Telepresence Robot at Home: A Long-Term Case Study

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Abstract The paper presents the current findings of an almost one-year case study of fielding the GIRAFF robot in a real home. The testing phase, which is still running, involves an older user, affected by Parkinsons disease, and his family, in the daily usage of a telepresence robot. Initial evidence show that GIRAFF has become part of the daily routine of the user being judged as a valuable tool for communication and close connection with the remote user. In general, the attitude of the user towards the aid remains stable being constantly positive over time. Nevertheless we also noted an impact of the technology robustness on user's acceptance that will be further investigated in this continuation of the study.

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S. Longhi et al. (eds.), *Ambient Assisted Living*, DOI: 10.1007/978-3-319-01119-6_8,

1 Introduction

In the past decade, the Human Robot Interaction (HRI) was approached in many different ways, mainly focusing on the human perception of robots appearance, behaviours and personality [16]. Analysis were mostly conducted in controlled settings, despite the overall aim of creating robots for assisting people in performing daily activities, from entertainment to cooking, for example. This paradoxical situation is due to the challenging and unpredictable nature of the real setting characteristics, that does not allow a deep control over all the key variables as the lab condition, as well as the short time reserved to the in-home trials that does not permit the real engagement of the users with the robot. The interest in longitudinal studies on human-robot interaction has mainly originated from non-residential environments (such as offices, schools and hospitals) as ecological setting of study, emphasizing that the prolonged interaction may result in a change in attitude and behavior of the person, influencing the user experience and its relationship with the adopted aid [4–7, 9, 10]. The objective of our research is to deepen the knowledge of what really happens when a social assistive robot is introduced in the home of an elderly person and his/her caregiver, becoming part of their daily lives for a long period of period time. To understand how the effect of a long-term interaction influences the behaviour and attitudes of end-users can indeed be fundamental for the design of an aid that hopefully remains useful and acceptable in the long term.

In this perspective, the ExCITE project (http://excite.project.eu), part of the AAL EU initiative (http://www.aal-europe.eu), is assessing the robustness and validity of a telepresence robotic platform, named GIRAFF produced by the Swedish company Giraff AB (http://www.giraff.org), as a means to support elderly and to foster their social interaction and participation. The whole project is based on the idea of deploying several GIRAFF for long periods of time (at least 3 months, and possibly 1 year) in three different countries (Italy, Spain and Sweden) in real contexts of use. Feedback obtained from the users (both older users having the robot at home and the clients, who is people connecting and visiting the older) is used to both improve the robot and gather results on aspects related to the long-term human-robot interaction. The GIRAFF case study represents a good example of a long-term analysis where a robot interacts with an older user in a real setting, giving the opportunity of deeply investigating the effects of a long term interaction on the person's behaviour, attitude, technology acceptance and general experience of use.

To find and set up such long terms studies turned out to be a rather difficult and demanding activity. In this light a specific CNR effort within EXCITE was devoted to establish relationship with possible user groups representative of different realities (e.g., healthcare professional, healthy and not healthy elderly, nurses, relatives, friends, etc.).

In this paper we specifically focus on one of the on-going case studies performed in Italy derived by the cooperation of CNR participants to the EXCITE project as responsible for the evaluation activities, with colleagues of INRCA (Istituto Nazionale di Riposo e Cura per Anziani) and UNIVPM (Universitá Politecnica delle Marche)

who have collaborated in the execution and monitoring of this specific test site. It is worth highlighting how the specific test sites has presented specific challenges for its peculiarity of being installed in a distant city entailing a continuous collaboration between the CNR group with the team in Ancona who followed the instantiation and maintenance of the test sites more closely. We here report some results of the work illustrating the experience related to the user interaction findings of the long-term usage. More specifically the paper is organized as follows: Sect. 2 describes the motivation of the study and the technological steps needed to perform the long term test case within the ExCITE project; Sect. 3 introduces in details the specific long-term case study dwelling on its peculiarity and challenges and showing the current results on the long-term user experience; Sect. 4 ends the paper.

2 Assessing a Telepresence Robot in the Field

When a robotic aid is to be introduced and evaluated in the home, to promote and sustain a long-term interaction becomes a fundamental aspect of use. The home is becoming one of the contexts of use more attractive for robotic applications especially for the elderly care. However, evaluating a long-term interaction in a domestic context is still an open challenge.

Most of the successful examples of longitudinal researches on human-robot interaction has mainly originated from non-residential environments. Of particular importance in the domain of elder care are the studies on Paro, a seal-shaped robot equipped with touch, light, auditory and balance sensors, capable of responding to external stimuli and designed for therapeutic interventions with older people and children affected by genetic syndromes and developmental disorders. The effects of time in the use of Paro were assessed for example, in a group of 12 elderly residents in a nursing facility, who have interacted with the robot for a continuous period of 30 days. The results of systematic ethological observations by therapists of the structure have shown that Paro was able to improve and enhance the ability to relate in older people with a positive effect on their levels of physical and psychological stress [15]. Another study, [9], confirmed an improvement of the patients' social skills in response to a therapeutic intervention based on prolonged use of Paro, as well as a positive effect on their emotional sphere.

More recently, [12] have described the results of an ethnographic study in which a humanoid social assistive robot (called Robovie) interacted for a period of 3 months and a half, with 55 elderly residents in a care center. The robot was operated remotely to interact verbally with patients. The analysis of the interviews and the results of the observations, performed by a therapist of the structure, suggested that the robot had been well accepted among residents, especially for its ability to socially engage patients through verbal reminders and simple conversations. However, the effects of long-term interaction between a human and a robot does not always have positive implications, but they can reveal changes in the behavior of people who may be indicative of an experience of use and interaction not completely satisfactory. It may happen

for instance that the initial effect of novelty and curiosity, towards a robotic aid and its use, quickly fades resulting in a reduction in the interest and attitude of the person towards it [2, 5, 8, 13, 14]. For this reason, longitudinal studies, although they may be difficult to organize especially in ecological contexts, are gaining significant relevance to understand how to promote long-term interactions, considering the effect of time on the behaviour and attitudes of the human user toward the robot. However, the literature on interactions and long-term deployment of robotic platforms in a domestic setting, it is still rather incomplete and this opens new possibility of studies. In fact, our research is motivated by the interest in understanding how the continuous use and the sharing of physical and social spaces in the home, influences the experience, the use and attitude of seniors people and their caregivers (family and/or professional) of the telepresence robot. In so doing we explored the challenge of moving laboratory experiments to real people life settings by delivering robots into the house of old person and assessing several aspects of the long-term usage and interaction.

The next section describes the effort done for one these long-term studies. Specifically we illustrate the evaluation plan, which has been slightly updated with respect to the general procedure conceived for ExCITE due to the particular case we were able to set up. We also present the results we currently have after several months of usage.

3 A Long-Term Case Study

For conducting this specific analysis, an older end-user was recruited in Ancona and he was asked to take part in the ExCITE long-term case study. The beginning of the testing phase was characterized by technical issues that needed to be solved and that have also affected the testing timing delaying the actual start of the evaluation plan. In the next subsections we describe in details the used approach and illustrate the results so far.

3.1 Method

The method used for this assessment is based on longitudinal research and specifically on the single case study, which essentially allows in depth observation within a real-life context, collecting a lot of details that would not normally be easily obtained by other research designs. The present article focuses on long-term experience of usage of the telepresence robotic platform on behalf of the older user at home. Specifically, we aimed at investigating acceptance, attitude toward the robotic aid, appearance, impact on the home environment and usability. It is worth highlighting how we here report some of the results of an on-going test site; hence also the material reported is the one we have used for the specific period of experimentation we are describing here. For the complete list of the questionnaires foreseen for the whole experiment the reader can refer to [1].

Fig. 1 The primary user interacting with the GIRAFF robot

3.1.1 Material

The material used for this long term assessment is composed of both standardized measures and specific questionnaires we developed on purpose to assess the aspects mentioned above. Specifically at this time, for the primary user we used: a consent form describing the aim and procedure of the study to be signed by participant; a socio-demographic data form to gather some relevant information on the user like sex, age, gender, familiarity with technology, etc.; the UCLA Loneliness Scale [11] a 20-item Likert scale (0–4) designed to measure ones subjective feelings of loneliness as well as feelings of social isolation. The MSPSS Multidimensional Scale of Perceived Social Support [19] which consists of 12 items to identify the social support factors perceived by the individuals; the GDS (Geriatric Depression Scale—[18]) is a 30-item self-report assessment used to identify depression in the elderly; SF-12, a short version of the SF-36 [17] that allows to investigate the perception of the state of physical and mental health; an ad hoc questionnaire based on Almere model [3] that allows assessing dimensions of technology acceptance; a questionnaire we developed on purpose to assess the attitude and general evaluation of older persons toward such technology.

3.1.2 Participant

The older user is affected by Parkinson's disease since 2005. Both his walking ability and the speech were deeply compromised by the severe stiffness in movement as well as the muscle rigidity of the face. In particular, due to the speech restriction, the user

often refuses the communication with the others and prefers to stay alone. The fear of feeling bad outside home and the difficulty in speech have led to a progressive departure from the community life. The interruption of his social life has caused him relevant mood alterations: sometimes, he has reported to be very depressed and feel that anyone could help him. Currently, he lives with his wife, in the centre of a small town. He can reach by feet all the most important places in the town and the sea-side too. His wife is a very active woman instead, and she takes care of him constantly. His son (the Client) and his daughter live far from the town (respectively 30 and 60 Km), so he does not see them very much. He is currently engaged in physical rehabilitation and speech therapy. The user has showed some basic skills with technology, mainly motivated by his interests: he is able to use Internet connection, to play online games. In addition, he is able to use the mobile phone basically, just for calling but not for sending text messages or photos, for example, while he uses daily the digital TV for looking at sport events.

3.1.3 Procedure

The method used for this test site is taken from the general evaluation plan conceived for EXCITE and described in [1]. It entails a period of N months (with $3 \leq N \leq 12$) during which the primary user has the robot at home and the secondary users (family members, formal caregivers or health professionals) can visit him/her through the robotic platform. Assessment happens across different steps S_i. Specifically, after an initial assessment at S0 at the beginning of the experimentation (baseline), different potential psycho-sociological variables of interest are measured at regular intervals (S1–S3) to observe changes over time. At the last month the GIRAFF is removed from the end user apartment and the same variables are assessed again after 1–2 months from this removal (S4). A researcher and a technician conducted the training on the robot use, in order to exhaustively answer all kind of questions. At this purpose, verbal explanations and practical examples were mainly given to the user, making him free to ask all the needed information. Finally, the team, who intervened when necessary, both from remote and at home, always supported the user. After the training period, the standard evaluation plan started. We have currently completed the S2 phase, following the schema listed below :

Primary user

- S0: At time S0 we asked the primary user to fill in the consent form and the Socio-Demographics Data Form, the UCLA, the SF-12, the GDS, the MSPSS, and the ad hoc questionnaire based on Almere Model.
- S1: After a period of usage at time S1 the primary users filled in the questionnaire on the Attitude and General Evaluation towards the robot, the UCLA, the GDS, the MSPSS.
- S2: At time S2 we asked the primary users to fill in ad hoc questionnaire based on Almere Model.

For the subsequent phases the users will follow the evaluation plan foreseen in [1].

To explore how primary users perceive and think about the robot and which are the dynamics in their real context of use, we decided, for this test site, to also collect data in the form of ethno-graphic notes through a Participant Observation (PO). The participant observation has been possible taking advantages form the collaboration between CNR and the colleague of INRCA who has specific competence in ethnographic research methodology. The choice of adding a participant observation, was mostly motivated by the setting characteristics of this specific case study as well as the opportunity of drawing up data and concepts to be matched with the past assessment analysis. Some field notes were written during the PO but they were definitely elaborated after each session of observation, which corresponded to the evaluation step S0, S1 and S2. Besides the assessment of the validity of the answers and the user cooperation, self-reflexive notes were also taken, on what the researcher considered important.

3.2 Results

This section describes the results of the long-term experience of use of the system on behalf of the primary user. Results are related to both the questionnaires and participant observation analysis. Findings from questionnaires are related to the instruments for collecting data of general evaluation plan conceived for ExCITE and mainly report to the current status of the test sites, which will be completed toward the end of this year.

3.2.1 General Evaluation Plan Results

Psychological measures. The results of Geriatric Depression Scale (GDS) at time S0 and S1 show scores substantially similar, indicative of the presence of mild depressive symptoms (scores between 10–19). Similarly, the scores on the perceived loneliness scale (UCLA) indicate an experience of strong loneliness (UCLA score = 52 at S0, UCLA score = 47 at S1, range score 20–80). The score of the Short Form-12 Health Survey (SF-12) show low mean meta scores of the Physical Component Summary ($M = 23.5$) and Mental Component Summary ($M = 38.4$) of the score denote a perceived health condition characterized by significant limitations in self-care and in physical, social and personal.

In the pre-adoption phase (S0), the scores of the Multidimensional Scale of Perceived Social Support Scale (MSPSS) indicate that the end user perceives a higher social support from family (sum of the scores = 28) with respect to that received from the friendships network (sum of the scores = 8) and /or from significant other persons close to the user (sum of the scores = 4) (see Fig. 2). After the adoption and the first period usage of the robot (S1), the family continues to be the main source of perceived social support (sum of the scores = 23), while the perceived support from

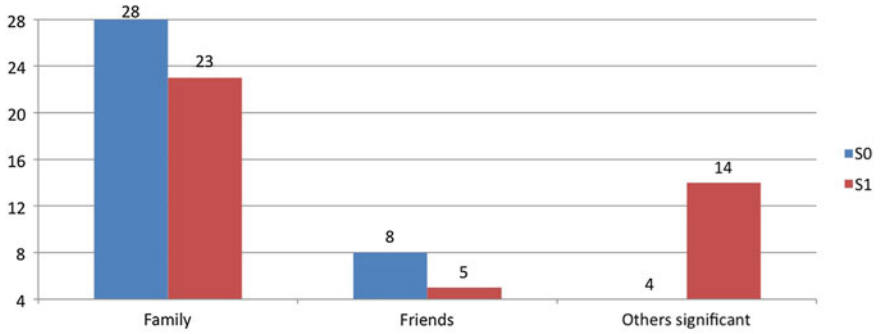

Fig. 2 Total scores for each dimensions of MSPSS obtained from the sum of the responses from the items in each of the three dimensions (range score 4–28)

the friendships network (sum of the scores = 5) further decreases, and the feeling of social support from significant other persons increases to some extent respect (sum of the scores = 14) (see Fig. 2).

Attitude and general evaluation towards the robot. Based on the dimensions of attitude and evaluation described in [1], Fig. 3 shows the results of the questionnaire related to significant dimension of evaluation from the primary users perspective. Specifically at time S1, after the adoption and the first period of usage, the user does not perceive a high level of intrusion into his privacy ($M = 0.67$), does not show distrust in terms of psychological distance between himself and the adopted aid ($M = 0.60$), and recognizes the benefits and advantages ($M = 2.79$), of the system related to his needs (e.g., GIRAFF simplifies the management of daily life or relieves the workload of people who "take care of me"). Nevertheless he shows a partial satisfaction of the GIRAFFs functionalities and features ($M = 2.47$), (e.g., the quality of the video and the movement of the robot are not very satisfactory) and some notable apprehension related to the difficulty of maintenance of the robot ($M = 3.25$), maybe justified also by the technical difficulties that emerged.

Furthermore, the user would like additional features of the robot like for instance the possibility to have a direct link with his doctor via GIRAFF. The emotional reaction of elderly user to the robot is very good, scoring high on the positive adjectives useful, interesting, stimulating, and funny, and very low on the negative adjectives scary, overwhelming, gloomy, dangerous, and uncontrollable.

Robots Acceptance. The mean scores of each Almere model acceptance constructs (see Fig. 4) show an increase on Intention to Use (ITU) the robot between S0 and S2 ($Ms0 = 4$ vs $Ms2 = 5$) and of Social Influence (SI) ($Ms0 = 3$ vs $Ms2 = 4$). Similarly, the Facilitating Conditions (FC) increase ($Ms0 = 3$ vs $Ms2 = 4$). However there is a slight increase in the perceived Anxiety (ANX) towards the use of the robot ($Ms0 = 2.5$ vs $Ms2 = 3$). The Perceived Easy of Use (PEOU) decreases ($Ms0 = 4.8$ vs $Ms2 = 3.8$). as well as the Perceived Usefulness (PU) decrease ($Ms0 = 4$ vs

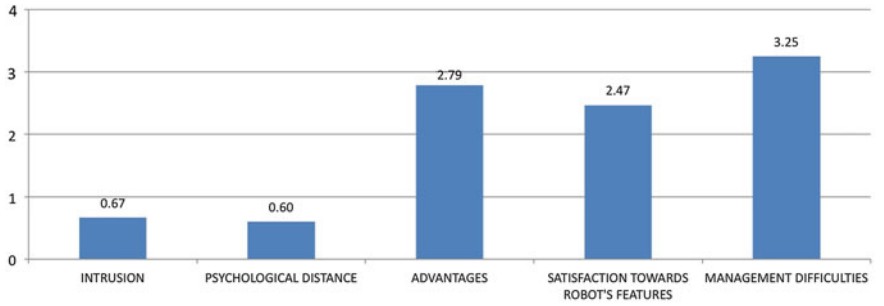

Fig. 3 General Attitude of users toward the GIRAFF system after a period of usage. Mean scores for each dimension explored by questionnaire ad hoc (5 points Likert scale, from 0= completely disagree to 4= completely agree)

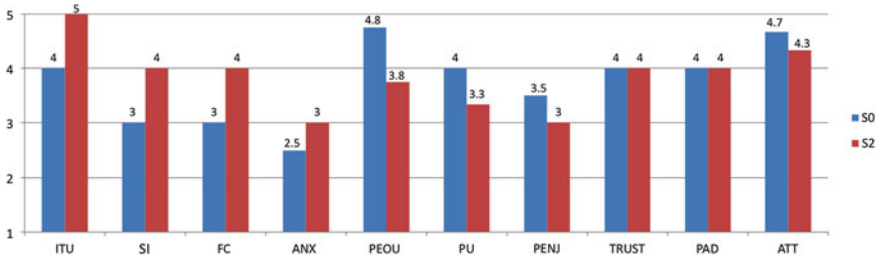

Fig. 4 End User Acceptance over time (differences between S0 and S2). Mean scores for each Almere Model construct (5 points Likert scale, from 1= completely disagree to 5= completely agree)

$Ms2 = 3.3$), accompanied with a lower Perceived Enjoyment (PENJ) of the user ($Ms0 = 3,5$ vs $Ms2 = 3$). The levels of Trust, Perceived Adaptiveness (PAD) of the robot to the individual needs and the Attitude (ATT) towards GIRAFF remain high and stable.

3.2.2 Participant Observation Results

Participant observation results focusing on understanding GIRAFF functioning and perception from the primary users point of view reveal important data on behavior, attitude and reactions of the user towards the introduction and adoption of the robot in his domestic life environment. We discuss and integrated the collected observational notes into the three main categories below.

Appearance. The participant observation showed a positive judgment of the user on this dimension. Since the first home visit (S0), the end-user has liked GIRAFF, considering it was funny and not too "technical" to be used. The animal shape reminds him more to an electronic toy than to an assistive tool for the daily communication.

The familiar shape have also transmitted him the feeling of an easy-to-use tool, as the shape was the metaphor of its functioning. The positive evaluation of the robot appearance was maintained all along the experience with the robot, as well as the absence of stigmatization perception.

Attitude. Results of the participant observation highlight that at the beginning, the end-user has underestimated the complexity of the robot: he felt to be able to use it very quickly and without the support of a technician. In addition, the restricted number of operations that can be performed has given him the sense of mastery in use, as well as the presence of clear commands for answering a call, controlling the volume, and turning on/off the robot. It could be said that, during the first home visit (S0), the perception of easiness of use was the dimension that mostly influenced the positive attitude towards the robot, as well as its use. In addition to the robot characteristics, the reason of this feeling could be partially justified by the technological skills of the user: he is able to use Internet to play online games, send emails, do home banking operations, looking for events and stuff of his own interest. After a period of usage (S1), some technical obstacles that emerged influenced the positive attitude, and specifically a decreasing in the sense of self-efficacy and competence emerged, together with a feeling of frustration. After the resolution of the technical problems, the user partially recovered the positive attitude towards the robot during S2 phase.

The participant observation highlighted the following aspect. The acceptance of the robot seems to be gained after some time of daily use: from the initial underestimation of the robot complexity (S0) to the achieved comfort in use (S1), it seems that the representation of GIRAFF was passed through a "normalization" path (S2). The weak points of the "path to the robot acceptability" could be found in two different phases:

– at the beginning, due to the overestimation of the own technological skills and/or the underestimation of the robot complexity (S0);
– during the first period of use, in which the user considered himself not able to use the robot, instead of researching the reason of the failure in the technical obstacles (S1). In this case, it could be said that there was an erroneous attribution of the events to the internal locus of control.

On the observer side, it seems that the creation of a daily routine with the robot was the key driver for the robot acceptance (S2): before dinner time, they knew they would be in touch with their son and his family, taking part to their domestic life. The affection to the robot was mainly mediated by the successful experiences with it and the overcoming of the technical obstacles (S2). For the end-user, in particular, who presents a severe mobility restriction, as well as difficulty in speech, the robot represents a valuable mean for "feeling connected", not just for communicating.

Usability. Despite the interest and the initial positive approach to the robot usage, the end-user did not learn easily how to use the robot: the turn on/off command and the red/green buttons for answering to a call were often confused (S0). Also

the use of the remote control was not successful: the user still preferred to answer directly from the robot. It seems that the end-users initial representation of the robot did not match the real condition of use, at the beginning (S0). Starting with the daily use, the user has gained a good level of autonomy in operating as well as the achieved competence in referring all the robot activities to the technical staff. Once the technical issues were solved, the end-user felt more comfortable and the robot became soon the preferred mean for talking with the client (S1). The key benefit for the user was of course the opportunity of seeing the client as well as the availability of the service as free. At the same time, the user tried to understand how to cope with the robot when system errors occurred, in order to be able to solve them by himself. Moreover, he asked for additional functionalities, in order to ameliorate the communication also with professionals and physician from remote (S2).

4 Conclusions

The profile of the primary user, with respect to the psychological variables, reflects the clinical picture of Parkinson's disease. The presence of depressive symptoms, joint to the sense of loneliness and to a state of health perceived by the user as rather fragile, are to be interpreted as the common psychological reaction of a person suffering from a debilitating chronic disease, such as the Parkinson's disease.

The family is the main source of support (not only physical but also social) perceived by primary. The function of the family in terms of social support is confirmed over time. However, in recent months the use of GIRAFF seems to have also contributed to increase the sense of the perceived social support from other persons significant for the secondary user. Presumably, the presence of personnel for technical support, may have contributed to an increase in the user 's perception of being able to rely on other people outside his family network, in relation to the management and operation of adopted aid.

GIRAFF has become part of the daily routine of the user being judged as a valuable tool for communication and close connection with the secondary user. The function of visual contact of the telepresence system helps to validate the user's primary beliefs about the effectiveness of the robot as a communication aid. In general, the attitude of the user towards the aid remains stable being constantly positive over time. It is plausible to think that the attractiveness of GIRAFF, the users familiarity with the modern information and communication technologies and the adequacy of aid with respect to personal needs, have contributed to the a positive attitude of the user. This attitude has affected his intention to use and acceptance of the robot over time.

Obviously we cannot overlook the role that the technical problems have had on the user's attitude so far. Results show indeed an increase over time of the worries with respect of maintenance of the robot and a decrease of his satisfaction of the system's functionality. The malfunction may be responsible for the perceived anxiety over time related to the use of GIRAFF. Moreover, the presence of feelings of

frustration, accompanied with a decrease of the sense of self-efficacy reported during the participant observation, highlight the need of reliable and robust assistive robot to ensure and interaction with the user which is effective and safe.

Acknowledgments CNR authors are partially supported by the EU under the Ambient Assisted Living Joint Program—ExCITE Project (AAL-2009-2-125).

References

1. Cesta, A., Cortellessa, G., Orlandini, A., Tiberio, L.: Evaluating telepresence robots in the field. Commun. Comput. Inf. Sci. **358**, 433–448 (2013)
2. Gockley, R., Bruce, A., Forlizzi, J., Michalowski, M., Mundell, A., Rosenthal, S., Sellner, B., Simmons, R., Snipes, K., Schultz, A., Wang, J.: Designing robots for long-term social interaction. In: Intelligent Robots and Systems. IEEE/RSJ International Conference on. IROS 2005. pp. 1338–1343 (2005)
3. Heerink, M., Kröse, B., Evers, V., Wielinga, B.: Assessing acceptance of assistive social agent technology byolder adults: the almere model. Int. J. Soc. Robot. **2**(4), 361–75 (2010)
4. Huttenrauch, H., Severinson Eklundh, K.: Fetch-and-carry with CERO: Observations from a long-term user study with a service robot. In: Proceedings of 11th IEEE International Workshop. Robot and Human Interactive Communication, 2002. ROMAN. pp. 158–163 (2002)
5. Kanda, T., Sato, R., Saiwaki, N., Ishiguro, H.: A two-month field trial in an elementary school for long-term human-robot interaction. IEEE Trans. Robot. **23**(5), 962–71 (2007)
6. Kim, H., Lee, H., Chung, S., Kim, C.: User-centered approach to path planning of cleaning robots: Analyzing user's cleaning behavior. In: Proceedings of the ACM/IEEE International Conference on Human-robot Interaction. HRI '07. pp. 373–380. ACM (2007)
7. Lee, H., Kim, H.J., Kim, C.: Autonomous behavior design for robotic appliance. In: Proceedings of the ACM/IEEE International Conference on Human-robot Interaction. HRI '07. pp. 201–208. ACM (2007)
8. Leite, I., Martinho, C., Paiva, A.: Social robots for long-term interaction: a survey. Int. J. Soc. Robot. **5**(2), 291–308 (2013)
9. Marti, P., Pollini, A., Rullo, A., Shibata, T.: Engaging with Artificial Pets. In: Proceedings of the 2005 Annual Conference on European Association of Cognitive Ergonomics. EACE '05. pp. 99–106. University of Athens (2005), http://dl.acm.org/citation.cfm?id=1124666.1124680
10. Mutlu, B., Forlizzi, J.: Robots in organizations: the role of workflow, social, and environmental factors in human-robot interaction. In: Proceedings of the 3rd ACM/IEEE International Conference on Human Robot Interaction. HRI '08. pp. 287–294. ACM (2008)
11. Russell, D., Peplau, L., Cutrona, C.: The revised ucla loneliness scale: concurrent and discriminant validity evidence. J. Pers. Soc. Psychol. **39**, 472–80 (1980)
12. Sabelli, A.M., Kanda, T., Hagita, N.: A conversational robot in an elderly care center: An ethnographic study. In: Proceedings of the 6th International Conference on Human-robot Interaction. HRI '11. pp. 37–44. ACM (2011)
13. Salter, T., Dautenhahn, K., Bockhorst, R.: Robots moving out of the laboratory - detecting interaction levels and human contact in noisy school environments. In: 13th IEEE International Workshop on Robot and Human Interactive Communication, 2004. ROMAN. pp. 563–568 (2004)
14. Sung, J.Y., Grinter, R.E., Christensen, H.I.: Domestic robot ecology—an initial framework to unpack long-term acceptance of robots at home. Int. J. Soc. Robot. **2**(4), 417–429 (2010)
15. Wada, K., Shibata, T.: Living with seal robots: its sociopsychological and physiological influences on the elderly at a care house. IEEE Trans. Robot. **23**(5), 972–80 (2007)

16. Walters, M.L., Syrdal, D.S., Dautenhahn, K., te Boekhorst, I.R.J.A., Koay, K.L.: Avoiding the uncanny valley: robot appearance, personality and consistency of behavior in an attention-seeking home scenario for a robot companion. Auton. Robots **24**(2), 159–78 (2008)
17. Ware, J., Kosinski, M., Keller, S.: A 12-item short-form health survey: Construction of scales and preliminary tests of reliability and validity. Med. Care **34**, 220–233 (1996)
18. Yesavage, J., Brink, T., Rose, T., Lum, O., Huang, V., Adey, M., Leirer, V.: Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr. Res. **17**, 37–49 (1983)
19. Zimet, G., Dahlem, N., Zimet, S., Farley, G.: The multidimensional scale of perceived social support. J. Pers. Assess. **52**, 30–41 (1988)