and mobile tablets, online communication often occurs alongside face-to-face communication as part of today's social world. Experience sampling methodology, as one example, may provide an opportunity for future research to assess the effect of concurrent face-to-face and online interactions, and to measure other ways that one's offline social context may moderate the effect of social internet use on psychosocial well-being.

Research has also not fully examined the affective nature of the online world. Measures that distinguish between online behaviors on the basis of the valence of the interaction (positive or negative) and the target of the interaction (someone with whom one has an offline relationship or not), for example, will provide a much richer tapestry from which to ascertain the relationship between social internet use and loneliness. Likewise, measures that can assess the online social community's response to peoples' online behaviors (e.g. the number of "likes" or responses a Facebook post or Tweet receives; c.f. Deters & Mehl, 2013; Kivran-Swain et al., 2014) will allow researchers to assess the extent to which the online behavior of other members of the online social network influences a person's loneliness.

Chronic vs Transitory Loneliness

The current literature examining loneliness and social internet use has not defined differences between chronic loneliness and context-dependent or transitory loneliness. This is an important contrast because there may be differences in the way in which those experiencing transitory loneliness interact with social technologies in comparison to those who are experiencing chronic loneliness. Although the state of loneliness is adaptive and encourages a person to seek out reconnection, when experienced chronically it is associated with a negative interpretation of social interactions (Qualter et al., 2015, Vanhalst et al., 2015) resulting in a negative cycle that maintains the loneliness condition (Cacioppo & Patrick, 2008; Cacioppo & Hawkley, 2009). The distinction between chronic and transient loneliness has not been made in the social internet research field because loneliness is typically used as a measurement of a negative outcome of social internet use in that literature and longitudinal designs have not generally been used. The distinction between the chronic and transitory loneliness is important because chronic loneliness (but not transient loneliness) has been associated with low self-worth, low trust, and an external locus of control, which leads to negative interpretations of social interactions, thus hindering reconnection and serving to maintain loneliness (Qualter et al., 2015). If people who are experiencing chronic loneliness use the internet in a different way and interpret other people's communication differently to those who have been lonely for a short period of time, then capturing loneliness and social internet use at a single time-point (as is the case for cross-sectional studies) will not help to disentangle differences in social internet use between those who are chronically and transiently lonely.

Personality and Social Internet Use

An important factor that may be involved in the relationship between loneliness and social internet use is personality. Although there are limited studies on this relationship, personality is shown to impact the way people use and interact with social technologies (Hamburger & Ben-Artzi, 2000; Orchard & Fullwood, 2009). High Facebook users are more extroverted, narcissistic and less conscientious (Ryan & Xenos, 2011). Extraversion is negatively associated with internet usage (Launders & Lounsbury, 2006) and extraverts tend to reject the communal aspects of the internet and make more use of information seeking aspects of social technologies (Amiel & Sargent, 2004). Extraversion is positively associated with using social technologies for leisure in men but negatively associated with this type of use in women (Hamburger & Ben Artzi, 2000). Neuroticism, in contrast, is linked to use of social technologies to feel a sense of belonging, to keep informed and is predictive of using social technologies to make new friends (Amiel & Sargent, 2004; Russell et al., 2003).

Given that loneliness has been linked to higher neuroticism and reduced extraversion (Cheng & Furnham, 2002; Russell, Peplau & Cutrona, 1980; Vanhalst et al., 2012) and studies have linked personality to specific uses and motivations for using social technologies, personality may explain some of the inconsistencies in the findings in the associations between loneliness and social internet use. However, to date there are only a few studies that have examined the interplay between personality, loneliness, and social internet use. When this has been examined in a small scale study, the best explanation of the relationship was that neuroticism predicts levels of loneliness, which in turn, led to using the internet more for social services (i.e. discussion, chat rooms). But this effect was only evident in women; in men there was no association between these

factors (Amichai-Hamburger & Ben-Artzi, 2003). Thus, the findings of that study indicate that neurotic women are lonelier and tend to use social technologies more. In another study, a positive association between loneliness and making friends online was found, but a structural equation modelling analysis revealed that neuroticism and shyness explained the link between loneliness and making friends online (Russell et al., 2003). Taken together these studies indicate that personality may be an important influence on the relationship between loneliness and social internet use or may explain the relationship, particularly when measuring formation of relationships online. Importantly the theoretical model that we suggest in this review does not outline mechanisms or other variables that may link social internet use to loneliness. Future research will need examine personality alongside loneliness and social internet use because personality may explain the relationship between loneliness and social internet use and/or specific social internet use.

Conclusion

With the near ubiquitous presence of online technologies in our everyday lives, it is now a most pressing time to consider the relationship between social internet use and loneliness. We have presented an argument that the relationship between loneliness and social internet use is dynamic and bidirectional. The current research on this work suggests that the behaviors in which a person engages while utilizing social technologies determines the extent to which he or she will benefit from social internet use, or whether the pangs of loneliness will persist. But the internet is not the destination. In today's multi-modal social world, when used as a way-station, social internet use is a stop along the way to the ultimate destination of social reconnection. Although it

may offer a brave new world for lonely people who express a preference for this medium, research indicates that those who are experiencing loneliness are unlikely to use the internet in this way. Despite lonely people expressing that they can be more themselves and are friendlier online, there is evidence that the withdrawal and passivity of social behaviors that are evident offline in lonely people are also evident in online interactions and lonely people are more likely to displace offline relationships and social activities with online ones. Therefore, lonely people will need support to utilize the digital world in a way that promotes reductions in loneliness.

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Table 1: Journal articles that have examined the association between internet use and loneliness

Authors	Year	Age Range Mage/SD (where reported)	Sample Size	Country	Measure of internet use	Loneliness measure	Association (where reported)
Studies with Children/Adolescents							
Subrahmanyam & Lin	2007	15-18.4	156	US	Time spent online/email (high, medium, low groups)	RULS	Differences between groups not significant (results not reported)
Erdoğan	2008	15-17	1049	Turkey	Internet attitudes scale (Tavsancıl & Keser, 2002)	UCLA	0.11** (use), 0.05 (attitudes)
Gross	2004	11-13	130	US	Time spent online	UCLA	No association found (results not reported)
Gross et al.	2002	11-16	262	US	Time spent online (daily time, time spent in specific activities and lifetime exposure)	UCLA	No association found (results not reported)
Undergraduate studies							
Guo et al.	2014	18-39	142	China	Time spent SNS	UCLA-3	0.14
Lemieux et al.	2013	Not specified	313	US	Time spent on Facebook No. of Facebook friends	SELS	0.41*** (time spent) -0.13* (no. of friends)
Kross et al.	2013	Mage = 19.52, SD = 2.17	82	US	Time on the internet (time-event sampling)	Single item measure	0.22*
Skues et al.	2012	Mage = 20.59, SD = 5.17	392	Australia	Time spent on Facebook, No. of Facebook friends, No of logins	UCLA	0.10* (time spent) 0.07 (log-ins) -0.17***(No. of Friends)
Sheldon	2012	19 to 76	327	US	Facebook user vs non-Facebook user	UCLA	Facebook users lonelier than non-users ($F(1,3250) = 10.14$, $p <.005$, $\eta p^2 =.03$)
Lou et al.	2012	18-19 (90%)	340	US	Facebook Intensity, Motives for using facebook	UCLA	-0.15* (intensity) -0.09 (motives)
Ryan & Xenos	2011	18-35	1324	Australia	Facebook users vs non Facebook users	SELS	Facebook users lonelier than non-users $F(1,1322) = -19.40$, $p < .001$, $\eta p^2 =.01$
Ong et al.	2011	20- 46	651	Taiwan	Intent to chat-online Time spent online chat	SELSA-S	SL = 0.01 (intent), 0.00 (time spent)
Matsuba	2006	Mage = 20.5, SD = 4.1	203	Canada	Time spent online, Internet motivation scale (Wolfrat & Doll, 1999)	UCLA	0.19* (time spent online) 0.16* (communication) 0.01 (entertainment) -0.08 (information)

Table 2: Journal articles that have examined the association between problematic internet use and/or internet addiction and loneliness

Authors	Year	Age range Mage/SD (where reported)	Sample Size	Country	Measure of internet use	Loneliness measure	Association (where reported)
Ozsaker et al.	2015	Mage = 20.92, SD = 2.15	459	Turkey	PIUS	UCLA	0.31***
Özdemir et al.	2014	18-35	648	Turkey	IAT	UCLA	0.32**
Bozoglan et al.	2013	18 - 24	384	Turkey	Internet Addiction Scale (Chen et al., 2003)	UCLA	0.61**
Aktepe et al.	2013	Not specified	1,645	Turkey	Internet Addiction Scale (Nichols & Nikki, 2004)	UCLA	Logistic regression = loneliness higher in addicts (β = -0.03, odds ratio = 0.97***)
Casale & Fioravanti	2011	18 - 29	157	Italy	GPIU	ILS	SL = 0.27* EL = 0.21*
van der Aa et al.	2009	11–21	7888	The Netherlands	Compulsive Internet Use (CIU, Meerkerk et al., 2007)	UCLA	0.34***
Ghassemzadeh et al.	2008	14–16	1968	Iran	IAT (addicts, possible addicts, moderate users and non-users)	UCLA	Addicts had higher loneliness than moderate users and non-users (F = 5.642**) results not reported
Ozcan & Buzlu	2007	Mage = 20.84, SD = 1.95	730	Turkey	DOCS	UCLA	0.34***
Caplan	2002	18 – 57	386	US	GPIU (subscales: mood alteration, social benefits, compulsivity, excessive time, withdrawal, social control, negative outcomes)	UCLA	0.24**, 0.36**, 0.15**, 0.11*, 0.13**, 0.17**, 0.24**
Engelberg & Sjöberg	2004	18-28	41	Sweden	IAT	UCLA	0.33*
Nalwa & Anand	2003	16–18	100	India	DOCS	UCLA	Dependents had higher loneliness than non-dependents (t = 2.99**)
Ceyhan & Ceyhan	2008	Not specified	559	Turkey	PIUS	UCLA	Regression analysis with loneliness as criterion (β =0.47, t = 12.16***)
Matsuba	2006	Mage = 20.5 SD = 4.1	203	Canada	Pathological Internet use (Morahan-Martin, & Schumacher, 2000)	UCLA	0.21***

Note: 1. UCLA = Russell (1996), ILS = Italian Loneliness Scale (Zammuner, 2008), DOCS = Davis Online Cognition Scale (Davies, Flett, & Besser, 2002), IAT = Internet Addiction Test (Young, 1998), GPIU = Generalized Pathological Internet use (Caplan, 2002), PIUS = Problematic Internet Use (PIUS, Ceyhan, Ceyhan, & Gürcan, 2007)

2. *** significant at p <.001 level, ** significant at p < .01, * significant at p < .05 level

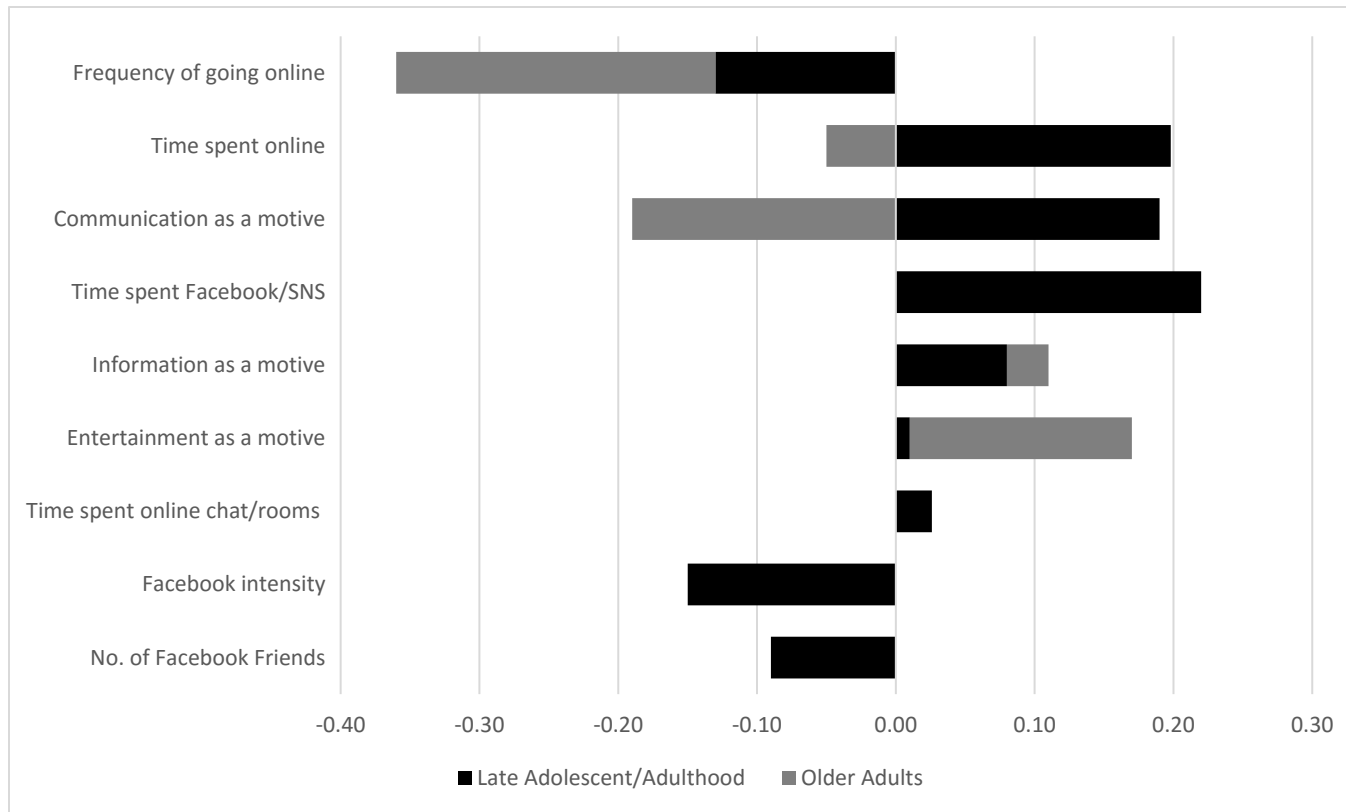3. SL = social loneliness, EL = emotional loneliness

Figure 1. Graphic representation of the effect sizes for the association between social internet use and loneliness in studies involving late adolescent/adults and older adults

Footnote: Typically the studies in the Late Adolescent/Adulthood category are with undergraduate populations. Studies in the Older Adults category are those that have specifically recruited older people (i.e. all studies had people over the age of 55 years only). The r statistic was used as the effect size for all studies, where more than one study was available mean weighted effect size was calculated using simple mean effect size method (Hunter & Schmidt, 1990 cited in Ellis, 2010).