A Robot of My Own: Participatory Design of Socially Assistive Robots for Independently Living Older Adults Diagnosed with Depression

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Abstract. This paper presents an ongoing project using participatory design methods to develop design concepts for socially assistive robots (SARs) with older adults diagnosed with depression and co-occurring physical illness. We frame SARs development in the context of preventive patient-centered health-care, which empowers patients as the primary drivers of health and aims to delay the onset of disease rather than focusing on treatment. After describing how SARs can be of benefit in this form of healthcare, we detail our participatory design study with older adults and therapists aimed at developing preventive SARs applications for this population. We found therapists and older adults to be willing and able to participate in assistive robot design, though hands-on participation was a challenge. Our findings suggest that important areas of concern for older adults with depression are social interaction and companionship, as well as technologies that are easy to use and require minimal intervention.

Keywords: Assistive robotics · Social robots · Participatory design · Elderly · Depression · Patient-centered healthcare

1 Introduction

Recent years have seen the proliferation of socially assistive robots (SARs) developed to improve the functioning and quality-of-life (QOL) of people who experience chronic and age-related health issues [1, 2]. Much of the research and evaluation related to these emerging technologies is performed in laboratories and institutionalized care settings (e.g. nursing homes) and focuses on treatment and rehabilitation. The growing focus on patient- and community-centered care, however, emphasizes that health is a daily and lifelong concern, not just an issue that becomes relevant when someone is diagnosed with a medical condition. Impacting health in daily life – prior to the development of illness or the need for institutionalized care (i.e. preventative healthcare) – therefore represents a novel opportunity for exploring applications of assistive robotics. This, in

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turn, brings up the need to understand how robots may fit into peoples' everyday lives and caregiving communities.

A noteworthy example of a space in which socially assistive robots might be used is clinical depression in the elderly. Depression is the second leading cause of disability in the United States [3]; clinical depression affects 15–20 % of older adults in the US [4]. One particular area in which SARs stand to be beneficial is in addressing loneliness, which is a key component of depression in the elderly and a risk factor for physical/cognitive decline in this population [5]. Research with SARs in institutionalized settings has shown that robots can help alleviate feelings of loneliness in older adults [6], suggesting they could provide therapeutic benefits that reduce symptoms of clinical depression in older adults living independently as well.

The project presented here explores how SARs could be designed for and used in the homes of older adults before they become institutionalized, with the aim of preventing or delaying the need for institutionalization. To address the social and ethical challenges of developing and deploying assistive robotic technologies in domestic settings, and in accordance with the paradigm of patient-centered care, we use a participatory design (PD) approach. This method actively involves relevant stakeholders – older adults with depression, therapists, and case workers – in deciding on the issues that need to be addressed by research, as well developing ideas for and evaluating new technologies. The long-term aim of our project is to provide a better understanding of appropriate designs, deployment methods, and uses of SARs that can lead to more successful technical and social outcomes. We also explore which PD methodologies are appropriate for co-designing assistive robots with older adults and staff. We describe the motivation for our work in more detail below, followed by a description of our participatory design methodology and initial results from stakeholder interviews and two participatory workshops held in the Summer and Fall of 2014. We conclude with a summary of lessons learned so far, and directions for future work.

2 Background and Motivation

2.1 Socially Assistive Robots in Eldercare

Socially assistive robots are expected not only to help people accomplish certain tasks, but also to have measurable behavioral, cognitive, or therapeutic effects [1]. Researchers have shown that the therapeutic effects of SARs on the elderly can include positive health impacts, decreased stress and improved mood, decreased loneliness and better communication with others [2]. One projected use for socially assistive robots is to complement therapists in the course of rehabilitation (e.g. [7]), as well as play both functional and affective roles in the lives of older adults. Care-O-bot, for example, supports independently living older adults by delivering meals and drinks [8]. The seal-like robot PARO [9, 10] is used as a social companion. Robots can also act as communication devices between older adults and remote caregivers (e.g. [11]).

SARs development has so far focused on two main contexts of use: the home, where robots can provide aid to independently living individuals, and institutions such as nursing homes and hospitals, where robots assist caregivers as well as older adults.

The development of SARs for these environments raises significant social concerns beyond the technical issues involved. Field studies of interactions between people and robots in hospitals (e.g. [12]), nursing homes (e.g. [13, 14]), and private homes (e.g. [15]) have brought attention to the effects of emergent social factors (e.g. workflow, user values and life histories, the physical environment) on the success and consequences of robots in healthcare. This suggests that developing SARs for everyday use requires research, design, and evaluation sensitive to the social context.

2.2 Healthcare-Related Challenges and Opportunities

A patient-centered, long-term view of health emphasizes the importance of preventive care for improving a person's quality-of-life over their lifespan [16]. This is particularly true in chronic illnesses, where a cure is often not available [17]; with issues like dementia, for example, delaying onset is a key strategy [18]. A preventive approach to health can also reduce costs and better aligns with patient preferences to minimize time spent in institutionalized settings [19].

SARs hold significant potential in supporting preventive healthcare, especially among the elderly. A majority of older adults (70 % of the broader population from which we draw our participants) have multiple co-occurring chronic health conditions and/or are at risk of several others. Development of mental illness in older adults (e.g. clinical depression) often precipitates a significant decline in physical health, which in turn often leads to the need for institutionalized care [20], and the incidence of co-occurring disorders only increases with age [21]. SARs can be used to directly intervene in this cycle, using the abovementioned benefits of SARs to assist users in their homes, before they become institutionalized.

2.3 Participatory Design and Healthcare

In concordance with patient-centered care and prevention, our approach is also informed by the use of participatory design methods to develop healthcare solutions. Over forty years of practice and research in participatory design (PD) for information technology has shown that negotiation of the social meanings, uses, and effects of technologies by various groups that stand to be affected throughout the design process can lead to more successful technical and social outcomes.

Applications of PD methodologies to robotics, though few to date, suggest that active participation in the design of robotic technologies can empower users with knowledge about technology, allowing them to take part in critical discussions of the potential social consequences and meanings of robots [22]. PD has been used to work with community members to build robotic sensing devices [23]; older adults have also evaluated assistive robot mock-ups in their homes to explore the potential uses and appearance of assistive robots [24]. Ezer et al. [25] found that technological experience, rather than age, was the main predictor of people's expectations from robots, suggesting that making older adults more aware of the technical possibilities of robots through PD could increase acceptance [26]. We can therefore expect stakeholders active in system development to be invested in and scaffold its deployment and use.

3 Method

3.1 Participants

Our participants were recruited among older adults (>55) experiencing co-occurring chronic mental (major clinical depression) and physical illness (mainly hypertension, diabetes, chronic pain, and cardiovascular disease), who receive treatment services from a large outpatient healthcare provider in rural Indiana, and care staff at the institution. The providers see over 80,000 distinct patients a year across 150 outpatient clinical sites in multiple states (e.g. Tennessee, Indiana, Kentucky, and Illinois). The director of one of the provider's facilities helped us identify appropriate staff members and older adults for the study. With their help, we recruited five staff members and five older adults. The staff members included two therapists, two rehabilitation specialists, and one care coordinator. The five older adult participants included two women and three men, with ages ranging from 58 to 71. One of the five older adults was currently employed and all lived independently on their own.

3.2 Study Procedure

We conducted in-home interviews with individual participants to understand their daily living context, and then two group workshops to study how participants make sense of existing SARs, which everyday life issues they find important for their quality of life, and which design characteristics they desire to be part of future SAR technologies. Interviews and workshops were transcribed and thematically analyzed by researchers to describe how older adults thought about and evaluated robots, the challenges they faced on a daily basis, and how robots might be used to help them.

Interviews. Five *staff members* were interviewed about their experiences working with independently living older adults with depression to better understand their practices and needs. We showed staff videos of existing assistive robotic technologies and asked them to critique the robots, letting us know whether they thought they would be useful in their work and what kinds of attributes they thought assistive robotic technologies should have so they could use them successfully. The videos presented three different types of robots that were either already available on the market, or under development for everyday use by older adults in their homes: the seal-like robot PARO[1], an assistive home robot Care-O-Bot[2], and the assistive telepresence platform Giraff Plus[3]. The videos showed people in nursing homes interacting with PARO in a group activity, while Care-O-Bot and Giraff Plus were filmed in a user's home. Care-O-Bot reminded a user to take her pills, and Giraff Plus was used by a physician to remotely check in on and examine an older adult at home.

Initial semi-structured interviews were also performed with five *older adults in their homes*. We first collected demographic information about participants, and then asked

[1] https://www.youtube.com/watch?v=3npV-npZkxI.
[2] https://www.youtube.com/watch?v=3tTKiVuyem4 (showed approximately first 3 min).
[3] https://www.youtube.com/watch?v=Pjgf3Yi81ao.

them to tell us about their current life situation and experiences, the social relationships they were involved in (e.g. partners, family, friends), specific issues they faced in their daily lives (e.g. mental and physical health, social interaction), and the types and uses of technology in their daily life. The interviews ended with a walk-through of the participant's house, documented through field notes and photos.

Participatory Design Workshops. We held two participatory design workshops with older adults to give them opportunities to more actively contribute to the development of SARs.

The *first workshop* lasted approximately two hours. Four participants (3 male and 1 female) and four researchers were in attendance. One participant could not attend due to health reasons. For the first hour, participants watched and critiqued the same videos showing assistive robotic technologies that the therapists saw (PARO, Care-O-Bot, Giraff Plus), with one additional robot (Papero[4]). The Papero robot was added as an example of a robot used for multimedia communication and social interaction, since the initial interview suggested these topics were of particular interest to participants. Papero was described in the video as a robot that could recognize individual participants and help them use email and communicate with others. In the second hour, participants saw live demonstrations of robots, including the robotic seal PARO, MugBot, Keepon, and Roomba (see Fig. 1). The live demonstrations consisted of researchers giving a brief description of each robot's functions (e.g. "Roomba can vacuum the floor by itself"; "Keepon can dance to music") as the robot performed them (e.g. PARO moved and made seal-like sounds, Keepon danced, and we showed how to program Mugbot using a simple Scratch-based interface). During the demo, participants could touch and explore the robots as they liked. Our main aim for this workshop, and the focus of questions to participants, was to learn what participants think of existing technologies, how they relate these technologies to their experiences and concerns, whether they can see themselves using such technologies, and what they would want such technologies to do for them in the future. We also noted successes and challenges in getting participants to actively participate in the workshop to help us further develop PD methodologies for older adults.

Fig. 1. Participants experienced live demos of PARO, the Roomba, MugBot (a programmable social robot), and Keepon, during which they could freely interact with the robots.

[4] https://www.youtube.com/watch?v=s7MqCNgFAzY.

The *second workshop* lasted approximately 3 h. Three participants (1 female and 2 male) and five researchers were in attendance. This time two participants could not attend due to health reasons. The aim of the workshop was for researchers to work together with participants to design assistive robots that could fit into their daily lives. We started the workshop by asking participants to tell us about specific challenges they faced the last time they were feeling sad or lonely. We also explored PD methods to help participants engage in creative thinking regarding assistive technologies. Researchers assisted participants in materializing their visions of robots by sketching them out during the workshop. We ended the workshop with a general discussion of the potential uses of assistive technologies, how they can be used to address issues related to aging and depression, and comments on the workshops themselves.

4 Findings

4.1 Interviews

Staff members showed a lively interest in integrating more digital technologies, including robots, into their therapeutic practice. After viewing videos of four different assistive robots, the staff was unanimous in choosing PARO as the one they would be most likely to use with their clients. They particularly commented that the robot was low maintenance, and could provide companionship for the older adults they worked with– something they can care for like a pet, without overwhelming them. The interviews with older adults, carried out in their homes, showed this population is interested and able to take part in participatory research related to SARs. In the course of the interviews, one of the main challenges older adults emphasized was loneliness, along with physical health problems. They all mentioned social interaction with friends, family members, and pets as a factor that can make them feel better when they are depressed. Two of the five older adults had pets, but both mentioned they may not be able to take care of them for much longer due to their condition. All the participants used computers and cell-phones, but only two used it regularly for email and online purchasing, and only one enjoyed using the computer. These interviews also provided researchers with a sense of participants' home arrangements, which included one house, three apartments, and a trailer home.

4.2 Workshop 1

Four older adults participated in the first workshop, led by the first author. In contrast to expectations that older adults might be wary of robots, the participants had no hesitation about discussing them and considering their usability at home. All participants described several ways they might use the robots and commented which devices they would like to buy, defining themselves as potential consumers of robots.

The most positive responses were to PARO, both after watching the video and while interacting with the robot. One participant, who had previously worked in a nursing home, was impressed at the level of interactivity older adults in the video showed toward the robot. Participants liked that PARO was easy to take care of and did not require cleanup. One participant remarked that the robot's presence created a "happy attitude about life" in users. The only downside to PARO that participants mentioned when prompted was that it was "not alive". When asked where they might use PARO, participants mentioned it could be helpful after surgery or at home, particularly during "gloomy days."

Participants were also positive about the Giraff Plus telepresence robot they viewed. They liked the idea of having someone track their activities, and the ability to communicate with medical staff, family and friends in a more physically embodied way. Participants liked the idea of having a robot present in case of a fall, mentioning that it could notice the problem more quickly than they could call for help, and be able to assist them and keep them company while they wait for humans to arrive. They commented on the robot's ease of use. One additional design request was for portability, so they could take the robot outside while doing yard work or walking.

The Care-O-Bot, a mobile domestic robot, was seen as good for reminding participants about their medications (a function shown in the video), and possibly warning them against eating too many sweets or doing other unhealthy things (ideas from participants). Participants commented positively on the robot's ability to support communication and staying in touch with loved ones. They described the early version of the Care-O-Bot shown as not aesthetically pleasing, too big to fit in their homes, and not appropriate for children and pets, who might harm or get hurt by the robot.

NEC's communication robot Papero also inspired many positive comments. Participants found it easy to use and fun, and appreciated its communication and social capabilities, particularly the ability to recognize people and adjust to their needs for personalized interaction. One participant also mentioned that Papero might be able to help him get out of his gloomy moods by talking to him and keeping him company.

In addition to responses to robot videos, the robot demonstrations allowed us to see how participants might actually interact with robots. As mentioned above, participants started interacting with PARO as soon as it was brought out and did not hesitate to touch and talk to it. They also easily approached Keepon, which they anthropomorphized readily (one participant said the robot "didn't like him," another mentioned it was "checking everyone out"). One participant mentioned Keepon would be good for their grandkids to play with when they visited, another said it might inspire him to get up and dance. Participants liked the appearance of MugBot, a minimalist social robot, but were quite negative about the possibility of developing programs for the robot with the Scratch-based[5] interface we showed them. They commented that working with the computer seemed difficult, and one participant mentioned that he preferred not to be on the computer, though he had one at home. Two out of four participants said they would like to use the Roomba, and one chose it as the robot they would most like to have in their house.

Overall, the ability to support companionship and sociability, whether with the robot itself or with others through telepresence, emerged as the most compelling use of SARs for this group. The unanimous interest in PARO seemed due to the possibility of having a close, tactile interaction with it. One participant described it as "inviting… almost like

[5] http://wiki.scratch.mit.edu/wiki/Scratch_User_Interface.

a real animal that can relate to you." Another said he found it "comforting" and "motivating" to be more active. Papero was appreciated for its ability to recognize individual users and its communication skills. In contrast, the most machine-like robot seen on video, and the programmable robot we demonstrated, were quickly dismissed as unattractive, difficult to use, and not fitting into the home.

4.3 Workshop 2

The negative responses participants gave to the mechanical appearance of the Care-O-Bot and the idea of programming MugBot suggested they were not ready for hands-on work with robots, so we decided to design and critique robots with them by visualizing their ideas on paper. We first prompted participants to tell us about the day-to-day challenges they face in their homes, then reminded them of the various capabilities robots have to provide social and physical assistance, and finally asked them which functions and capabilities they would want robots to have to help them with the daily issues they had identified. In order to make the process iterative, two researchers produced drawings of the robots as participants described their appearance, capabilities, and uses. The three participants then critiqued the drawings, pointing out things they liked or did not like, and leading to further iterations of their desired robot designs.

When asked to remember a time when they were feeling sad or lonely in the last month, and to tell us something they would have liked help with during those times, one participant mentioned physical challenges: difficulties in lifting things around the house and cleaning. Another pointed to his anger issues, and the desire to have some help in curbing them. A third participant mentioned that his big challenge were the upcoming Thanksgiving and Christmas holidays, with which the other two then agreed. The participants went on to discuss not being able to spend the holidays with family, friends and loved ones for various reasons. They also mentioned not having money, or the health for holiday preparations. Most of all, participants discussed wanting someone to talk to and spend the holidays with, even pets. Two participants mentioned they had been able to work as volunteers before their illness; they now missed the feeling of helping others and being useful. All participants described the lack of companionship as a trigger for their depression, mentioning that days when they do not have doctor visits of other activities planned (such as the weekend) were the most difficult, "the longest days."

After discussing their everyday challenges, participants and researchers collaborated to design robots that might be able to help them. The first suggestions from participants were to make a talking version of the robotic seal PARO, which might say "Good morning to you" or "It is now time for this [activity]," or that it could be used as a medicine or event reminder. Participants then said that what they really want is a something or someone that will keep them company, read and discuss the news and television shows with them, play games and eat with them. The participant who had mentioned anger issues pointed out that such a robot could help him deal with his anger by asking him to "Get your act together." Another participant said the robot could know the weather and tell her how to dress, and help her control her diet.

To realize these ideas about robots, two researchers drew up their interpretations of the participants' ideas as the conversation proceeded. The first suggested embodiment was a robotic coffee pot (See Fig. 2), which participants unanimously evaluated as not being humanlike enough. One participant mentioned that he would like his robot to be like the singer Mariah Carey, more humanlike in size and appearance. The need for portability, and wanting to take the robot along on walks, to the park, to the doctor's office, was brought up. Finally, participants agreed that the robot would have to be low maintenance, not something they would need to fix or attend to in any way.

Fig. 2. Workshop 2 produced designs for robotic appliances, small robotic assistants, and humanlike robots that could provide a companionship role for participants.

As in the prior workshop, the need for companionship and social interaction was discussed at length and became a focal point of participants' designs. Along with social interaction, however, participants also pointed out a variety of health-related functions that robots could perform, including providing reminders and suggesting appropriate things to eat, wear and do during the day. The use of visualizations during the second workshop allowed participants to critique and develop more specific ideas of robots that would be appropriate for their daily lives. In future work, we are interested in inspiring more in-depth discussions of specific interaction scenarios between robots and people, so that we can further hone our understanding of participant needs and perceptions of domestic SARs designs.

5 Conclusion

Socially assistive robots are a promising technology for preventive, patient-centered care. The ongoing project described here uses participatory design to explore appropriate ways of implementing SARs to aid older adults with co-occurring depression and chronic physical illness in order to delay the need for institutionalized care. The participatory design activities we performed provided us with concrete evidence of interest and support from both staff and older adults for the introduction of SARs technologies into their therapeutic services. These experiences also demonstrated that there is clearly a place to explore the therapeutic value of these technologies in the home and gave us confidence, based upon our developed understanding of these specific home environments, that it will be possible to integrate them into therapeutic practice and the daily life of their clients. We identified companionship as a central unmet need in the lives of our older adult population, and started discussing with them how this need might be met through the application of robotic technology. Finally, we showed that older adults are willing and able to participate in design projects for SARs (admittedly their participation is partially motivated by the desire to get social interaction), and identified the need for developing methods for actively engaging older adults in SARs design. Our future work will focus on further understanding how older adults might interact with SARs in their homes, and on increasing the level of hands-on participation of our participants and their self-identification not only as consumers, but as creators of assistive robotic technologies.

References

1. Tapus, A., Matarić, M.J., Scassellati, B.: The grand challenges in socially assistive robotics. IEEE RAM **14**, 35–42 (2007)
2. Broekens, J., Heerink, M., Rosendal, H.: Assistive social robots in elderly care: a review. Gerontechnology **8**(2), 94–103 (2009)
3. González, H.M., Tarraf, W., Whitfield, K.E., Vega, W.A.: The epidemiology of major depression and ethnicity in the United States. J. Psychiatr. Res. **44**(15), 1043–1051 (2010)
4. Ciechanowski, P., Wagner, E., Schmaling, K., Schwartz, S., Williams, B., Diehr, P., Kulzer, J., Gray, S., Collier, C., LoGerfo, J.: Community-integrated home-based depression treatment in older adults. JAMA **291**(13), 1569–1577 (2004)
5. Adams, K.B., Sanders, S., Auth, E.A.: Loneliness and depression in independent living retirement communities: risk and resilience factors. Aging Ment. Health **8**(6), 475–485 (2004)
6. Robinson, H., MacDonald, B., Kerse, N., Broadbent, E.: The psychosocial effects of a companion robot: a randomized controlled trial. J. Am. Med. Directors Assoc. **14**, 661–667 (2004)
7. Kang, K.I., Freedman, S., Matarić, M., Cunningham, M.J., Lopez, B.: A hands-off physical therapy assistance robot for cardiac patients. In: Proceedings of ICORR 2004, pp. 337–340 (2005)
8. Graf, B., Reiser, U., Hagele, M., Mauz, K., Klein, P.: Robotic home assistant Care-O-bot 3-Product vision and innovation platform. In: Proceedings of ARSO 2005, pp. 139–144 (2005)
9. Šabanović, S., Bennett, C.C., Chang, W.L., Huber, L.: PARO robot affects diverse interaction modalities in group sensory therapy for older adults with dementia. In: Proceedings of ICORR 2013, pp. 1–6 (2013)
10. Shibata, T., Wada, K.: Robot therapy: A new approach for mental healthcare of the elderly - a mini-review. Gerontology **57**(4), 378–386 (2011)
11. Ogawa, K., Nishio, S., Koda, K., Balistreri, G., Watanabe, T., Ishiguro, H.: Exploring the natural reaction of young and aged person with Telenoid in a real world. J Advanced Computational Intelligence and Intelligent Informatics. **15**(5), 592–597 (2011)
12. Mutlu, B., Forlizzi, J.: Robots in organizations: the role of workflow, social, and environmental factors in human-robot interaction. In: Proceedings of HRI 2008, pp. 287–294 (2008)
13. Chang, W.-L., Šabanović, S., Huber, L.: Situated analysis of interactions between cognitively impaired older adults and the therapeutic robot PARO. In: Herrmann, G., Pearson, M.J., Lenz, A., Bremner, P., Spiers, A., Leonards, U. (eds.) ICSR 2013. LNCS, vol. 8239, pp. 371–380. Springer, Heidelberg (2013)
14. Chang, W., Šabanović, S.: Interaction expands function: social shaping of the therapeutic robot PARO in a nursing home. In: Proceedings of HRI 2015 (2015, in press)

15. Forlizzi, J.: How robotic products become social products: an ethnographic study of cleaning in the home. In: Proceedings of HRI 2007, pp. 129–136 (2007)
16. Wilson, I.B., Cleary, P.D.: Linking clinical variables with health-related quality of life: a conceptual model of patient outcomes. JAMA **273**(1), 59–65 (1995)
17. World Health Organization: Constitution of the World Health Organization Basic Documents, Forty-fifth edition, Supplement (2006). http://www.who.int/governance/eb/who_constitution_en.pdf. Accessed 26 June 2014
18. Bennett, C.C., Doub, T.W.: Expert systems in mental healthcare: AI applications in decision making and consultation, In: Luxton, D. (ed.) Artificial Intelligence in Mental Healthcare. Elsevier Press (2015, In Press)
19. Fratiglioni, L., Qiu, C.: Prevention of cognitive decline in ageing: dementia as the target, delayed onset as the goal. Lancet Neurol. **10**(9), 778–779 (2011)
20. Kane, R.L., Kane, R.A.: What older people want from long-term care, and how they can get it. Health Aff. **20**(6), 114–127 (2001)
21. Lee, Y.: The predictive value of self assessed general, physical, and mental health on functional decline and mortality in older adults. J. Epidemiol. Community Health **54**(2), 123–129 (2000)
22. van Oostrom, S.H., Picavet, H.S.J., van Gelder, B.M.: Multimorbidity and comorbidity in the Dutch population–data from general practices. BMC Public Health **12**(1), 715 (2012)
23. DiSalvo, C., Nourbakhsh, I., Holstius, D., Akin, A., Louw, M.: The Neighborhood Networks project: A case study of critical engagement and creative expression through participatory design. In: Proceedings of Conference on Participatory Design, pp. 41–50 (2008)
24. Frennert, S., Eftring, H., Östlund, B.: What older people expect of robots: a mixed methods approach. In: Herrmann, G., Pearson, M.J., Lenz, A., Bremner, P., Spiers, A., Leonards, U. (eds.) ICSR 2013. LNCS, vol. 8239, pp. 19–29. Springer, Heidelberg (2013)
25. Ezer, N., Fisk, A.D., Rogers, W.A.: Attitudinal and intentional acceptance of domestic robots by younger and older adults. In: Stephanidis, C. (ed.) UAHCI 2009, Part II. LNCS, vol. 5615, pp. 39–48. Springer, Heidelberg (2009)
26. Flandorfer, P.: Population ageing and socially assistive robots for elderly persons: the importance of sociodemographic factors for user acceptance. Int. J. Popul. Research, Article ID 829835, 13 pp. (2012). doi:10.1155/2012/829835