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Social Robots in Aged Care: Care Staff Experiences and Perspectives on Robot Benefits and Challenges

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Social robots have the potential to augment the care provided to older adults in residential aged care homes. However, social robots can only be of value in aged care if care staff perceive them as valuable and incorporate them successfully into their ongoing care practices beyond a limited research period. This study examines the benefits and challenges of using different types of social robots in real-world practice from the care staff perspective. We conducted semi-structured interviews with eleven staff members who have first-hand experience of employing robots in their work. Our findings highlight the entangled relationships among the actors in the older adult/carer/robot triad. We discuss the role of robots in supporting a mutually beneficial relationship between care staff and older adults, and how robopets and humanoid robots impact care staff in different ways. Finally, we offer recommendations for the future deployment of robots. We argue that a successful and sustainable deployment of robots in care practice might involve recognizing and promoting positive impacts for both the human parties in the triad, and that the practice of using robots needs to align with the needs and interests of both caregivers and care recipients.

CCS Concepts: • **Human-centered computing → Human computer interaction (HCI)**; *Empirical studies in HCI*.

Additional Key Words and Phrases: Social robots, Aged care, Care staff, User experiences, Ethics

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1 INTRODUCTION

Rapid ageing of populations worldwide has spurred interest in HCI research into technologies designed to address the needs of older adults. CSCW research, for example, has investigated telepresence systems that aim to support aging in place [41, 65]. Similarly, HCI researchers have developed communication applications to support isolated older adults and to enable people living in residential aged care to stay connected to loved ones [55, 57, 85]. Other HCI and CSCW researchers have co-designed virtual reality experiences to enrich the lives of older adults [7, 28]

Social robots—i.e., robots made for social settings and possessing some social features—are also receiving attention from HCI, CSCW, and gerontology researchers whose research focuses on technologies to support older adults' physical and mental health. Previous work has reported on the positive effects of social robots on the well-being of older adults, such as enhancing positive mood, reducing agitation and anxiety, providing comfort and companionship, and improving social engagement [11, 15, 31, 66, 77]. The potential benefits of social robots make them a focus of interest for both academic researchers and commercial companies. Paro, a seal-like robot for older people, has been commercialized for over ten years worldwide [31]. Other lower-cost robopets, such as Joy for All (JFA) brand robocats and robodogs, have also been introduced into aged care facilities in recent years [73]. Meanwhile, humanoid robots, such as Nao and Pepper from Softbank company

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[69, 70], and Matilda from an Australian company [37], are available to be purchased or leased by organisations that provide care, including residential or nursing home care, to people in advanced later life.

In many countries, residential aged care facilities, also known as nursing homes, are a crucial part of the aged care service system. These facilities provide long-term care to older adults who lack the capacity to live independently at home, including those living with dementia and those with minimal or no cognitive impairment but who have other reasons for needing long-term care, such as sensory and mobility impairments [22, 44]. In response to residents' social and emotional needs, aged care facilities seek to offer varied lifestyle and therapeutic activities [45, 56]. Existing research suggests that social robots might help to promote this goal. However, it is unlikely that social robots will achieve their full potential if they are not perceived and treated as valuable by aged care staff in practice. In residential care organisations, staff are responsible for introducing robots, running programs involving robots, and supporting residents in using robots. Previous work by Hornecker et al. has regarded staff as part of a triadic relationship comprising staff member, older person, and the robot [29].

Research to date has largely focused on care providers' general attitudes towards robots which they have not actually used, or on their assessments of a particular type of robot in research trials, very often Paro [1, 18, 31, 38, 52, 60, 67, 80, 84]. However, little is known about how different robots are used and viewed by care staff beyond research trials. When continuously used in real-life situations, robots may have a more positive impact, or else present new challenges and responsibilities for care staff, than in a short research period. As more robot options become available, there is a need to gain a deeper understanding of how different types of robots are currently being used in aged care settings, and how their use impacts older adults and care staff.

In this paper, we report findings from semi-structured interviews of eleven care staff working in Australian residential aged care organizations who had first-hand experiences of using robots in their work. We aimed to understand what factors influence the use of robots in real-world practice and how to ensure robots are used effectively to benefit residents from a care staff perspective. To achieve this goal, our research asks two questions: (1) What are the benefits and challenges from a staff perspective of using different robot types in aged care? (2) How can social robots be used effectively to ensure they provide benefits to residents?

This paper makes three contributions to a growing body of HCI and CSCW literature that aims to understand and improve the use of varied social robots in aged care contexts. First, drawing on our findings, we highlight the entangled relationships among the actors in the older adult/carer/robot triad, and the role of robots in shaping a mutually beneficial relationship between care staff and older adults and in promoting a healthy care system. Second, we compare the different impacts of robopets and humanoid robots. We highlight that the benefits of using social robots in aged care differ according to the types of robots used and the interactions they support. Robopets predominately provide comfort, but older adults may easily form an attachment with them, which can cause an ethical issue of balancing scarce resources and high demand. Humanoid robots allow for a wider range of interactions but present a number of challenges for staff in facilitating those interactions. Last, we discuss lessons that HCI and CSCW researchers and aged care practitioners can draw on for a successful and sustainable deployment of robots in aged care, namely that: 1) it is important to engage and motivate care staff when deploying robots in aged care, 2) sustainable deployment of robots involves recognizing and promoting positive impacts for both care recipients and caregivers, and 3) if resourcing allows, a one-to-one policy could be adopted enabling all care recipients to have access to personal robots.

2 RELATED WORK

The use of robots in aged care has received significant attention from researchers in multiple disciplines, including HCI, HRI, CSCW, philosophy, gerontology, sociology, and nursing (e.g., [1, 15, 20, 21, 40, 42, 71, 79, 86]). These studies have examined the design and deployment of robots to support aged care, people's attitudes towards and adoption of the use of robots in healthcare, ethical issues associated with robotic care, the therapeutic effectiveness of robots, and the social impact of introducing robots into care settings. Of particular interest to this paper is research that has investigated people's experiences and attitudes of using robots from sociotechnical perspectives. Below we provide a discussion of research focusing on developments in research on the use of robots for older adults, and the benefits and challenges that the use of robots brings to older adults and care staff.

2.1 Robots and aged care

Many kinds of robots have been designed or developed to assist with caring for older people. For example, robots have been designed to provide functional assistance (e.g. Robotic Walker [19] and Shopping Assistant [32]), nursing assistance (e.g. Care-O-Bot [25], which can monitor safety and remind people to take their medication), and emotional and social support (e.g. companion robot Paro [81] and entertainment robot Matilda [36]).

Robots that can interact and communicate socially with people are categorized by researchers as social assistive robots, or social robots [14, 24]. Two kinds of social robots that are commonly studied in aged care are robopets and humanoid robots. A robopet is a small robot that resembles the appearance or behaviour of a companion animal [23]. Examples of robopets include both familiar animal-like robots, such as robotic dog AIBO and JFA robocats and robodogs, and unfamiliar animal-like robots, such as a baby seal (Paro robot) and teddy bear CuDDler [1, 73]. Robopets that are relevant to our study are Paro, and JFA robocats and robodogs. Paro is the most frequently studied robopet. It has been commercialized and used in different countries for more than a decade [31]. In contrast, JFA robocats and robodogs have only become available in recent years. They have fewer functions than Paro and are more affordable [38]. Both Paro and JFA are non-mobile robots that are covered with soft fur and can autonomously respond to human touch and stroke through vocalizations and body movements.

Compared with robopets, humanoid robots are designed to provide a wider range of functionalities, and can therefore interact with older people in more ways [5]. Examples of humanoid robots include large robots that have a similar height to a human, such as PR2 [64], and Pepper [15], and smaller robots with the height of a toy, such as Nao [30]. Nao is an intelligent programmable robot, which can recognize shapes and interpret speech, track people and objects, have conversations with people in multiple languages, play music, perform dance, and read stories [69].

Studies have identified that both robopets and humanoid robots can provide multiple therapeutic, emotional, and social benefits to older adults. For example, a scoping review of 61 publications with clinical outcomes from social robot trials showed that robopets and humanoid robots can play positive roles in therapeutic interventions and social interactions, improving the quality of life and wellbeing for older adults [2]. Literature review studies on the effects of robopets have identified similar results, suggesting that robopets could benefit older adults living with dementia through enhancing mood and social communication, lowering loneliness, improving health conditions, and reducing negative behavioural symptoms [1, 31, 38, 84]. A recent scoping review on humanoid robots has categorized four domains in which humanoid robots can create benefits, including assisting with daily tasks, providing entertainment, and facilitating cognitive and physical training

[5]. Another review study has highlighted that humanoid robots can provide personalized services, and adapt to users' preferences and care needs [61].

Although prior empirical studies have tested the use of social robots in real care settings, in most studies the robots are provided by researchers, rather than owned by individuals or care homes [15, 17, 32, 49, 50, 53, 68]. This points to a gap in research, with limited studies reporting experiences from when robots have been integrated into older adults' lives over long periods. One explanation for this gap may be related to the limited robotic products on the market in earlier years. A review study published in 2015 identified that among 107 robots that had been designed and developed to prolong independent living for older people, only six are commercial products [9]. Another possible reason may be associated with the high price of care robots. For example, Paro costs approximately US $6000. This high price is a significant barrier for it to be widely used [31, 52].

However, in some recent studies [12, 73, 74], we see this trend beginning to change as some low-cost brands of social robots enter the market. A study by Thunberg [73] reported that many care homes in Sweden have begun to purchase and use low-cost JFA robocats and robodogs. Some humanoid robots, such as Nao and Pepper are also available to be leased [69, 70]. These developments suggest that more social robots will be introduced into aged care in the near future. Therefore, it is necessary to gain a deeper understanding of how different types of robots are currently being used, and how their use impacts the stakeholders in aged care settings, including both older adults and care providers.

2.2 Social robots and older adults

Prior work on older adults and social robots has investigated older adults' attitudes towards having robots to assist them with their daily lives [3, 10, 63], their perceptions on the design and potential value of robots [20, 42, 64], and their experiences with using robots [15, 32, 53, 54]. These studies focus on both older adults living independently and older adults living in residential care homes.

Research has identified that although social robots can potentially provide multiple benefits, they are not suitable for all older adults. Birks et al.' work has shown that cognitively intact residents showed less interest in Paro than did residents with cognitive impairment [11]. Moyle et al.'s work has found that although many older residents reacted positively to Paro, its introduction in some cases elicited strong verbal and behavioural negative reactions [53]. In a pilot study with a robot teddy bear CuDDler, some older people with dementia had no engagement with the robot [54]. Similarly, a ten-week study by Melkas et al that implemented the humanoid robot Nao in several care facilities reported that Nao did not engage all residents. While bringing happiness to some, the robot evoked irritation and fear in others [50]. Therefore, to ensure that using robots can provide benefits to older adults without incurring harm, it appears to be essential to match the robots with older adults' individual needs and interests.

Furthermore, robots may create ethical issues. Turkle (2020) recounts studies of bringing robotic dolls into nursing homes, noting that some residents in the studies formed strong emotional attachments with the robots and projected their emotions toward family members onto them [76]. Turkle was concerned that the relationship formed between a human and an emotionless robotic companion could deceive older people [76]. A recent CSCW study investigated how independent-living older adults perceive the impact of different types of companion robots on their dignity and autonomy, and found that companion robots could strike some older adults as patronizing and demeaning [20]. Similar findings are shown in earlier research that reported robots could elicit negative feelings about stereotypes related to old age, such as being lonely and frail. In that study, healthy older people tried to distance themselves from the robots [63].

In the context of residential aged care, older adults tend to be frail care recipients with complex care needs [57]. In such settings, older adults are social actors working in partnership with their caregivers, rather than individual users of the technology [17]. Therefore, when robots are used in care settings, caregivers are important stakeholders whose perspectives and experiences as technology users merit consideration, alongside the views of older adults.

2.3 Social robots and care staff

Previous HCI research has identified that the effectiveness of technologies in aged care depends not just on older adults' responses to the technologies, but also on the involvement of caregivers. Caregivers are often expert at interpreting older adults' needs, and assessing how the design of technologies can potentially meet these needs [6, 16, 21, 43]. Caregivers' attitudes towards technologies and their mediation in associated activities involving technologies can significantly influence older adults' interactions with technologies [15, 17]. Therefore, to ensure a long-term successful integration of technologies in aged care, caregivers apparently need to actively participate in the implementation process [78]. Prior work that involves caregivers in the design and use of robots in aged care has investigated both family caregivers [6], and professional caregivers, or care staff [62]. In our study, we focus on care staff experiences of using social robots in their workplaces. In the following, we review the literature associated with aged care staff and social robots.

Some previous research has examined care workers' attitudes towards the use of social robots in care settings. This body of work has reported that staff generally have positive attitudes towards working with robots. Staff anticipate that robots can assist them in several ways, such as making the treatments more interesting and diversified, reducing their work burden, and increasing efficiency [18, 60, 80]. A major limitation of this body of work is that participants (staff) have limited or no previous experience using robots. It was therefore difficult for staff to fully evaluate the functionalities of robots, and their opinions are likely to be based on their needs [18, 51, 75, 80]. Due to this limitation, a recent study by Chen et al. suggests that care staff experiences of using robots should be an area of future study [18]. This is the topic we explore in this paper.

Interestingly, although the above literature indicates that care staff want the robots to enhance their work, in empirical trials that have implemented robots in care institutions, care staff have highlighted the benefits that robots provide to residents, rather than to themselves [46, 52, 59]. Discussion about how the use of robots can benefit care staff themselves remains limited [60]. To our knowledge, only a small number of studies have reported the positive impact of robots on care staff. One study with Paro found that the relationships between therapists and residents deepened through the use of Paro [11]. Another study with robocats concluded that care workers' burden was reduced since the robocats could reduce agitation and anxiety for residents living with dementia [48]. Studies with Nao found that some staff experienced more fun at work when using the robot [30], and some staff who were shy about instructing exercise movements publicly felt relieved because Nao could do this task for them [49, 50].

In some cases, the introduction of robots seems to bring more challenges than benefits to care staff. For example, technical problems can make care staff frustrated and can consequently lead to less frequent use of the robots [26, 30]. Some staff members have ethical concerns that using robots will infantilize residents [11] or substitute for human care [49, 50]. Further, some staff have voiced concern that robots might pose a threat to their jobs, and therefore were reluctant to accept robots into their workplace [26].

Another key consideration is the added workload for staff who already have busy schedules. For example, because Paro cannot be machine washed, keeping it clean and preventing infection can add extra work and responsibility for staff [31]. In addition, learning to involve an unfamiliar robot in care activities requires care staff to dedicate time and to adjust their work routines, which can

cause tension and result in some staff members' negative attitudes towards the robots [16, 49, 50]. A qualitative study that involved trying Nao in three care facilities for ten weeks showed that whereas Nao created positive interactions with residents, it presented many challenges to care staff, due to the extensive time required in training to use and in operating the robot [59]. Similarly, an interview study with staff using Paro found that although care staff acknowledged the positive effects of Paro on residents, they abandoned it in care routines because of multiple practical difficulties [58], including low availability of Paro, lack of knowledge and training about how to use it, fear of breaking an expensive device, and hygiene issues. Drawing on the difficulties staff faced, studies emphasize the need to provide training and technical support to staff [30, 49, 50, 58]. These studies illustrate that the challenges encountered by care staff in the deployment of robots are not only influenced by the technology itself, but also, and perhaps more importantly, by the socio-technical context in which the robots are used.

Researchers have argued that we need to investigate human-robot interactions in real-world situations, to get a deeper understanding of how social actors engage with and appropriate robots into their daily lives, and how robots fit in and influence social environments [34, 59, 62]. While existing studies have sometimes revealed the complex impact of social robots on care staff and older adults, most of them are short-term trials, and the use of robots is initiated by researchers rather than care institutions. Such research cannot therefore provide information on whether and how robots will be used beyond the research trial. When used in a more ongoing way, robots may lead to more positive responses and/or place new challenges and requirements on care staff than in a limited research period. In research trials, researchers often act as moderators to facilitate the interactions between robots and older adults, and manage technical problems. However, busy care staff may feel overwhelmed to do these tasks when not supported by a research team [15].

In the limited studies that report the use of robots outside research settings, Niemelä et al.'s work [58] and Thunberg et al.'s work [74] have shown that many factors can hinder the long-term use of robots in daily care routines. For example, care staff may have less time and low intention to facilitate the use of robots. They can have trouble getting access to the robots when needed and may fear breaking the expensive devices. Also, older adults' interest in robots may change over time, and care staff need to respond to these changes. These findings point to the complexity of using robots in real-world settings and implies that more research is needed to explore factors that impact real users' experience of using robots in their daily lives. Furthermore, this body of research has examined the implementation of a single type of robot, but an understanding of how staff engage with a range of robots is missing. In this study, we aim to address these gaps by focusing on the perceptions of care staff who have had experience in using social robots (humanoid and animal) in long-term aged care settings.

3 METHODS

3.1 Participants and recruitment

We met some difficulties in recruiting participants due to the restrictions in aged care facilities associated with the Covid-19 pandemic. During the time of our research, many aged care facilities in Australia were locked down and not allowed to have visitors or volunteers. In addition, care staff could only work at one aged care facility, whereas many of them normally worked at two or more facilities. Therefore, many aged care homes faced a serious shortage of personnel while managing Covid-19 outbreaks, which caused heavy workloads for care staff. In this situation, it was quite difficult to ask care staff to devote their time to our research. Furthermore, we aimed to recruit staff who worked in care facilities that have used or are using social robots, but social robots are not widely used in Australian aged care homes, and so our sample size is necessarily

limited. Nonetheless, we were able to access a number of committed respondents who provided us with valuable insights.

We used purposive sampling to select participants. At first, we sent our advertisement to a broad range of aged care facilities and posted it on social media, but we got limited responses. We then focused on the care homes that have been featured in online news stories about their use of social robots for aged care residents. We contacted these facilities directly. In addition, we asked some participants to recommend their colleagues to us.

Eleven staff members working at different care locations across six Australian residential aged care organizations agreed to participate in the study. All the care facilities provide long-term care to older adults who cannot live independently, including people living with dementia, and those without dementia but cannot live by themselves. Participants all had previous experiences of using social robots for older adults as part of their care practice. The robots were owned by the aged care facilities where they worked for, and can be categorized into two types of robots: robopets, including Paro and JFA robotic cats and dogs; and the humanoid robot Nao. Except for Doris who had used Nao for three months, three participants (Carol, Amy, Fiona) had used Nao for over a year while working at different care homes in the same aged care organisation, which we have called Blossom Aged Care. Another three participants (Emily, Noah, Oliver) worked at different care homes run by Heart Aged Care. They had experiences of using both Nao and robopets. Oliver had used Nao for over four years, since it was first introduced into Heart Aged Care. Emily and Noah had used Nao for over two years. All had used robopets for over two years. The remaining four participants (Helen, Julia, Kate, Betty) worked at different aged care organizations and had used robopets for different periods. Helen had just started using robopets for one month. Julia had used robopets for about eight months, and the other two had used robopets for over two years. Participants' job roles included nurse, care manager, lifestyle coordinator, therapists, and director. Overall, two participants are male, and the others are female. To protect privacy, the names of participants and care facilities are pseudonyms. Detailed information about participants is listed in Table 1.

3.2 Data collection

We conducted nine in-depth semi-structured interviews from July 2020 to January 2021, and two additional interviews in August 2021. Because of the Covid-19 restrictions, all the interviews were conducted online via Zoom with individual participants. The study obtained approval from the ethics committee of our university, and every participant provided verbal informed consent after reading an information sheet that provided full details of the research.

The first author conducted all the interviews, which lasted approximately one hour each. First, we administered a brief questionnaire to gather the demographic information of participants and their experience with robots to inform the interviews. Then in the interview, the interviewer asked background questions about the care facilities participants worked in and their job roles, and questions that focused on their experience of using robots, their perceptions of the design of robots, and ethical issues related to the use of robots. Questions included: Can you tell me about your experience of using robots in your work? How did residents and other care staff respond to the robots? Have you received any negative feedback? What benefit do you think the robots can bring to residents? What benefit do you think the robots can bring to care staff? What challenges do you face when using robots? How do you overcome the challenges? Do you have any concerns about potential risks or ethical issues of using robots? Do you think the robots you have used supplement or replace human care? Do you think residents can form an emotional bond with those robots? If you can design a future robot for aged care, what kind of robot would you like to design?

Table 1. Information of participants.

Pseudonym	Gender	Job role related to the study	Robot(s) used	Robot(s) use time	Aged care facility pseudonym
Amy	F	Director of care	Nao	1–2 years	Blossom Aged Care
Carol	F	Lifestyle coordinator	Nao	1–2 years	Blossom Aged Care
Doris	F	Professional care assistant	Nao	3 months	Blossom Aged Care
Fiona	F	Lifestyle coordinator	Nao	1 year	Blossom Aged Care
Noah	M	Diversional therapist	Nao Paro Robocat	2–3 years	Heart Aged Care
Emily	F	Director of nursing	Nao Paro Robocat	2–3 years	Heart Aged Care
Oliver	M	Lifestyle coordinator	Nao Paro Robocat	Nao: 4–5 years Paro, Robocat: 2–3 years	Heart Aged Care
Helen	F	Occupational therapist	Robocat	1 month	SPQ Aged Care
Julia	F	Care manager	Paro Robocat	2–3 years	Best Aged Care
Kate	F	Lifestyle coordinator	Robocat Robodog	2–3 years	Japa Aged Care
Betty	F	Lifestyle coordinator	Robocat Robodog	8 months	Net Aged Care

Would you recommend the robots to other aged care facilities? Where necessary, we also asked appropriate follow-up questions to further clarify and probe participants' responses.

3.3 Data analysis

All interviews were audio-recorded and then transcribed verbatim for analysis. We employed thematic analysis as outlined by Braun and Clarke [13] to analyze the main themes in the interview data. After reading the transcripts several times and becoming familiar with them, the first author generated a list of initial open codes inductively, and then synthesized and grouped the codes to create higher-level themes [13]. The first author created a codebook with all the themes and discussed them with the research team. All authors reviewed and refined the codes and themes several times, and reached an agreement on the final results. The initial analysis centered on themes related to the benefits of using robots for residents and care staff, and the difficulties participants have experienced. As analysis proceeded, we realized that the benefits that the use of robots brought to both care staff and residents were closely related. Through this iterative analysis process, we further focused on themes that reflect similarities and differences between robopets and humanoid robots. Finally, three key themes and seven subthemes were derived from our data analysis, which we discuss in the Findings section below.

4 FINDINGS

4.1 How robots are used and perceived by care staff

In this theme, we report on how care staff integrate the robopets and Nao in care processes and their general perceptions of these robots. This theme includes three subthemes: a) integrating the

use of robots in various care activities, b) adapting the use of robots to individual needs, and 3) different experiences of using Nao.

4.1.1 Integrating the use of robots in various care activities. Participants used robopets as therapeutic tools to reduce residents' negative emotional and behavioural symptoms like agitation and depression, and as companions to provide companionship and comfort to residents. Participants noted that robopets had significant social and emotional benefits for residents living with dementia. Noticing the potential benefits of robopets, some participants extended the use of robopets into a broader range of care activities. For example, Emily used robopets in end-of-life care to console residents. She said: *"When people are edging towards the end of their life, they [Paro and robocat] are really comforting."* Julia used Paro in wound care to reduce the use of pain-relieving medicine:

> *"Rather than giving analgesia 20 minutes prior to taking the [wound] dressing down, we were experimenting with their [residents'] permission … to interact with the robot [Paro]… They became so engaged and so enthralled by the robot that they forgot about the dressing."*

Participants who had used the humanoid Nao also talked about their experience of trying to create meaningful activities with it. For example, Doris shared an example of expanding a traditional music activity involving Nao into a public concert which she thought was a special and enjoyable experience for residents.

> *"We actually ended up doing a concert with the robot [Nao] and the residents, the family members and people from head office at the care home with a lot of hard work…Especially when we did sing-alongs and the whole group was singing together with this robot, there was a lot of joy."*

Similarly, Emily creatively involved Nao in residents' daily routines to provide enrichment and proactive engagement:

> *"We used to get them [Naos] in a morning, and they'd go knock on the door to wake people up and say, 'Good morning. Will you come in for breakfast?'... They [residents] were so engaged with them [Naos]."*

4.1.2 Adapting the use of robots to individual needs. Participants reported that since robopets did not suit each resident, to facilitate an effective interaction, they tried to embed residents' past relationships with animals into their personalized care plans. Noah provided an example of this personalization:

> *"We do assessments when they [residents] first come in, such as asking them what's their favourite animals, and some will say cats. For them, the cats [robocats] will generally work a hundred percent of the time. Some of them will say, I hate animals. We won't try because they [the robopets] won't be effective... So it just depends on the person's life history and what they like."*

In addition to understanding residents' preferences, Kate emphasized the importance of respecting residents' perceptions of robopets while using them:

> *"They [some residents] think they [the robopets] are real... We treat them [robopets] as real too. We don't just grab them and throw them back in the trolley... They [residents] see the respect that we have towards the animals [robopets], and the same sort of being is with them."*

Carol shared an example of using Nao to meet the emotional needs of a particular group of residents who could not speak English. She thought it was a rewarding experience for her to help those residents:

> *"Some of the most rewarding days I've worked with Nao were with some people who didn't speak English. They are in our facilities and, of course, must be so isolated, so lonely. I would just program some songs in their language… When you watch these people's faces, they just light up and it [Nao] makes them get quite emotional."*

4.1.3 Different experiences of using Nao. Interestingly, whereas participants showed predominately positive attitudes towards robopets, their perceptions of Nao were more varied. Many participants noticed considerable positive engagements between residents and Nao in diverse entertainment care activities. However, a few participants thought Nao could not provide meaningful value to residents and stopped using it eventually.

Participants who were positive about the benefits of Nao used words like 'brilliant', 'tremendous', and 'amazing' to describe residents' responses to Nao. They thought the fresh and different experience that Nao brought could intrigue residents' curiosity and provide them with an opportunity to *"get away from their normal sitting in their chair"*, as Amy put it. They also noted Nao could bring substantial joy to residents. For example, Carol programmed Nao to welcome residents, play games with them, and also have brief one-on-one chats. She said that most residents enjoyed interacting with Nao:

> *"She [Nao] is like an entertainment tool and really most of the residents absolutely loved it… A lot of them [residents] looked forward to seeing her [Nao]."*

In contrast, Noah and Oliver found residents lost interest in Nao very quickly. Noah thought robopets were more valuable than Nao because they could engage with residents for a much longer time:

> *"Residents with dementia will laugh at it [Nao] for about five to ten minutes, and then they'll lose interest pretty quick, compared to Paro and the cats [robocats] where they could be engaging with them for hours... They [residents] can have a laugh for ten minutes, but is it really a truly meaningful interaction?"*

Oliver observed that residents' initial response to Nao was positive, but as they got used to the robot, it was no longer attractive. However, residents sustained a longer-term interest in the robopets:

> *"It [Nao] was something new and really interesting. But then two, three, maybe a month down the line, it's pretty much the same thing… They [residents] were so excited for a few times, and then they just became, 'Oh, we're doing this again.' … I don't think there's a novelty with the pets [robopets]. I believe that they [residents] believe themselves that the pets [robopets] were real animals, so they're really happy to spend time with them."*

Participants also had different opinions on the relationships between older adults and Nao. Emily thought Nao could play as *"a perfect companion and friend"* for some residents who were socially isolated. However, Noah thought it was natural for residents to build an affectionate relationship with a familiar animal-like robot, but building a relationship with *"a gimmick toy"* like Nao was hard:

> *"It [Nao] is not really a companion since there's no sort of familiar aspect... It is obviously hard for people to relate to it on a personal level. Whereas that cat [robocat] is a home familiar type. When they [residents] have dementia, a lot of them do believe at times it is a real cat."*

4.2 Perceived value of using robots for care staff

When reflecting on their experience with robots, participants also talked about the reciprocal value of using robots for care staff, in addition to the benefits for residents. In this theme, we focus on

participants' views on how the use of robopets and Nao benefits care staff. This section includes three subthemes: a) reducing care staff job stress, b) expanding opportunities for providing social care, and c) increasing care staff job satisfaction.

4.2.1 Reducing care staff job stress. Some participants noted that robopets enabled care staff more freedom to allocate their time. They said taking care of residents with dementia could be a particularly stressful part of the care job. In addition, staff usually had a heavy workload because they were responsible for caring for many residents. Therefore when some residents were occupied with robopets, staff were sometimes less stressed, as Noah said:

> *"The cats [robocats] and Paro kind of act like a staff member in a way, because obviously those residents will start interacting with a cat rather than the staff and we'll allow the staff to do other things. So they [the robots] give that kind of rest spot period to staff, making sure that they're able to keep going without having that mental fatigue."*

Helen shared a similar case that a robocat successfully calmed down a resident who was a wanderer and who got easily agitated, and significantly reduced the stress of caring for her. Interestingly, she noted that care staff tried many methods but found the robocat was the only way that could change the residents' behaviour:

> *"... We have to basically provide one-to-one care to her [the resident]... We tried a few things... but they just didn't work. So, we started to use the cat [robocat] a few weeks back, and it works very well. The resident just sits there and then pats the cat for a whole day. When she can sit down, we can feed her at lunchtime. We were really surprised what it [the robocat] did."*

4.2.2 Expanding opportunities for providing social care. Some participants noted that Nao introduced a novel and impressive experience for them. Because it was their first time using a humanoid robot in aged care, several participants said they underestimated older adults' acceptance of Nao. Amy commented that using Nao helped care staff to *"see those alternate ways of socially engaging and using technology".*

Both Fiona and Emily highlighted the role of Nao in supporting diverse lifestyle activities. Fiona commented that enhancing social engagement with Nao could be very useful especially during the Covid-19 period when visitors were not allowed to enter aged care homes. Emily thought Nao could help staff to introduce meaningful activities:

> *"I think that they [Naos] can be a support mechanism. So, you could set the robots up to run classes. You can never have enough leisure and lifestyle purposeful engagement going on. And they would be able to introduce purposeful, meaningful activities with residents."*

Emily further remarked that Nao had the potential to support care workers in many ways, not only in lifestyle activities but also in other scenarios. For example, she shared her plan to use Nao as a doorman to welcome visitors and to bring new and interesting experiences to residents:

> *"What I really wanted to do, (was) to use him [Nao] as a concierge, because I thought that would be a beautiful way of taking visitors to go and see their loved one… I think they [Naos] really play a part with people in aged care."*

4.2.3 Increasing care staff job satisfaction. For Kate, the use of robopets seemed to be an enjoyable experience. She was happy when talking about her experience of using robodogs and robocats in the lifestyle activities she conducted. She said the activities lasted for an hour and the residents loved them the whole time. She described a video she took of residents' interaction with robopets to the interviewer:

> *"She [resident] is talking to the puppy dog [robodog]. The puppy dog's head is moving and then she laughed. She leans forward and says, 'Give me kisses, give me kisses.' It's just beautiful. It makes your heart melt."*

Although she was reflecting on the residents' experiences, Kate's description here suggests she found these experiences personally uplifting. Meanwhile, Julia explicitly expressed the view that using Paro could bring joy to care staff. She said staff members' mood was lifted by witnessing the pleasure residents showed when interacting with Paro:

> *"Staff also just get pleasure from seeing the interaction and the joy on the residents' faces. That makes their workday a lot more satisfying."*

In addition to bringing happiness to residents and care staff, robots could also help staff provide better care to residents. Participants appreciated that using robots helped them to fulfil their responsibility for caring. For example, Carol said that due to the heavy workload, she lacked time to socially engage with the residents, but designing and participating in the social activities with robots provided such an opportunity:

> *"I really looked forward to these days [working with robots]. It was just so rewarding to work with the social side of my patients and clients… I would definitely say job satisfaction was very high as a plus for staff."*

Noah talked about a similar case that helping a resident with a robocat increased his job satisfaction. This resident suffered from serious depression. She would isolate herself in the room and be constantly expressing suicidal thoughts. But when the care staff gave her a robocat, she began to come out of her room, despite still not actively engaging with other residents. Noah commented that this was a meaningful experience for him:

> *"If you can provide something that is even very small, like an electronic cat [robocat] that reminds them [residents] of comfort at times, then that helps us as well. Because we feel like we have given them [residents] something that really is meaningful to them, and really relates to them as a person and their old family life… That's ultimately what we're here for, to keep residents comfortable and happy."*

4.3 Perceived challenges in the use of robots

The key challenges participants encountered in their use of robots were related to two subthemes: a) difficulties associated with withdrawing and sharing robopets, and b) staff members' skills and willingness to facilitate meaningful interactions.

4.3.1 Difficulties associated with withdrawing and sharing robopets. Participants observed that some residents build an emotional bond with their robot companions. Although quite a few participants thought this relationship could reduce social isolation for residents, some noted that it was difficult to withdraw robots from residents who were strongly attached to them. For example, Emily said:

> *"We've got one lady that lives with dementia. Her cat [robocat] goes everywhere with her, seriously… If removing that cat, you will have a problem, because she loves him [robocat] so much."*

This problem was also obvious in group activities when residents needed to share the robots. For example, Noah said some residents would take ownership of the robopets and *"fight over"* them. This issue points to the frequently constrained resources available in aged care. Many participants said they needed to be able to purchase more robopets. For example, Betty said:

> *"The challenges are sometimes not having enough [robots]. We'll have residents in an area and if you've only got one, well we have to take it off and share it around, and sometimes we need more."*

To avoid residents' conflicts of the ownership of robopets in group activities, Oliver said in his care homes, robopets were more often used in one-to-one activities:

> *"We have used it [robopet] more for one-to-one than group activity. I find it's better with one-to-one because you've got less of that like if someone doesn't let it [robopet] go and somebody else wants to go with it. Sometimes that can create a little bit of friction."*

Julia mentioned that the design of robopets brought some further challenges associated with robot use in group settings. Taking Paro as an example, she said since the fur of Paro was hard to clean and could not be cleaned by washing machines, sometimes cleaning Paro took a long time. While waiting for staff to clean Paro in group activities, some residents would be very nervous:

> *"When we remove it [Paro] from one resident, and wipe it down before giving it to another, we had to be mindful. There was a lot of anxiety around those times as to what we were doing, where we were taking it and why we were removing it. So they [residents] reacted and felt very protective towards it."*

4.3.2 Staff members' skills and willingness to facilitate meaningful interactions. Several participants said facilitating the interactions between residents and Nao may cause stress to some staff members. For example, Noah said it was hard for staff to prolong residents' interaction with Nao. Oliver thought solving this problem needed knowledge of technology, but it was beyond his capability:

> *"I think our biggest barrier to the use of it [Nao] more is to program it to do things that would keep things a bit more excited and a bit more innovative… It [Nao] is great. I just wish I was better with the tech itself."*

However, for Carol, mastering technology was not difficult. She thought the main problem lay in whether staff were willing to try and use the technology. She believed that the main thing staff needed to do was to understand residents' interests in order to break the ice between residents and Nao. But she acknowledged that engaging withdrawn residents in social activities involving robots was challenging to some staff members, especially those who were introverted or who did not know residents very well.

> *"A lot of staff were very frightened of the technology and very frightened that they would be asked to do what I was doing. The silly thing is it's so easy. You don't need any computer speed. You just need to connect with people and ask them questions... There will be others [staff] who probably would struggle very much on how to get a program, or even the interactions with the robot [Nao]... You definitely wouldn't want a real introverted person running a group like that. They need to initiate a lot of that interaction by knowing the person [resident] and trying to draw a response." (Carol)*

According to Emily, who had used three kinds of robots, staff needed to match the characters of robots to the preferences of residents to enhance their effective use. Since robots were not a one-size-for-all solution in aged care, pursuing a person-centered approach was not easy. She suggested that it was crucial to provide care staff with appropriate training and to engage them to run the programs with robots, because otherwise she observed that the robots might be easily abandoned by staff members.

Similar to Emily, Amy also found it was common for staff to reject the new technology. She commented that a technology champion who was interested in operating the programs with Nao was essential for its success:

> *"You always get the ones that you find those people that are the key champions. I think that's one of the important points, is to ensure that it's somebody interested in technology and let her take on the role. Because it's not mandated, "You must do this." There's always someone who's fascinated with technology."*

Emily and Amy highlighted that staff motivation and proper training were key to the successful implementation of robots in aged care. The example of Carol verified this point. Carol was a technology champion for the use of Nao. She wrote a training manual which Fiona praised was very easy to follow by staff who were not good at using technology. Carol was also very enthusiastic about promoting the benefits of Nao. She intentionally made the manual public for staff in other aged care facilities to learn how to use the robot. She said:

> *"I actually wrote a manual on how to use these. It was there for other people from other facilities, not just ours. Where they could get the manual and get a Nao, they can start the programs in their own facilities... You can't just put something like this into an aged care facility with no training. Otherwise, it's just going to end up in the cupboard. If you're going to have such an amazing tool like Nao in the facility, it should be used."*

5 DISCUSSION

This study aims to identify the benefits and challenges of implementing different types of social robots in real-world aged care practice from care staff perspectives. We conducted semi-structured interviews with eleven professional caregivers who have first-hand experience of using social robots in aged care daily practice. By exploring the voices of experienced care staff, we seek to shed additional light on the impact of robots in the aged care system.

Drawing on Actor-Network Theory [83], Hornecker et al. propose the idea of a triadic interaction structure among care staff, older adults, and robots [29]. They argue that it is necessary to understand the deployment of robots in care settings through the lens of this structure. Our findings support this perspective, and extend it by adding insight into how the use of robots in real-world settings is shaped by the intertwined relationships among the three actors in the triad: robots, caregivers, and aged care residents. Care staff and older adults can influence how robots are used; the use of robots in turn can shape the practice of care staff and their relationship with older adults. Older adults can also build relationships with the robots, which adds complexity to their work.

In this section, we explore the interplay among the actors in this three-way relation. To answer our research questions, we first discuss how the use of robots benefit care staff and shape the reciprocal relationship between care staff and older adults. We then compare the challenges caused by different types of robots and raise some related ethical issues. Finally, we briefly expound the lessons for the future deployment of robots in aged care.

5.1 Robots may support a mutually beneficial relationship between care staff and older adults

Care staff at long-term care facilities can face substantial job stress. For example, exposure to the agitated behaviour of residents with dementia and the death of residents who they cared for can cause emotional exhaustion to care staff [87]. The high demand of caring for residents with cognitive and physical decline, combined with organizational factors, such as staff shortage and high turnover, results in heavy workloads [22, 72]. Moreover, some care staff struggle to balance the procedural and profit-driven job tasks and their desire to provide genuine care. This tension sometimes makes them feel that they are being instrumentalized and that their work is undervalued [35]. Further, care staff sometimes cannot get enough organizational support. Their needs, motivations and personhood are often ignored, partly because the primary focus in care homes is the wellbeing of

residents [35]. All these factors threaten staff wellbeing, and impede their willingness and ability to provide compassionate and person-centered care to residents [35]. In this way, the wellbeing of care staff crucially influences the quality of care delivered to residents [4, 47].

The care staff we interviewed appeared to be motivated by the desire to provide good care to the residents of the aged care homes in which they worked. Participants spoke of the joy they experienced when residents were comforted by robopets or when residents experienced social enrichment through interactions with Nao. Our findings therefore suggest that staff could obtain vicarious pleasure from seeing older adults' joyful emotions when interacting with robots. Staff also felt more rewarded and fulfilled because they could provide better care to residents and have closer relationships with them. On a more practical level, staff found the use of robots could ease their work by reducing the agitated behaviours of residents and keeping them occupied.

Since staff burnout and compassion fatigue are associated with emotional exhaustion, feelings of detachment from the job, and low self-accomplishment [39, 87], the positive impact of the use of robots on care staff may contribute to reducing burnout and improving wellbeing. Care staff play an essential role in mediating and scaffolding interactions between residents and robots [15, 29]. The enthusiasm of care staff can drive them to initiate and extend the use of robots in more care situations, and lead to effective integration of robots in daily routines to provide better care to residents, potentially promoting a healthier care system.

These observations point to an interesting link between the benefits of social robots for older adults and the benefits for staff members that has not been previously discussed in HCI and CSCW research: the benefits that robots bring to older adults can have various reciprocal positive impacts on staff as well. Social robots seem sometimes to create a positive cycle that amplifies the benefits and wellbeing of both care staff and older adults. In this cycle, staff and older adults' interests are aligned and interdependent. We argue that this aligned relationship can be important for a healthy care system. Research has revealed that the demands of caregivers who care for people with mental disabilities and the demands of care recipients can conflict in some situations [35, 88]. For example, when care recipients become agitated, they may show verbal and physical aggression or offensive attitudes to caregivers, making caregivers feel upset and even abused [35, 88]. This can in turn negatively affect the quality of care delivered. A healthy care system should respond to the needs of all actors involved and where possible foster a mutually beneficial relationship between them.

Some participants in our study showed notable enthusiasm for incorporating robots in daily practices despite the challenges they met. They promoted the use of robots in different care situations and adapted the use of robots to residents' individual needs, acting as initiators, promoters, and designers in the implementation of robot use. For these participants, using robots was not considered an externally imposed obligation. Rather, their willingness and passion for using robots seemed to be driven more by an intrinsic motivation. Niemelä et al.'s study has identified that the challenges that care staff meet in the implementation of robots can impede their desire to adopt robots as part of the ongoing care routine, even if robots can bring benefits to residents [58]. Unbehaun et al. argued that successful integration of technology into the daily life of people with dementia is bound up with the added value that using technology brings to caregivers, and not just with the value it provides for care recipients [78]. In line with these studies, our findings suggest that the mutual benefits that robots provide to older adults and care staff may be an important factor in motivating care staff to use robots in the long term for the benefit of residents.

5.2 Different robots can bring different challenges to care staff

One challenge care staff perceived is facilitating the interactions between older adults and robots. Our findings suggest that the design of the robots may influence this challenge. Robopets are designed to semi-realistically mimic real pets. Their cuddly appearances and comforting tactile feel

can naturally evoke relaxation in some older adults [73, 82]. As found in prior work, when using robopets, care staff can act as observers without participating in the interactions between older adults and robopets [62], or leave the robopets with residents all day [74]. This ease-of-use feature is especially valuable for busy care staff who are overwhelmed by routine tasks. Humanoid robots, on the other hand, are generally more advanced and sophisticated in terms of the interactions they can have with the people using them. One advantage of humanoid robots over robopets is that they are programmable. Consequently, as some participants remarked, they have greater potential to support care work in diverse ways. Nao, for example, can move, dance, play music, and have dialogues with people [69]. Therefore, it has more interaction possibilities than robopets.

However, all these interactions need to be operated and programmed by care staff. In addition, humanoid robots are unfamiliar to residents, and they may also act unexpectedly due to technical issues. These features make them liable to confuse residents. To ensure a smooth experience in using humanoid robots, care staff need to explain the robots to residents and mediate their interactions. In line with previous work [15, 50], our findings suggest that the use of humanoid robots depends heavily on moderation and initiation from care staff. As mentioned by our interviewees, not all care staff are familiar with technologies and able to handle the interactions between older adults and humanoid robots. For these staff, incorporating robots in their work may add stress and lead them to abandon robots in their care practices. Since the use of humanoid robots depends more on the capability of care staff than the use of robopets does, robopets may be suitable for a wider group of care staff than humanoid robots.

Unlike in short-term research trials, in real-world situations robots are being used by care staff as part of their daily practice over a longer period. Older adults' preferences for different types of robots may change over time, which may not be sufficiently captured by research trials. Some participants who have used both robopets and Nao noted that older adults' interest in Nao decreased over time, but their interest in robopets remained high. Consequently, to maintain residents' interest in Nao for a longer period, care staff need to expend constant effort in programming new activities in Nao. The added long-term responsibility may cause challenges to care staff who already have busy working schedules. In the care homes where our participants work, some technology champions were able to successfully employ Nao. However, considering the high turnover rate of staff in care homes, this may not be a sustainable situation over a long period.

It should be noted that our work cannot prove that older adults' changing interests in robots are caused by the design features of the robots; ours is a qualitative study with a small sample size. Many factors may impact older adults' long-term interactions with robots, such as the progression of their dementia, the time needed by care staff to take care of the robots, and the frequency and length of engagement between older adults and robots [73, 74]. Currently, there are few previous investigations into how older adults' preferences for robopets and humanoid robots change over a long time in aged care settings, except for a limited number of studies reporting that robopets do not have an obvious novelty effect on older adults [12, 73, 82]. Our findings prompt interesting questions about whether different robots have enduring value for care staff and older adults, and how their interest in robots may change. This warrants future research.

Previous studies identify that introducing advanced robots can bring technical challenges to care staff [26, 30]. Care work is normally viewed as an area remote from technology, and care staff are regarded stereotypically as having little knowledge of innovative technologies [21]. In a recent study on potential users' perceptions of care robot orientation, researchers doubted whether professional caregivers can meet the requirements of providing training and orientation for using robots, because they lack enough technical knowledge and positive attitudes [33]. Our findings differ. For example, in our study Carol served as a technology champion in using Nao. She was proficient in programming Nao to engage with residents. She also developed training materials

for the use of Nao, which were very helpful to other staff. Such examples reveal the diversity of care staff interests, skills, and motivations. Care staff should not be simply considered as a group of people with uniform expertise in using new technologies. Indeed, some staff may be more suited than others to learning and operating new technologies, and thus it is important to involve them in the process of deploying new technologies in care homes to ensure successful and effective implementation.

We found that the use of robopets raised the ethical and practical issue of balancing scarce resources and high demand. Research reports that older adults can build strong attachments with robopets and are sometimes hesitant to share them among others [38, 74]. Our participants raised similar issues. A study by Thunberg & Ziemke [74] described a case in which two residents were upset when they could not both have the only robocat that they became attached to. Staff had to borrow another robocat from another facility to solve this problem. Similarly, our participants said that they use robopets in a one-to-one way rather than in group sessions to avoid the ethical and practical problem of sharing scarce robot resources. Nonetheless this does raise a general problem: What should happen when there are more older adults who need robots than there are robots available? Due to the financial constraints, it is difficult for care homes to offer robopets to every resident who wants one. So how can care staff decide who should own the robopets and how long individuals may play with robopets, when many residents are, perhaps to different degrees, significantly bonded to them?

These questions point to the ethical issue of justice and fair opportunity, an issue that occurs frequently in healthcare in the context of scarce resources [8]. Considering that residents living in care homes are a vulnerable population who may benefit from interacting with robots in a way that may not always be achieved by other objects or interactions (as is shown in the example shared by Helen, where a resident with dementia could not be calmed except by interacting with a robocat), care staff should be aware of a principle of justice or fairness when distributing robots. Of course, this issue is by no means straightforward, and organizational regulations may be required both to ensure fairness for residents and to relieve staff of making ethically dilemmatic choices without support. From this angle, it is clear that the relationships between older adults and robots can add complexity and challenges to care work, even as they bring advantages.

5.3 Lessons for future deployments of robots in aged care

In light of the above findings, individuals who are thinking about introducing robots into aged care may wish to consider some key factors. When incorporating robots in aged care, it appears to be important to engage with and motivate care staff to actively participate in the process of deployment. Different robots place different requirements on the capabilities of care staff. Some advanced robots are more suitable for staff members who are personally interested in using such technology. In addition, it is worth recalling that care staff may receive reciprocal value from the benefits that robots bring to older adults, and that this value may significantly influence staff members' motivation to use and to keep using robots in their care work. We have emphasized that successful and sustainable deployment of robots in care practice might involve recognizing and promoting mutually positive impacts for both human parties in the older adult/carer/robot triad. Ideally, the practice of using robots needs to align with the needs and interests of both caregivers and care recipients.

Robots play different roles for care staff and older adults. For care staff, robots are useful tools that can support them to provide a better quality of care. In contrast, older adults may consider robots as their friends and form emotional attachments with them. This can create an ethical challenge in real-world settings when limited numbers of robots are available and there are many older adults who wish to use them. If resourcing allows, we recommend that care institutions consider

adopting a one-to-one policy when using robots in aged care, providing enough robopets for all residents to have access to them when required. We further suggest that aged care institutions could benefit from manuals or guidelines that consider the relationships between older adults and robots, between staff and older adults, and between robots and staff.

5.4 Limitations

A major limitation of our study is the small sample size, which may result in possible sample selection bias [27]. There is a high possibility that only those who had a positive experience chose to participate in our interviews. Our participants may be more positive towards robots than they would because they were being interviewed by researchers who work on robots. Nonetheless, it is also true that participants did reflect a range of both positive views and negative views about robots. In addition, our participants individually had experience with very few types of robots. These robots may not reflect a bigger picture of how robots are used in aged care facilities and of the impacts that other kinds of care robots may have. Furthermore, our research drew only on care staff perspectives. It is possible that staff members' perspectives could be different from residents who have direct interactions with robots, and from family members who have observed their loved ones interacting with robots in aged care. We want to stress that it would be both methodologically unsound and ethically inappropriate to ignore the viewpoints and needs of the residents themselves, including when advice and recommendations are given about robot usage. Accordingly, our work must be considered alongside past (and future) studies that focus on the perspectives of older people [20]. Nevertheless, it is also worth emphasizing that the needs and interests of older people in residential aged care, and the staff who spend time with and care for them, are sometimes strongly mutually dependent and may often be most effectively promoted together.

6 CONCLUSION

This paper presented an interview study that aimed to identify the benefits and challenges of using different robots in real-world care practice from care staff perspectives. We found that social robots could add value to aged care by supporting a mutually beneficial relationship between care staff and older adults. Indeed, it is an important finding that the interests of care staff and older adults in relation to robots are sometimes intertwined: what benefits older people can in turn benefit care staff—and vice versa. However, it can also be challenging for staff members to develop skills in using the robots, and for dealing with the practical and ethical issues raised by older adults' attachment to robots. Through a comparison of participants' experiences with robopets and humanoid robots, we highlighted that the two types of robots can bring different benefits and challenges in aged care. We provided some insights into how to increase the beneficial use of robots in real-world contexts. We also argued that to ensure robots provide benefits to older adults in care settings, HCI and CSCW researchers, and perhaps aged care providers, should understand the entangled relationships among the actors in the older adult/carer/robot triad, and enhance positive impacts for both human parties in the triad.

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