Chapter 10
Robots as Social and Physical Assistants in Elderly Care

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Abstract Care robots are robotic applications targeted for use in care and nursing environments, or to support independent living for the elderly and those with disabilities. Robots may provide relief to the challenge in many countries of tending to an increased elderly population's needs for care services. This chapter provides an introductory review of care robots and discusses their acceptability within the field of elderly care. Our focus is on the end-users of robots, namely the elderly and care professionals, who are often neglected or misconceived within the field of technology development. We approach their perspective through three empirical studies: a citizen panel for older adults on their expectations and concerns for care robots, a case study of a social robot adopted within three elderly-care facilities, and a case study of a mobile telepresence robot piloted in two care facilities. In these studies, both elderly people and professionals showed positive perceptions towards care robots, at least from certain perspectives. They also presented requirements and framework conditions that should be taken into account when considering the use of robots in care. In particular, the study participants highlighted the priority of humans in care, although they accepted robots for carrying out secondary care tasks.

Keywords Care robot · Acceptability · Elderly care · Citizen panel · Telepresence robot · Social robot

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10.1 Introduction

Within the last decade or two, technology developments in certain areas – including computation, network and communication technologies, localization, machine vision, sensors and mechatronics, among others – have advanced to the point that robots are now becoming feasible and available for use in homes and workplaces, beyond factory floors and public settings. The development of robotics is often perceived as being so promising that policymakers in many countries that face the challenge of a growing elderly population have seriously begun to investigate how robots could be used to alleviate care work and to help the elderly at home (e.g. Swedish government, 2018[1]; Finnish government, 2016[2]; 'New Robot Strategy' of Japan, 2015[3]). For instance, the European Union's ageing society is a central challenge in which robotic technology could play a pivotal role in reducing the burden on younger people and the state.[4]

Care robots are not a homogenous category of technology; instead, they come in many forms, sizes and purposes. A 'robot' is a physical object that can move and potentially manipulate the physical world and has at least some degree of autonomy.[5] Care robots may appear as boxlike machines, or they can be human shaped or wearable, such as robotic 'power suits' for care workers. As formulated by Goeldner et al. (2015, p. 115), the field of care robotics encompasses 'all machines that operate partly or fully autonomously performing care-related activities for people with physical and/or mental handicaps'. The elderly and care professionals can use care robots as part of their service or work.

A number of robotic applications are currently being developed and tested (and in some cases have been permanently adopted) for the purposes of social and healthcare. Table 10.1 lists several central application areas and typical uses of robots in welfare services. Robotic assistance may be helpful for simplifying activities of daily life for elderly and/or handicapped people; increase users' quality of life by giving them more autonomy (Herstatt et al. 2011); or increase their safety or perform tasks with a certain quality standard, such as serving medication (Goeldner et al. 2015). Examples of 'typical' personal-care robots or robotic devices for the

[1] The Swedish government's committee directive 2018:82 (2018). https://www.regeringen.se/4a38da/contentassets/038d2f97ae9d475b97d1fe318fca236a/valfardsteknik-i-aldreomsorgen-dir.-2018_82.pdf

[2] The Finnish government's resolution on intelligent robotics and automation (2016). http://valtioneuvosto.fi/paatokset/paatos?decisionId=0900908f804c7484

[3] 'New Robot Strategy'. Japan's robot strategy – Vision, strategy, action plan (2015). http://www.meti.go.jp/english/press/2015/pdf/0123_01b.pdf

[4] Strategic Research Agenda for Robotics in Europe 2014–2020 (2014). https://www.eu-robotics.net/cms/upload/topic_groups/SRA2020_SPARC.pdf

[5] ISO 8373: https://www.iso.org/obp/ui/#iso:std:iso:8373:ed-2:v1:en. Sometimes purely non-physical computer-based assistants – such as so-called virtual agents or artificial intelligence software solutions that perform routine assistive tasks on computers – are termed robots as well, although nonphysical robots are beyond the scope of this chapter.

Table 10.1 Typical uses of robots in welfare services (Kyrki et al. 2016; ROSE consortium 2017)

Application area	Application (*not yet commercial)
Medical care	Surgical robots
Robots in institutional settings, especially logistics	Hospital pharmacies
	Internal logistics in hospitals
	*Lifting patients
Rehabilitation and prostheses	Robotlike rehabilitation devices
	Prostheses
	Exoskeletons
Personal physical assistance	Eating (e.g. robotic spoons)
	Mobility
	Lifting and carrying objects
	Cleaning
	*Cooking
	*Dressing
	*Hygiene
Personal cognitive and social assistance	Support for self-care (e.g. motivation to exercise)
	Companion robots
	Support for interaction (e.g. telepresence)
	*Cognitive support (e.g. reminding/memory aid, finding objects)

elderly include therapy-animal robots such as 'Paro' (Wada et al. 2004, 2009), telepresence robots such as 'Giraff' (Coradeschi et al. 2011), robotic walking support devices such as 'Lea'[6] and wearable walking-assistance devices such as 'Honda'.[7] For care professionals, robots provide a similarly wide variety of assistance to relieve physical burdens and to increase the efficiency of care work. For example, there are wearable robots to support physiotherapeutical rehabilitation, such as 'Indego'[8]; medicine-dispensing robotic devices for home care, such as 'Evondos'[9] (Rantanen et al. 2017); patient-lifting and transfer robots, such as 'RIBA' (Mukai et al. 2010); and a variety of logistics robots that can carry equipment and supplies for care workers.

Although robotic technologies can potentially enable a large variety of different applications, their introduction and adoption in actual elderly care appear to be painfully slow. Few care-robot products are on the market; some of those have enjoyed commercial success, but much robotic technology is still in the development phase. For example, in Bedaf et al. (2015) review study on care robots for supporting independent living among the elderly, the authors identified only six commercial products among 107 robots that had been developed for the elderly.

[6] https://www.robotcaresystems.com/

[7] https://world.honda.com/Walking-Assist/

[8] http://www.indego.com/indego/en/home

[9] https://evondos.com/

Many of the products in development could be described as technology-development platforms that lacked a commitment to get the product on the market. Developers have also tended to tackle issues that are less relevant to the actual elderly users themselves. For instance, the study found that robots were less developed to support physical mobility, self-care, and social relationships (the support the elderly often need); more often, robots were developed to support non-physical tasks such as reminding, monitoring, conducting health measurements and entertaining (Bedaf et al. 2015). In these kinds of tasks, the physical power and dimensions of robots tend to be underutilized.

One significant challenge to date in the development and commercialization of robots for elderly care has been their relatively low social acceptance. For instance, in a EU28-wide survey (Special Eurobarometer 427, 2015), citizens' attitudes towards robots in general were found to be quite favourable; approximately 64% of respondents perceived robots positively. Their attitudes towards robots that are used for care purposes (i.e. providing 'services and companionship') were less positive: fewer than 50% of Europeans were comfortable with the idea that robots could provide services and companionship for elderly or infirm people; see Fig. 10.1. Older age groups tend to exhibit lower acceptance than younger groups; only 25% of people 55+ were 'totally comfortable' with the idea of care robots, compared to 37% of young people aged 15–24 (Special Eurobarometer 427, 2015).

Some studies, in contrast, have shown high levels of acceptance of robots if they are used to help people to regain independence when they are old or handicapped (Arras and Cerqui 2005) or if the robots can help in daily household routines or tasks such as heavy lifting and cleaning at home (Ray et al. 2008). According to Broadbent et al. (2009), older people themselves are typically less willing to accept robots in general but are more positive about robots that provide independence and respond to older people's needs, for instance, the need to compensate for the loss of cognitive abilities. The authors identified several factors, both demographic and robot related, that influence older adults' willingness to use care robots. The factors

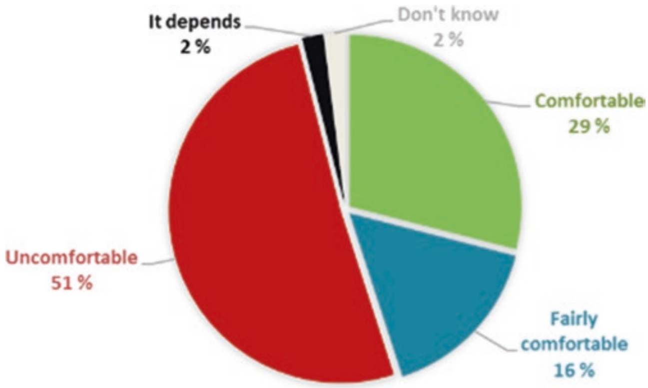

Fig. 10.1 European citizens' perceptions of care robots, according to Special Eurobarometer 427 (2015)

include age and gender; men are typically more positive towards robots than women (see de Graaf and Ben Allouch 2013), although Shibata et al. (2009) have found that women favoured interactions with Paro, the therapy seal robot. Other factors that reportedly influence acceptance include the person's cognitive ability, experience with technology and robots and education and cultural background; for instance, those who have experience with robots will have more positive attitudes towards them (Turja et al. 2018).

The way in which healthcare professionals perceive care robots is also a significant factor. Turja et al. (2018) studied Finnish healthcare professionals' acceptance of and experience with robots and compared them to the general Finnish population. They found that the healthcare professionals had less experience with robots and more negative attitudes towards them than the general population, although they welcomed robot assistance for certain healthcare tasks, such as heavy lifting and logistics (i.e. ergonomically challenging work). They also perceived tasks that are secondary to the actual care or human-centred work, such as sorting, shelving and delivering materials, as being suitable for robots. The authors noted differences in acceptance among occupational groups of nurses (Turja et al. 2018). Practical nurses stood out as having the most reserved attitudes towards robots, which may have been due to their relatively lower educational level or fear of job loss.

Considering the importance of older adults and care professionals – both of whom are stakeholders of the use of robots in elderly care – these groups are seldom engaged in the development and assessment of the technology. This seems to be problematic, especially with regard to the elderly themselves. Research on care robots, for example, relies largely on somewhat stereotypical views of older people as lonely, frail and incapable (Frennert and Östlund 2014; Parviainen and Pirhonen 2017; Neven 2010). Robotics engineers tend to view the elderly as a weak and deficient group of users (Compagna and Kohlbacher, 2015), the needs of whom are assumed rather than heard (e.g. Røtnes and Dybvik Staalesen 2009). If diversity among older users is incorporated at all, it is most often only in terms of age and gender differences (Flandorfer 2012). Current robotic solutions for the elderly are mostly 'technology push' innovations (Taipale et al. 2015). It also appears that diversity among professional caregivers (Turja et al. 2018) is not sufficiently taken into account in the research, development and integration of care robots. Care workers may be seen as incapable of assessing innovative technology (Compagna and Kohlbacher 2015), and technology-push innovations may cause novel types of problems in coping at work (e.g. Melkas et al. 2016). The impacts of technology usage, or the prerequisites for successful, effective application of technology, have been scarcely investigated in a comprehensive manner (Melkas 2013).

Overall, the field of care robotics from a nontechnical perspective is still an emerging sector of research (e.g. Pfadenhauer 2013; Karim et al. 2016; Broadbent et al. 2012; Smarr et al. 2012). Technical possibilities, limitations and targets tend to rule the development, and researchers and developers seldom take into account (1) the perspective of the actual end-users and their needs, (2) a view of care services and organizations as social systems and (3) the societal culture and system of care. For instance, Šabanović (2010) argues that when social issues are invoked to motivate robotics research, these issues are quickly subsumed by discussions of technological possibilities and concerns.

In the field of human-robot interaction (HRI), a few researchers have pointed to a need to take HRI studies out of the laboratory and 'into the wild': into real-world settings and multi-person contexts (Jung and Hinds 2018). According to Frennert et al. (2017), research on how humans interact with robots is still primarily carried out in laboratory settings with student participants. Although controlled laboratory experiments are crucial to the development of HRI, more 'in situ' robot studies should be conducted in their intended natural environments in order to provide insights into how people experience robots and how robots become embedded and used in people's everyday lives. Observing and analyzing HRI in real-life situations provides an understanding of how robots fit in and change social structures in the environment in which they are used (Jung and Hinds 2018) and of how people may invent new ways of using them. Daily life and work in care homes (for instance) does not always proceed in a 'controlled' way; clients' health conditions may change quickly, hence affecting the person concerned, care professionals and other clients. Engaging both older adults and care professionals more in the development process and as actual users in order to assess care robots in real-use environments could also help in gaining social acceptability for robots.

In this chapter, we highlight older adults' and care professionals' perspectives on care robots through data collected within three empirical studies: a citizen panel of older adults on the roles and requirements for robots in their future lives and care, as well as two case studies of actual usages of a telepresence robot and a social robot in nursing-care homes. We are interested in the expectations, experiences and impacts of robotic care in general and social robots in particular, as perceived by older adults and care professionals. Social robots are robots that are developed to communicate with humans in natural, intuitive ways and in a human-like manner (Kirby et al. 2010). One central purpose for social robots (or socially assistive robots) is to enhance the health and psychological well-being of the elderly by offering them companionship (Broekens et al. 2009). Although social robots are just one group of care robots, and their use is still a new approach in elderly-care services (Ott 2012; Compagna and Kohlbacher 2015), they likely have the largest potential to cause radical changes in social relationships and structures in care contexts; we thus should pay attention to them now, during their early development.

10.2 Empirical Studies

In this section we present three empirical studies to illustrate older adults' and care professionals' perspectives towards care robots. The studies have been conducted within a project titled 'Robots and the Future of Welfare Services', a multidisciplinary research effort that examines the potential of robots to be applied within elderly care in Finland.[10]

[10] http://roseproject.aalto.fi/en/

Table 10.2 Summary of the empirical studies

Study #	Robot	Purpose of the robot	Research questions	Method	Participants
1	Care robots in general: Physically assistive robots, telepresence robots and social robots		Expectations, assumptions and arguments about robotic care	Citizen panel with lectures and group discussions (three rounds)	Older adults (65+)
2	'Double', a mobile, remote-controlled telepresence robot with two-way video connection	Provides an easy and flexible method for social connections between family members and an elderly person in nursing care	Expectations and experiences of using a telepresence robot	Case study: Three 6–12-week field studies with the robot in two nursing-care facilities, observations, interviews and focus-group interviews	Elderly residents, family members and care personnel
3	'Zora', a small humanoid robot for elderly care, based on the NAO platform	Provides rehabilitation and recreation for the elderly through human-like interaction, speaking, dancing, etc. in nursing care	Expectations and experiences of using a social robot in an organizational setting	Case study: Observations, interviews, focus-group interviews during the robot-adoption process (10 weeks) at several nursing-care facilities	Elderly residents in nursing care; care personnel

The first study is a citizen panel in which people 65+ years old gathered three times to discuss various care robots, social robots included. This data was used to provide insights into older adults' perspectives on robotic care and their arguments about the acceptability and ethics of care robots as part of their possible future lives and care. The second and third studies are case studies of a telepresence robot and a social robot (respectively) in nursing care. The focus of the second study is on the expectations and actual experiences of three elderly residents in care facilities, their family members and the facility's care workers regarding the use of a telepresence robot for social connections between the resident and family members. The third study examines the use of a social robot for recreational purposes within two care homes and a hospital; the perspectives of elderly people and care workers are included. The studies are summarized in Table 10.2.

The studies and their methods were chosen so that the actual end-users (the elderly and care professionals) could have an informed and in-context say about care robots. 'Informed' means that in all three studies, the participants were provided with information and first-hand experience with a real and current off-the-shelf robot. During the panel discussion, the researchers also gave the participants presentations about various kinds of care robots, their technical state of the art and the purposes for which they were developed; the panellists were able to ask questions and discuss the issue with the researchers. The citizen-panel method itself includes a focus both on the participants' opinions and claims about robots and the arguments and reasoning that underlie their opinions. Each study was also implemented in an environment that was intended to be familiar to the participants: the citizen panel was held in a 'house for companionship', an open-meeting venue in a home-like building, while the case studies were arranged in nursing-care homes, where the participating care professionals and elderly residents used robots as part of their daily work and lives.

These approaches should ensure that we were able to collect rich, valid data from the actual end-users in the form of both verbal information and observations of actual use (in the case studies). Previous researchers (e.g. McLafferty 2004) have emphasized a familiar setting with a relaxed atmosphere that facilitates trust as being crucial for ensuring all focus-group members' participation. For the care professionals, participating in the study in the workplace may be the only opportunity due to their busy schedules and inability to leave their clients.

These studies together provide a multi-perspective view of the issues and influences involved in the use of care robots (social robots in particular) in elderly care. The case descriptions also illustrate the state of the art of actual current care robots and provide a window into several aspects of Finnish care and its robotization during the mid- to late 2010s.

10.2.1 Citizen Panel with Older Adults

A citizen panel was arranged to investigate, analyze and debate older adults' assumptions, expectations and arguments about using care robots and to together identify and elaborate on framework conditions that are critical when planning for the integration of care robots into the Finnish elderly-care service system. The panel was a joint effort of the VTT Technical Research Centre of Finland Ltd., the University of Tampere, and the Finnish Institute of Bioethics. A Finnish-language report of the panel and its results is available as an online document (Saxén 2017).

10.2.1.1 Method and Participants

According to Rowe and Frewer (2005), a citizen panel is a method for public consultation that is initiated by the 'sponsors' – in our case the researchers – where information is conveyed from members of the public to the researchers. The method is characterized by the selection of representative participants who meet several times to debate certain topics in a facilitated group setting. At the end of the meetings, the arguments and discussion are aggregated in a structured manner, for instance, by using a secret ballot or other types of voting. In our case, the citizen panel was particularly an effort to apply 'deliberation' to gather knowledge about older adults' views. Burgess (2014, p. 49) defines deliberation as 'a process of respectfully understanding different perspectives and technical issues, including uncertainty, while working toward convergence or consensus'. The method allows participants to express their opinions and to hear about others' opinions; they are allowed to ponder, challenge and justify their opinions together in order to construct a shared view about the topic of discussion.

The citizen panel was arranged during January and February 2017 in the city of Tampere in southern Finland. The panel consisted of three 3-hour sessions separated by 7–10 days. We invited older adults (people over 65 years old) to participate as panellists by open calls via paper posters on local public announcement boards (e.g. in libraries and grocery stores), in a local newspaper, via invitation letters on email lists of local elderly people's associations, and in social media and radio. We enrolled 25 participants (in order of enrolment) for the first panel session; although a few people left the panel after the first session, more than 20 panellists from the same pool of 25 people attended each time.

The three sessions were led and facilitated by eight researchers. Each session had a specific topic to be debated and analyzed together: either assistive-care robots, telepresence robots or social robots. The discussion of the topic was preceded by an introductory presentation of 20–30 min about the specific type of care robots; the social robot was also demonstrated as a real 'Zora' robot (a NAO robot with special software for elderly care; see Fig. 10.2). After the presentation, the elderly participants were divided into three groups, which remained the same throughout the panel. The discussion was facilitated by one researcher; another took notes and had an assistive role. The participants were encouraged to freely express their opinions about the topic, but they were also asked to justify and argue about their claims. At the end of each session, the groups were gathered together to share and discuss the summaries of each group debate.

At the end of the final session, all opinions and perspectives the participants had raised were investigated together in a facilitated discussion. The purpose of this discussion was to identify the most critical claims and arguments, to understand

Fig. 10.2 Panellists becoming familiar with social robots. (Photo: Katariina Tuominen)

whether these claims and arguments were generally accepted (or if participants had expressed conflicting views) and to aggregate this information into a public statement.[11] The researchers later finalized the draft document.

10.2.1.2 Results

The panellists were the most positive about assistive-care robots that would help the elderly and caregivers with physical tasks. For instance, they accepted the use of such robots for transferring a person between bed and a wheelchair or to other places. They also accepted different logistic and routine delivery tasks (e.g. of medicine, linen, laundry and waste). They felt that robots should do assistive and secondary care tasks, which would allow human caregivers to concentrate on social, emotional and communicative aspects of care; they also felt that robots could not replace humans in terms of presence, interaction and touch. The panellists saw robots replacing humans in care as a potential risk.

The panellists also perceived telepresence robots as being generally positive in providing health services to the elderly as well as in supporting social connections between people who live alone and their family members. Compared to nonmobile video connections (e.g. Skype via a computer), telepresence robots provide more possibilities for family members to remotely control the robot by moving around the apartment to check that it is clean or to find a fallen older person on the floor. On the negative side, the panellists viewed the use of telepresence robots as potentially leading to decreased physical visits to the elderly; the robot might also cause fear in those who suffer from memory problems.

Social robots were the most controversial topic in the discussions. In particular, three different views could be extracted. The participants viewed social robots as (1) a positive, useful way to provide warm companionship and emotional experiences to older people; (2) liable of providing deceptive relationships built on emotions that are not genuine; or (3) a practical means to provide light chatting companionship and to help in the household. In any case, the emphasis was on autonomy and letting people decide for themselves whether they wanted to adopt a social robot. If someone is emotionally attached to a robot, the participants felt that it should not be taken away then. Using social robots with people who have lower cognitive ability (e.g. due to a memory-related illness) was a major concern; one proposed solution was to let the decision be made by family members and professionals. A clear conclusion was that social interaction and humanity cannot be replaced by interactions with a machine.

The collective outcome of the citizen panel (i.e. the public-statement document) aggregates the debates of the panel and summarizes them as five values that were of importance to the participants' consideration of the wide-scale adoption of care robots in society (Table 10.3). The most acceptable values appear to have been such robot-based care services that were in line with older people's desire to continue

[11] The public statement (in Finnish): http://www.bioetiikka.fi/?page_id=1054

Table 10.3 The central values of integrating care robots within elderly care raised by the citizen panel

Value/boundary condition	Description
Autonomy and control	Importance of supporting the autonomy of the elderly and control over the robot, as well as their autonomy in allowing robots to be used in personal care
Knowledge and education	Desire for more knowledge and education about care robots for both the elderly and caregivers
Ethics and accountability	Importance and transparency of safety issues, ethics and legal accountability regarding care robots
Justice and equality	Emphasis on justice and equality in providing care services to people, even when robots are part of the service
Human care	The priority of humans in care, particularly for social and emotional needs

their lives as independent and autonomous individuals despite ageing and related deterioration and those services that supported their social (human) relationships. Mere robotic technology is not enough; people also need to be provided with knowledge and education about the robots and their use. Safety, standards, regulation, ethics and legal issues need to be developed in parallel with the integration of robots in care; the resulting service system should be experienced as justified and equal to all.

In order to put the results of the panel in context, we will now return to the method and the participants in particular. We used several channels to reach people, but we still had to compromise in our selection of participants; we were able to take everyone who volunteered to be a panellist. Although the panellists expressed a variety of views about robots, we have to question how well the participants actually represent older adults in Finland or even in the city in which the panel was arranged. Sparrow and Sparrow (2006) suggest that if deliberative polls were given to statistically representative samples of communities on the use of robots in elderly care, the respondents would reject most of the uses. While this may or may not be true, we can nevertheless conclude that some older people feel positively about robots, and some of them feel positively even about using robots for social and emotional purposes. We hope that the values highlighted in the statement, such as autonomy in decision-making, knowledge and the priority of human care, will feed further discussions and decisions about how and for what uses robots should be applied in the future, especially concerning elderly care.

10.2.2 *Case Study 1: Telepresence Robot in Residential Care*

Telepresence robots are mobile, remote-controlled robotic devices that enable people to be virtually present and to interact and thus socially participate from a remote location where the robot itself is placed. While the real-time video connection

Fig. 10.3 A Double telepresence robot, driven by the daughter of an elderly resident. (Photo: Minna Kulju)

through the robot's screen is a central functionality to enable the feeling of telepresence, the added value of telepresence robots is the remote user's ability to control the movements of the robot within its local physical spaces (Kristoffersson et al. 2013). In the healthcare context, remote users' enhanced control of their telepresence enables such services as televisits by medical professionals in hospitals and care facilities. In elderly-care facilities, telepresence robots are also a potential technology for non-medical usage, namely, to facilitate social connections between residents and their family members and to support the participation of bedridden residents in social activities within the building or even outside. Few studies of telepresence robots in residential care have been conducted to date (Niemelä et al. 2017b).

In our study, we used a telepresence robot called 'Double' by Double Robotics,[12] as shown in Fig. 10.3. The robot consists of a two-wheeled mobile platform and a tablet computer with a wireless internet connection on top. The tablet enables a video connection with a camera, a microphone and speakers. The movements of the robot (including adjusting the tablet's height and the video connection and volume) are totally controllable by a remote user by using a computer's internet browser. Although Double's tablet cannot be bent to look up or down, it does have another camera for the floor view in order to help remote drivers to have a better view of what is in front of the robot at the ground level.

10.2.2.1 Method and Participants

We arranged three 6–12-week field trials in total to explore the use of telepresence robots in residential care. In these trials, we installed the telepresence robot in a room of a long-term care-home resident for communicating with her or his family

[12] https://www.doublerobotics.com/

members. Three elderly residents participated in the trials in two facilities (24-h-service care homes). In each trial, the data was collected in several ways: as pre- and post-interviews of the residents, their family members and the personal nurses of the residents and as user observations and by keeping logs of the use of the robot during the trials. In Trial 1, we also videotaped three call sessions (1–10 min) of one daughter through the robot. The care personnel participated in focus-group interviews after the trials: three care workers at the first facility and five care workers and the manager at the second facility. The results of these trials have been discussed elsewhere in more detail (Trial 1: Niemelä et al. 2017b; all three trials: Niemelä et al. submitted).

10.2.2.2 Results

The interviews with the elderly users, their family members and the care personnel all showed that the telepresence robot was found to be useful in increasing the presence of the family members towards the elderly residents and vice versa. The feeling of presence between the elderly person and the family member was felt to be stronger than on the phone, mainly due to the two-way video connection. According to both family members and the elderly persons, the contents of communication did not change due to the use of the robot.

The most interesting and ‘robotic’ issue in a telepresence robot is the remote user’s ability to control the robot and move it around in its environment. In a care facility, a family member could use the robot to ‘walk’ with the resident to the facility’s common spaces and, for instance, follow and even participate in a recreation session with the resident. In this study, several remote-driving sessions, also in common spaces, were arranged; these sessions were controlled by the researchers in order to ensure the safety and privacy of other people in the facility.

Neither the residents nor the family members saw much of a need for remote driving in common spaces; they spontaneously used the remote control mainly to turn the robot in an optimal direction and to adjust the height of the screen and camera. The care workers, however, perceived that the central function of the robot was to enable family members to be more engaged in the daily life and activities of the facility. The remote-driving ability would support such engagement. Importantly, they also identified several issues that need to be solved before the robot could be taken up for such a use: the robot’s operators should be concerned about how other residents would react to a robot wandering the facility; the remote driver could see situations with other residents that might be embarrassing or private in nature and could possibly record them; and the remote driver could hear care workers’ conversations about other residents. In particular, the privacy of other residents was the main concern to prevent the full use of telepresence robots for engaging family members in facility life.

The care workers felt positively about the robot in general; the personal nurses did not feel that they had to do extra work because of the robot (although it was their task to help the resident with the robot, for instance, when adjusting the volume or charging the robot). They provided several ideas of how the robot could be utilized more

Fig. 10.4 Zora, the social robot for care and recreation. (Photo: Satu Pekkarinen)

in the facility: bedridden residents would be able to enjoy social events in the facility through the robot, for example, which could be remote-driven by a care worker, or volunteers or even therapy workers could contact residents by using the robot.

Telepresence robots appear to be a rather mature technology to be taken into use in care facilities in order to reduce the feelings of loneliness and isolation that residents in assisted living often confront. Telepresence robots could potentially help, through increased control over a remote user's virtual presence and mobility, to engage family members more in the general life of the care facility. But other residents' privacy was the main concern that should be addressed before such robots could be deployed in a facility.

10.2.3 Case Study 2: Social Robot in Nursing Care

'Zora'[13] is a 57-cm-tall humanoid robot (Fig. 10.4). It is based on Softbank Robotics' NAO robot platform,[14] which was adapted for use in rehabilitation and recreation. Zora is steered with a tablet or other computer and has sensors, a speech synthesizer, a microphone, a camera and speakers. The robot has human-like characteristics: it walks, moves its hands while speaking and blinks its eyes. It is preprogrammed to perform several functions; no technical programming skills are required for operation.

[13] http://zorarobotics.be/index.php/en/zorabot-zora

[14] https://www.softbankrobotics.com/emea/en/nao

10.2.3.1 Method and Participants

Zora was introduced to elderly-care services in the city of Lahti in southern Finland in early 2016. The pilot test period lasted for 10 weeks, from December 2015 through April 2016, when the robot was introduced for the first time in elderly-care environments. This adoption process was observed by three researchers from LUT University, Lahti campus (see also Chap. 14). The use of the robot has continued since that time.

The researchers collected the following data for this purpose at two 24-h-service care homes and at a geriatric rehabilitation hospital: (1) ethnographic observations of the robot being used for rehabilitation purposes, (2) focus-group interviews with the care personnel and (3) a group interview with five customers. A total of 40 people were interviewed. The 35 care worker interviewees were mainly nurses or assistant nurses. The ethnographic observations consisted of 27 sessions, of about 1 h each, in which the robot was either introduced to the customers in a special session or acted as part of regular group activities (exercise, music or other recreation groups) at the care homes or the hospital. The robot was first used for 2 weeks in the first care home and 4 weeks in the second. At the hospital, it was first used for a month. In addition to activity sessions, the robot was used individually with a few bedridden patients.[15] Lahti city officials renamed the robot 'Ilona' (a Finnish name containing the word 'joy') to make the robot easier to approach and talk about.

10.2.3.2 Results

The experiences showed that robot usage, as a form of digital service and as a physical assistant, requires various kinds of resources from the care organization and its personnel, including knowledge and skills, time allocation and organizational infrastructure. The care professionals highlighted the importance of knowing customers and their needs well in advance when planning to use the robot. They mentioned that ample time for training and orientation for all personnel was needed (Pekkarinen and Hennala 2016). Turja et al. (2018) recently underlined the importance of developing proactive workplace practices where different-level employees can collaboratively plan the possible implementations of care robotics. Those who operated the robot considered it rather easy to operate, but two care workers are needed in use situations: one concentrates on robot operation, while the other focusses on the customers. Several challenges for workers' busy care schedules arose. The robot also requires an internet connection and a depository where it is easily accessible.

As a physical assistant, the participants viewed the robot as a cute and sympathetic persona, although the small size also caused problems for elderly people with poor eyesight or when the robot was used amid a large group of people. Likewise, the robot's speaking voice was too quiet for those with hearing problems, and lip-

[15] Part of these results have been discussed in previous studies (Pekkarinen and Hennala 2016; Melkas et al. 2016; Tuisku et al. 2018; Melkas et al. submitted).

reading was not possible, both of which caused some confusion among the customers. Special context sensitivity is thus required of the staff when working with the robot to ensure that customers will know what is happening, especially when technical problems occur or other confusing situations arise (Pekkarinen and Hennala 2016). The customers at the care units needed quite a bit of assistance, and many had memory-impairing conditions. Considering these circumstances, they welcomed the robot surprisingly well. Our findings that residents had a more positive attitude towards robots than the care personnel did are also in line with other studies, such as Broadbent et al.'s work (2012).

The customers and care professionals generated several ideas about future opportunities in which the robot could be used (Melkas et al. submitted). The ideas represented various possibilities ranging from physical assistants to digital services; quite a few of the ideas contained elements from both. The robot could help demonstrate everyday routines, such as how to eat or brush one's teeth; it could also pick up trash from the facilities. The care professionals stated that with a robot, it was possible to simultaneously improve customers' functional capabilities from many perspectives: physical, cognitive and social. While performing dances or playing interactive games, the robot stimulated the customers into movement when it was waving its hands. The robot also elicited reminiscences, memories and social interaction. More multi-faceted functions could be found for this kind of use and for working with emotions and gestures in smaller groups. Another suggestion was that the robot could reduce loneliness in bedridden customers and calm restless customers by reading aloud from books and daily news items, especially during busy hours. Others highlighted that the robot could act as an interpreter in those circumstances where the care worker and the customer do not speak the same language (see also Turja et al. 2018). These ideas largely corresponded to the applications that Dahl and Kamel Boulos (2014) discussed in their study. The professionals quickly contributed their own ideas about the appropriate tailoring of robot usage in their particular environments. Many customers also wanted to express their ideas. Having opportunities to gain one's own experiences (as discussed by Savela et al. 2018) and valuing new ideas concerning robots' tasks appear to be important in building up the basis for meaningful future use, perhaps even including a sense of commitment towards robots (Michael and Salice 2017).

The participants mentioned many negative impacts and challenges as well, some of which depend on whether the 'novelty' fits in with one's work as a motivating issue, an extra burden or a cause of anxiety. The robot caused extra work during the implementation phase. The professionals noted tensions and questions about the essence of care work between robot-users and non-users. Some of the customers disliked the robot. Based on the results, the roles of the robot were particularly related to new and multi-faceted ways to maintain and promote elderly people's functional capabilities. The robot created various kinds of interaction (Wada and Shibata 2007) among customers, as well as between customers and care personnel. It did not especially help the care personnel during busy hours, as the challenges related to learning and time use were too great.

10.3 Discussion

The three empirical studies described in this chapter highlight how older adults and care professionals perceive care robots and their usage in care. In particular, the two empirical case studies demonstrated current off-the-shelf robots and their effects on social relationships and practices in care. As we have seen, although the robots are rather simple, one-purpose devices with very limited interaction capabilities, they provide the means to observe people's reactions and behaviour with robots during real-use situations and environments. This observation has allowed us to build a deeper understanding of people's expectations of and refusals to use robots in care. For instance, care facilities might well be interested in and ready to adopt telepresence robots for different usages in order to improve their services for the residents and their family members, but first the privacy of the residents should be ensured.

Even though the three studies were quite different (and the summarizing of case studies may not be necessary; Flyvbjerg 2006), they did indeed yield certain similar findings. Table 10.4 shows the values and expectations identified in the citizen panel connected to the experiences across the two implementation cases. The findings are in line with previous studies (e.g. on care professionals; Turja et al. 2018), but their combination increases our as-yet meagre understanding of the experiences of using robots in real-life settings and the expectations of present and potential users. Flyvbjerg (2006) has advocated case studies as a means of providing concrete, context-dependent knowledge; according to Flyvbjerg, formal, non-generalizable knowledge – such as that produced by case studies – can still contribute to the cumulative development of knowledge in a given field or society. In the case of robotics in elderly care, this is essential in our view, as the elderly-care field, robotic technologies and the societal structures found in elderly care are all transforming. Those changes – which in the case of technologies are very rapid – can be 'caught' with the help of case studies.

Although we have described care robots in this chapter as physical devices, they can be thought of as a part of the trend of digitalization of services and whole societies. 'Digitalization' itself has become somewhat of a buzzword today, as it is often used without specifying what it actually means. Still, digitalization is evident around us at many levels. For instance, older users are provided with digital self-care or recreation applications,[16] care organizations have adopted computer-based care resource management and mobile work and access-control systems, and in Finland, a nationwide effort is underway to collect citizens' health data and to provide certain health services such as medical e-prescriptions in one central information system, called Kanta (the National Archive of Health Information[17]). Computing-enabled, digitally controlled physical care robot devices may be thought of as one step of digitalization in

[16] As an example, a digital online reminiscence service has been developed for elderly individuals or groups; see Niemelä et al. (2017).

[17] https://thl.fi/en/web/information-management-in-social-welfare-and-health-care

Table 10.4 Summary of the findings according to the central values raised by the citizen panel (the main experiences in care facilities appear in *italics*)

Value/boundary condition	Description of the citizen panel's expectations	Experiences in care facilities
Autonomy and control	Importance of supporting autonomy of the elderly and control over the robot, as well as their autonomy in allowing robots to be used in their personal care	Autonomy through supporting social connections and providing 'light' companionship – To reduce loneliness and isolation, for example
		Autonomy through improving functional capabilities (Zora)
		Autonomy changes in a care-facility setting; this value was thus brought up more indirectly
Knowledge and education	*Desire for more knowledge and education about care robots for both the elderly and caregivers*	*Technology itself is not enough, but there is a need for new knowledge and training in robots and their use*
		Gaining one's own experiences also enables ideation about where and how robots could be used in the future
Ethics and accountability	*Importance and transparency of safety issues, ethics and legal accountability regarding care robots*	*Careful planning, including ethical issues, is needed when taking robots into use*
		Robot use should not lead to decreased physical visits by family members or deception (Zora) or breaches of privacy (Double)
Justice and equality	Emphasis on justice and equality in providing care services to people, also when robots are part of the service	Less emphasized in care facilities
		As with autonomy, the view of justice and equality is likely to change in a care-facility setting
Human care	*The priority of humans in care, particularly for social and emotional needs*	*Care robots were viewed relatively positively when used in well-specified tasks, such as secondary care tasks*
		Human caregivers are crucial for social, emotional and communicative aspects of care, and robots should not replace them

elderly care, where physical assistance is a necessity that cannot be provided by mere digital solutions or information systems.

Compared to other dimensions of digitalization, however, care robots may be subject to extra attention because of their concrete presence and operation in the same physical spaces in which people live and work and because of their attempts to communicate with people. This situation seems to be particularly true with social robots, which are designed to provide human-like, natural interactions, feelings of social presence and even emotional bonding for human users. According to Frennert et al. (2017), the consequences of increased digitalization in society are that human experiences are progressively mediated by technology. Digitalization changes human communication, actions and practices, and social robots may further intensify these changes. According to the empirical studies presented in this chapter, older adults and care professionals found several acceptable and desired uses for care robots in elderly care, but they also presented requirements and framework conditions. In particular, the participants in both case studies and the citizen panel highlighted the priority of humans in care, while the participants found robots to be acceptable for carrying out secondary care tasks.

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