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Can robots tackle late-life loneliness? Scanning of future opportunities and challenges in assisted living facilities

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ABSTRACT

This future-oriented study examines the opportunities and challenges offered by social robots and communication technology when aiming to decrease emotional and social loneliness in older people residing in assisted living (AL). The paper draws on prior literature on loneliness, elder care and social robots. The aim is to scan the futures regarding technology support for the frail older people in future AL. The analytical frame was built on Robert Weiss' division of relational functions: attachment, social integration, opportunity for nurturance, reassurance of worth, sense of reliable alliance, and guidance in stressful situations, and on a distinction between direct and indirect social robots. Our examinations show that social robots could tackle both emotional and social loneliness in assisted living by empowering people to engage in different forms of social interaction inside and outside the facility. However, ethical concerns of objectification, lack of human contact, and deception need to be thoroughly considered when implementing social robots in care for frail older people.

1. Introduction

Resulting from the growing number of very old people in Western societies, loneliness in old age has become a popular topic in gerontological research (De Jong Gierveld, Van Tilburg, & Dykstra, 2018; Victor, Scambler, & Bond, 2009). Although the majority of research has focused on community-dwelling older people, something is already known about the loneliness of older people residing in assisted living [AL]. We use the concept of AL to comprehend those forms of residential care for older people in which residents have their own apartments or rooms and where services from nursing staff are available around the clock. Previous research on loneliness in AL has largely concentrated on the prevalence and the explanatory factors of the phenomenon (Drageset, 2004; Drageset, Kirkevold, & Espehaug, 2011; Prieto-Flores, Forjaz, Fernandez-Mayoralas, Rojo-Perez, & Martinez-Martin, 2011). Some studies have found loneliness to be more common among AL residents than among community–dwellers (Pinquart & Sorensen, 2001; Routasalo, Savikko, Tilvis, Strandberg, & Pitkälä, 2005).

Several researchers have identified the transfer from the private home to an AL facility as a risk factor regarding loneliness *per se*

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(Johnson, 1996; Prieto-Flores et al., 2011; Street, Burge, Quadagno, & Barrett, 2007). Jaber Gubrium (1997) described the transfer from the private home to the care facility as a process of "breaking up a home," in which the people being transferred make constant comparisons between their past and current life. They are still attached to people, places, belongings, and memorable events from the past, although they understand that life cannot continue the same way as earlier, and this may easily result in feelings of loneliness and social isolation. According to Bethel Ann Powers (1995, p. 180), residents perceive the care facility as "the end of the line," where they become separated from the familiarities of the home and life outside the walls of the AL facility. Port et al. (2001) reported how contacts with friends, relatives, and neighbors halved after transfer to a care facility, and according to Lindgren and Murphy (2002), relationships become less intimate at the same time.

In a Finnish interview study, Jansson, Karisto, and Pitkälä (2019) found loneliness in AL as a time- and place-dependent experience. Loneliness was connected to certain times of day, days of week and seasons filled with feelings of waiting and meaningless. Place-dependent loneliness was evident in the ways the residents described the facilities: none of them called the apartment home. The older people felt stuck, isolated and invisible in the surrounding settings. (Jansson et al., 2019) Similarly in a Finnish study, Pirhonen, Tiilikainen, and Pietilä (2018) found that residents' experiences of social loneliness manifested as ruptures of affiliation with people both inside and outside the facility. Residents suffered from multiple limitations regarding bonding and integrating with people inside the facility, with issues including the qualities of the peers and nursing staff, the residents' own hampered functional abilities, and the routines set by busy personnel. Friends and relatives outside the facility were sometimes hard to reach for reasons like older friends avoiding visiting care institutions and the poor quality of cellphone networks. In addition to forms of social loneliness, the residents expressed feelings of longing for emotional companionship (Pirhonen et al., 2018). Next, we will set the scenery for this future-oriented research that is based on prior literature on loneliness, elderly care, and social robots.

2. Methodological and conceptual framework

In this paper, we scan the futures; we examine what kind of opportunities there could be to decrease (i) emotional and (ii) social loneliness by utilizing different types of social robots and communication technology in AL. The distinction between emotional and social loneliness was first introduced by Robert Weiss in 1970s, and it is still frequently referred to in loneliness studies (Weiss, 1973). To our knowledge, the distinction has not been used in-depth when examining loneliness in AL or other types of care facilities. We also examine the challenges related to use of social robots and communication technology in AL settings. The aim of this study is thus to conduct a futures scanning (Slaughter, 1994) regarding technology support for the frail older people in future AL.

Our analysis process represents an exploratory use of futures methods to inquire what the possible futures are and whether they are desirable (Glenn, 1994). The methodology draws on elements of an integrative literature review and concept analysis, yet from a future-oriented perspective (Walker & Avant, 2005; Whittemore & Knafl, 2005). We thus (i) collected and summarized prior knowledge on loneliness and social robots in the production of futures knowledge, and (ii) translated and interpreted this knowledge to produce an understanding of its implications for the future from the specific point of view of a particular form of elder care, the AL. Our analysis also presents a novel conceptualization of direct and indirect social robots. This distinction is something that has not been used in previous studies but may be particularly useful when examining the role of technology in human interactions.

As noted by Sardar (2010, p. 184), "futures studies are 'futureless' in a technical, specific sense: since we can have no true knowledge of the future, the impact of all futures explorations can only be meaningfully assessed in the present. We can look back on predictions and forecasts and see how right or far off the mark they were. But we cannot assess how right or wrong they actually are from the future itself. Thus the real relevance of the discourse lies in the present." Our analysis thus potentially has an impact on the present, too; by, for example, changing peoples' perceptions, making them aware of dangers and opportunities ahead, encouraging them to change and adjust (see Sardar, 2010). Like Rogers and Mitzner (2017) did in their study on technology support, we think about the lives of older adults in the future with a focus on envisioning potential ideal situations. Next, we will set the scenery in AL through previous knowledge on loneliness and social robots.

2.1. On loneliness

According to Weiss, feelings of loneliness may result from experiencing a deficit in one or more relational needs, of which Weiss identified six different relational functions: attachment, social integration, opportunity for nurturance, reassurance of worth, sense of reliable alliance, and guidance in stressful situations (Weiss, 1973). In his theory of relational loneliness, Weiss proposed a distinction between two types of loneliness: "loneliness through emotional isolation" and "loneliness through social isolation." Emotional loneliness refers to the absence of a significant other or someone to turn to; it is similar to the distress of a small child who fears that she has been abandoned by her parents. Emotional loneliness may at worst result in a sense of existential loneliness (Ettema, Derksen, & van Leeuwen, 2010) – a feeling, as existentialists would put it, that one is "thrown–in–the–world" all alone. From the list of relational functions above, the opportunity for nurturance, reassurance of worth, sense of reliable alliance, and guidance in stressful situations are related to emotional loneliness. Social loneliness, on the other hand, relates to loneliness caused by a lack of a sense of belonging or a dissatisfaction with one's social network. The relational functions of attachment and social integration deal with social loneliness, which may manifest as feelings such as boredom, exclusion and marginality (Weiss, 1973).

The conceptual distinction between emotional and social loneliness has underpinned the development of a variety of different measurements, and it has remained important for contemporary social surveys of older people (Gierveld & Van Tilburg, 2010; Victor et al., 2009), including residents living in care facilities (e.g., Banks & Banks, 2005; Prieto-Flores et al., 2011). According to Van Baarsen, Snijders, Smit, and van Duijn (2001), the distinction between emotional and social loneliness may be particularly relevant in

the case of older people, because the probability of having or finding an intimate figure of attachment decreases with age. However, several studies have shown that older people experience both types of loneliness (Gierveld & Van Tilburg, 2010). The distinction may be particularly relevant in the context of AL where loneliness is known to be a multifaceted experience connected to not only lack of social companionship but also emotional bonds.

Compared to the progress in understanding the causes and outcomes of loneliness, relatively little has been achieved in identifying effective interventions to address the problem. Reviews of loneliness interventions have concluded that although there is a widespread belief that interventions can counteract different forms of loneliness, there is little research evidence to support it (Cattan, White, Bond, & Learmouth, 2005). Of four different primary intervention strategies – (a) improving social skills, (b) enhancing social support, (c) increasing opportunities for social contact, and (d) addressing maladaptive social cognition – Masi, Chen, Hawkley, and Cacioppo (2010)), found the latter to be most successful when alleviating severe loneliness. Based on a systematic review, Dickens, Richards, Greaves, and Campbell (2011) identified a few very general characteristics of effective interventions targeting older people's social isolation: having a theoretical basis, using a group format in social activity and/or support, and involving older people as active participants.

The theoretical basis offered by Weiss, i.e. understanding and identifying the different forms of loneliness, is a plausible starting point when aiming to develop intervention policies and strategies alleviating loneliness (Dahlberg & McKee, 2013). Having one type of social need satisfied does not necessarily mean that loneliness is alleviated, since different relational functions satisfy different needs. For example, the absence of a figure of close emotional attachment can only be substituted by another close and intimate bond, and the absence of a social network can be remedied only by integration into such a network (Weiss, 1973). However, it is widely known that the meaning and importance of different kinds of social relationships may change over the life course. For example, older people tend to invest in emotionally close and meaningful relationships rather than wider social networks (Carstensen, Isaacowitz, & Charles, 1999).

According to Khosravi and Ghapanchi (2016), various technology–based interventions have been offered to reduce loneliness and social isolation, but research demonstrating the role of various types of technologies and their effectiveness among older people has been scarce. Most of the studies on robots and the loneliness of older people have been conducted by giving people robot babies (Turkle, 2011), robot animals (Banks, Willoughby, & Banks, 2008; Pu, Moyle, Jones, & Todorovic, 2018; Robinson, MacDonald, Kerse, & Broadbent, 2013; Wada & Shibata, 2007), or other devices and then by observing the robot's influence on human behavior. According to a Japanese study, for instance, the continuous use of Paro seal showed that the robot can encourage elderly residents to spend more time in the care home's public area and communicate with each other (Wada & Shibata, 2007). Humanoid robots as walking partners have also been tested in Japan (Karunarathne, Morales, Nomura, Kanda, & Ishiguro, 2018). However, more research on the dimensions of loneliness in connection to solutions is needed to make social robots a genuine and ethically sustainable way to decrease the loneliness of older people in the future. Social robots have been proposed as one solution to this increasing problem (Kachouie, Sedighaedeli, Koshia, & Chu, 2014; Robinson, MacDonald, Kerse, & Broadbent, 2013; Vandemeulebroucke, Dierckx de Casterlé, & Gastmans, 2017), yet the idea of robotics in elder care has raised ethical concerns as well (Sharkey & Sharkey, 2012; Turkle, 2011; Vandemeulebroucke, Dierckx de Casterlé, & Gastmans, 2017, Decker, 2008; Sparrow & Sparrow, 2006).

2.2. *Direct and indirect social robots*

Social robots are systems that may enhance psychological well–being of the elderly by offering them companionship. They can be perceived of as social entities with communication capacities. (Broekens, Heerink, & Rosendahl, 2009; Wu, Fassert, & Rigaud, 2012) They are further defined as robots capable of communicating in a human–like manner (Kirby, Forlizzi, & Simmons, 2010); they are designed to assist humans with predefined tasks and to communicate using natural human social interaction techniques such as speech. Social robots have also been defined as artificial agents embodied with the features of a human or animal (Pu et al., 2018). They can be used for many different types of tasks, such as providing information in malls or acting as guides in museums (Aaltonen, Arvola, Heikkilä, & Lammi, 2017). However, their use is still a new approach in elder care services (Compagna & Kohlbacher, 2015; Ott, 2012). Some impact studies have been conducted (e.g., Aaltonen, Arvola, Heikkilä, & Lammi, 2017; Pu et al., 2018; Melkas, Hennala, Pekkarinen, & Kyrki, 2020), while many more comprehensive ones are needed.

For the purposes of this paper, social robots can be referred to as robots that provide a social service and support users by developing dyadic ties to people (Bemelmans, Gelderblom, Jonker, & de Witte, 2012; Frennert & Östlund, 2014; Khaksar, Khosla, Chu, & Shahmehr, 2016; Pfadenhauer & Dukat, 2015; Riether, Hegel, Wrede, & Horstmann, 2012; Shibata & Wada, 2011). There are several different types of social robots, such as humanoid robots [e.g., Zora and Pepper], therapeutic robots [e.g., Paro and JustoCat] and telepresence robots [e.g., Double and Giraff]. The service and support provided by these different types of robot are quite different, and the ethical concerns related to them also differ. In this paper, we use the term "direct social robots" to cover humanoid robots and therapeutic robots whose purpose is to interact with people. The goal of direct social robots is to interact with people in a human–like way (Breazeal, 2004) in order to develop close and effective interactions between the robot and the human for the sake of interaction itself (see Feil-Seifer & Matarić, 2005). In addition, we refer to equipment designed to link people together, such as telepresence robots and sophisticated moving aids [such as exoskeletons and robot wheelchairs], as "indirect social robots." The difference is thus that direct social robots are designed to socialize with people *per se*, whereas indirect social robots help people bond with each other. In our view, this not only outlines the broad sphere of robots, but also provides a basis for a more refined analysis.

3. Future perspectives to reducing loneliness in AL

In this section, we will present our findings; the opportunities for social robots and communication technologies to reduce social and emotional loneliness in AL separately, although social and emotional aspects of loneliness do intermingle and overlap in the real world. We also discuss the relevant challenges.

3.1. Robots and social loneliness

In scrutinizing social robots' opportunities to decrease social loneliness in AL, we utilized Weiss' concepts of attachment and social integration (Weiss, 1973). In Finland, older people usually enter AL once they have been allotted a placement in a facility by municipal officials. People usually take the first free vacancy since it is the cheapest option, but this means they have no chance to choose their social surroundings. According to previous literature, the qualities of the peers in the AL may not be a match for the new resident, the working culture of the nursing staff may be more or less person centered, and friends and relatives are not always keen to visit a facility (Pirhonen, 2017; Pirhonen et al., 2018). All this may result in social loneliness.

Residents who lack meaningful social contacts in AL could benefit from both direct and indirect social robots. Direct social robots, such as the humanoid robot Pepper [Picture 1], could keep up a decent conversation on a chosen topic—be the subject whatever a resident desires—especially as they develop technologically in the future.

Direct social robots could thus decrease loneliness by creating conversational opportunities and, as prior literature (Turkle, 2011) shows, even a sense of attachment. Since the available company does not always meet residents' expectations, a direct social robot could, for example, read newspapers, play music, or engage in memory and guessing games with them. Future artificial intelligence applications might provide even more novel and meaningful opportunities. However, in several studies (e.g., Sharkey & Sharkey, 2012; Melkas et al., 2020) fears regarding the use of robots as replacements for humans have been noted. In a pilot study, the care personnel recognized the potential of the robot to occasionally tell stories or read a book to lonely people when the personnel were busy with other tasks, but they were still concerned about the ethical issues and did not accept that a robot could entertain people all day long (Melkas et al., 2020).

In a study where a humanoid robot Zora was piloted in elder care services, the care personnel noted—among other things—that unlike a human caregiver, the robot does not get tired, it always responds in a friendly way, and it repeats things over and over if needed. Furthermore, the robot does not take things personally (Melkas et al., 2020). Breazeal (2004) mentions that one of the advantages of social robots is that they do not have any "social baggage" and therefore do not judge. In addition, it may be less stigmatizing for an older person to receive care from a robot than from a human (Prieto-Flores et al., 2011). Indeed, Parviainen et al. (2019) note that while humans have the capacity for bodily awareness and express their kinaesthetic feelings and affective states through bodily movements, robots do not possess this capacity. Thus, robots do not have personal intentions, embodied intelligence or their own personal motives, since they are only programmed to make moves or gestures.

Picture 1. Humanoid robot Pepper: [photo: Satu Pekkarinen]..

Previous research shows that residents' hampering physical abilities and shortage of nursing staff are yet another issues increasing the risk of social loneliness (Pirhonen, 2017; Pirhonen et al., 2018). Indirect social robots, such as the Double or Giraff [Picture 2] telepresence robots, could enable social integration by strengthening connections to other people outside the facility.

Telepresence robots or other telepresence equipment are designed to enable human interaction from a distance and thus enable AL residents to keep in touch with people outside the facility or even remotely attend events such as concerts, exhibitions, courses, and so on.

Different kinds of indirect social robots could help residents also to move around independently of the busy staff and thus help older people to socialize with others. Robot wheelchairs, assistive walkers, and exoskeletons are examples of present solutions [Picture 3 , exoskeleton]. Exoskeletons, as assistive devices, are external structural mechanisms with joints and links corresponding to those of the human body. A powered exoskeleton is a motorized mobile machine consisting of an exoskeleton–like framework worn by a person and a power supply. The exoskeleton assists by augmenting the movements of the user's limbs (Sale, Franceschini, Waldner, & Hesse, 2012).

An exoskeleton could even enable residents with physical impairments to walk again. The social isolation and loneliness of bed–ridden people with no or early–stage memory disorders could be assuaged by robots enabling them to get out of bed independently. Moreover, a preventive viewpoint would also be important; such an exoskeleton would provide sufficient rehabilitation and physical exercise to maintain and strengthen the user's remaining abilities and thus improve opportunities for social interaction as well.

However, the use of such aids requires understanding and monitoring of the user's cognitive [and other] health, because the technology must be adapted to the health condition along the user' life span to avoid a false reliance on technology (Melkas, 2004). This issue applies to the use of any form of technology.

3.2. Robots and emotional loneliness

Weiss' concept of emotional loneliness concerns the relational functions of the opportunity for nurturance, reassurance of worth, sense of reliable alliance, and guidance in stressful situations. In essence, emotional loneliness arises from a lack of close relationships (Weiss, 1973). As we outlined in the previous section, it is not always easy to bond with people and find close relationships inside the facility. Connections to the outside may also be limited (Jansson et al., 2019; Lindgren & Murphy, 2002; Pirhonen et al., 2018; Port et al., 2001) although residents do appreciate phone calls and visits from outside the facility (Pirhonen et al., 2018). Risk of emotional loneliness may thus increase in AL.

Turkle (2011) found that older people bond with robots on a personal level, naming them and telling them all their secrets. On one occasion, an older woman learned to prefer a robot baby to the child of her kin. People do get attached to objects, and that is a normal human condition, but emotional bonding with direct social robots has been found to be dubious (Sharkey & Sharkey, 2012; Vandemeulebroucke et al., 2017b). Researchers have talked about deception, especially when people with cognitive disorders are provided with social robots, since these people cannot necessarily tell the difference between living and artificial things (Sharkey & Sharkey,

Picture 2. Giraff, a telepresence robot: [photo: Helinä Melkas].

Picture 3. Exoskeleton, the brand name of this type: Indego [photo: Linus Lindholm/ Folkhälsan].

2012; Sparrow & Sparrow, 2006). This was also highlighted as an important point by the care personnel in a study by Melkas et al. (2020); the personnel must be skilled in telling the clients about what robots are and what they do. On the other hand, the personnel may maintain and even create a certain illusion of the robot being alive by the way they speak about it (Parviainen et al., 2019), thus possibly exacerbating the deception.

Picture 4. Paro, the pet seal: [photo: Satu Pekkarinen].

Table 1
Current and potential outcomes of social robots in AL, with ethical concerns acknowledged.

	Emotional loneliness				Social loneliness		
	Relational functions				Relational functions		Main robot type -specific ethical concerns
	Opportunities for nurturance	Reassurance of worth	Sense of reliable alliance	Guidance in stressful situations	Attachment	Social integration	
Direct social robots	+ are "something to love" + encourage human interaction	+ address residents with respect (+) remember residents' individual details	+ obey residents' instructions (+) may be companions	+ may act as calming instructors (+) may be companions	+ provide company and activities + provide opportunities for attachment	(+) may be companions	Deception when the line between humans and robots is blurred
Indirect social robots	+ bring loved ones closer virtually + help reaching other people physically	+ help maintaining sense of being capable (moving aids)	+ maintain sense of belonging to groups outside the facility virtually and physically	+ offer virtual comfort from loved ones	+ help reaching other people virtually and physically	+ help reaching other people virtually and physically	Objectification when eldercare is "left to machines"
Common ethical concern	Risk of lacking live human contact						

+ = current outcomes / (+) = in the future, mainly.

Therapeutic robots, such as pet–like companion robots, could be another solution when we think about older people's opportunities for nurturance or the reassurance of worth in care facilities. People with advanced dementia have profited from embodied interaction with Paro, a pet seal (Broekens et al., 2009). [Paro in picture 4].

It could be claimed that in the case of pet–like robots, the problem of deception is perhaps less severe. In a study by Moyle, Bramble, Jones, and Murfield (2017), the family members of older people in long–term care described Paro as "something to love," and it therefore had a positive impact on the older person's mood by providing opportunities for nurturance. Paro was also described as an enabler for family involvement: in bringing the family members together, interaction with the pet seal was seen as a form of collective "pet therapy." In a similar vein, a Sony AIBO robotic dog has been shown to reduce loneliness and increase the subjective assessment of one's quality of life (Kanamori, Suzuki, & Tanaka, 2002). These findings appear to be related to both social and emotional loneliness, although the studies did not distinguish between the two.

The residents' reassurance of worth could be strengthened by both direct and indirect social robots. Direct social robots could address people using their favorite "titles" (whether from their previous profession or private life) and by their name (reassurance of worth) and ask questions about daily life in the old times or recent history, thus eliciting positive reminiscence. Such conversations were mentioned as having positive future potential in a study by Melkas et al. (2020). In his study on robot companions, Pulman (2007) noted that being a companion means recognizing the user as a unique object and being able to distinguish the user from other people and animals. Recognizing the user as an individual is also related to understanding the user's intentions and remembering habits and preferences (Frennert & Östlund, 2014; see also Leite, Martinho, & Paiva, 2013).

In addition to preventing social loneliness, easily operated telepresence robots (e.g., Aaltonen, Arvola, Heikkilä, & Lammi, 2017; Cesta, Cortellessa, Orlandini, & Tiberio, 2016; Koceski & Koceska, 2016) could also decrease emotional loneliness by bringing close ones outside virtually inside the facility. Telepresence robots in particular allow human operators to be virtually present and to interact in a remote location through the robot's mobility and bidirectional live audio and video feeds (Koceski & Koceska, 2016). A robot that could enable a video call to a friend or family member (or a professional helper) by a simple voice command might relieve emotional loneliness and contribute to a sense of reliable alliance and guidance in stressful situations. Ethical questions need to be considered, however; who is the one establishing the connection, and what is visible? In addition to developed software and hardware, these kinds of activities would demand reliable wireless networks as well.

4. Discussion

4.1. Summary of current and potential outcomes

Based on this futures scanning study, we argue that both direct and indirect social robots could tackle the loneliness of AL residents. We have summarized the current and potential outcomes of social robots in Table 1, categorized according to emotional vs. social loneliness and direct vs. indirect social robots, to frame especially the future opportunities. There are also major ethical concerns listed in Table 1.

Regarding social loneliness, robots could encourage attachment and social integration in older people. Direct social robots could create new conversational and meaningful pastime opportunities, which could help residents with cognitive impairments in particular. In previous literature (Pirhonen, 2017; Pirhonen et al., 2018), particularly a lack of cognitively capable peers and the busyness of staff resulted in feelings of social loneliness. In addition to developing conversational opportunities, direct social robots could act as entertainers, e.g. showing pictures or playing music for residents, as has been done with NAO humanoid robots (Sarabia et al., 2018).

Indirect social robots could tackle social loneliness by bringing people together, both virtually and physically. Verbally commanded telepresence robots could be an easy way to get in touch with people far away, such as friends and relatives, and to connect with various events or services. On the other hand, robots that assist older persons in moving around more independently, such as robot wheelchairs and exoskeletons, could multiply residents' opportunities to join other people physically.

Regarding emotional loneliness, social robots could create opportunities for nurturance, assert reassurances of worth, add to the sense of reliable alliance, and provide guidance in stressful situations. As previous literature shows, older people do attach themselves emotionally to social robots, be they humanoid or therapeutic [animal] robots. Robots have already provided people with something to love and nurture. (Turkle, 2011) It is not a far–fetched idea that future direct social robots may add to residents' sense of reliable alliance and provide skilled guidance in stressful situations [perhaps when combined with telepresence solutions to provide mentally skilled guidance by humans]. Indirect social robots, such as telepresence robots, could help to maintain emotional bonds with people outside the AL facility and generate opportunities to participate in society (e.g., Choi, Kong, & Jung, 2012). Another important factor is maintaining a sense of safety and security, but that is perhaps not as relevant in AL facilities as it is in home care.

More research is needed on the topic of "robot–friendly" environments. This is beyond the scope of this study, but reliable wireless networks and wireless charging points are needed for robots to function properly. In addition, the skillful integration of different technologies into larger networks has yet to happen; different technologies are still developed and utilized in a fragmented way (Pekkarinen & Melkas, 2019). In order to benefit from robots, understanding is thus required regarding the nature of the context in which they are used in terms of the physical and structural environment, in addition to the understanding regarding the users themselves (Mitzner, Chen, Kemp, & Rogers, 2013).

4.2. Ethical concerns

In addition to the above-mentioned advantages, we must consider the robot–related ethical concerns in the care of older people as

highlighted by previous literature. Regarding social robots in care, the objectification of older people (Decker, 2008; Sparrow & Sparrow, 2006) might occur when residents are provided with robots due to the needs of the care organization or other people instead of the older people themselves. Robots would then be a solution, for example, to a lack of human workers or the relatives' reluctance to visit AL facilities. These ethical concerns would then arise from the reasons for utilizing robots, not from robots *per se*. On the other hand, a humanoid robot talking with an older person may be seen as objectification *per se*. Turkle (2011) suggests that we are eager to bring robots into elder care because we imagine both robots and people with dementia lack a deep human element – the ability to imagine the situation of the other person. Providing older people with robots then shows that we regard them as objects. Then again, in this scenario we seem to have lost older people's intrinsic value independently of robots. While these considerations are of the utmost importance, some of the arguments may be based on misconceptions or a lack of knowledge concerning the wide field of robotics and the meaningful tasks of different types of robots such as exoskeletons. If an older person is helped to walk again, this can hardly be viewed as objectification; in fact, the opposite is true.

In this research, the role of ethical concerns over older people lacking human contacts due to social robots is complex. On the one hand, indirect social robots, such as telepresence robots and robot wheelchairs, enable older people to get in touch with other people and thus strengthen human contacts. Some researchers (Vandemeulebroucke et al., 2017b) have warned that telepresence robots may de facto decrease human contacts, since it is easier to pop in to an older person's home virtually than physically, and thus "live" contacts may reduce. Turkle (2011) notes that sometimes older people's children feel less anxious about leaving their parent with a robot as a "companion" in their homes compared to leaving them all alone. These worries need to be taken seriously, yet robots may also evoke new interaction between humans. Melkas et al. (2020) found that such interaction may consist of new discussion themes [wondering about the robot's actions and discussing robotics in general] between older people and their caretakers.

Based on our reflections, direct social robots could be understood as a means of empowering particularly older people with fewer social resources (see Burholt, Windle, Morgan, & CFAS Wales team, 2016). Khaksar et al. (2016) reported that social robots play a mediation role in elder care by delivering personalized services, socializing with and entertaining older people, and creating social connectivity. It has been also noted that a companion robot [Paro] encouraged people to participate in social activities like group games (Moyle et al., 2013). In addition, in a study by Riether et al. (2012), the presence of a robot was reported to influence human beings and their social interaction in the same way as the presence of another human being. Michael and Salice (2017) went even further and studied the sense of commitment in human-robot interaction, claiming that there is immense potential for robots that exhibit and/or elicit a sense of commitment.

Therefore, the potentially deceptive nature of human-robot interaction is a delicate issue. This depends considerably on the type of the robot in question, but in general, transparency should be highlighted in human-robot interaction. People may be unsure what is expected from them when a humanoid robot is addressing them and who is really producing the sentences when it seems that the robot is talking (Melkas et al., 2020). Thus, there is a danger of (unintentionally) misleading older people. People tend to anthropomorphize objects and machines, and to imagine that they are capable of more than they actually are. Human–like or animal–like appearances can encourage and mislead the older people into thinking that robots are capable of more social understanding than is actually the case. For example, in an empirical study by Hutson, Lim, Bentley, Bianchi-Berthouze, and Bowling (2011), the participants compared the animal–type robots to house pets and expected them to behave like real animals. The participants also reported feeling responsible for the robot animal's welfare, although there are concerns regarding well-being of real animals when they are treated by people with dementia as well (Preuβ & Legal, 2017). The robot's appearance and behavior can lead people to think that they can form adequate replacements for human or animal companionship and interaction. This kind of personalization plays a particularly important role in the interaction design of companion robotics (Parviainen et al., 2019).

The robot-related objectification of older people, lack of human contact, and deception have been framed as stripping older people of dignity (Vandemeulebroucke et al., 2017b), but robot use in elder care is not a black–and–white issue. As we have shown, social robots may also make it easier to adapt to assisted living and enable the older persons feel a better about their lives. Residents do not want to feel like burdens (Zimmerman et al., 2005), and social robots have the potential to strengthen older people's agency in many ways. As pointed out earlier, robots do not discriminate in their role as human beings might. This may be particularly relevant for older people with cognitive impairments who are already burdened by negative attitudes and discourses (Burholt et al., 2016). However, from this point of view, the use of social robots may include a risk of outsourcing "strange" or "difficult" residents from human nurses and excluding older people even further from human contact.

5. Conclusions

We have in this research considered the lives of AL residents in the future with a focus on explorative envisioning. Rogers and Mitzner (2017) brought up the challenge in research on older adults and technology support due to Sardar's (2010) laws of futures studies. Envisioning the future of older adults corresponds to Sardar's first law; "Almost all the problems we face nowadays are complex, interconnected, contradictory, located in an uncertain environment and embedded in landscapes that are rapidly changing" (Sardar, 2010, p. 183). The COVID-19 pandemic has already resulted in new scenarios concerning the role of robotics in care (Yang et al., 2020). In any situation, the older adults are a heterogeneous group with differences in their lifetime of experiences, illnesses, environmental exposure, education, and so forth, thus also the needs, capabilities, and limitations vary widely (Rogers & Mitzner, 2017). While emphasizing that exploration of the future cannot be an exact field of inquiry (Sardar, 2010) and that we cannot represent the complexity of the situations for all kinds of individuals (Van Notten, Rotmans, van Asselt, & Rothman, 2003), this research contributes to building alternative futures; opening up pluralistic potentials (Sardar, 2010), and to knowledge building to affect the now (Rogers & Mitzner, 2017).

Thus, when aiming to tackle a complex social issue such as loneliness, it is important to note that single solutions are problematic, perhaps even impossible to find. Loneliness is influenced not only by the physical environment and individual situations, but also by the ways older people and their needs are perceived in society. Arguably, as noted by Burholt et al. (2016), recommendations arising from meta–analyses are often skewed because of the domination of the medical understanding of loneliness and the selection of studies focusing on decreasing loneliness as a primary outcome. After all, we are dealing with a highly complicated human mosaic; empathy and appreciation must be used as the basis for meaningful, informed technology–based assistance (see also Rogers & Mitzner, 2017). Our original intuition – that tackling social problems with technological solutions is a delicate ethical issue – only received support based on this study. If we want to make the positive futures identified in this study real, careful crafting of both services, policies, technologies, and contexts is needed.

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