Social robots for older users: a possibility to support assessment and social interventions

Daniela Conti[1][0000-0001-5308-7961], Alessandro Di Nuovo[2][0000-0003-2677-2650] and Santo Di Nuovo[3][0000-0002-3786-3323]

[1,2] Sheffield Robotics, Sheffield Hallam University, Sheffield, S1 1WB, UK
{d.conti,a.dinuovo}@shu.ac.uk
[3] University of Catania, Via Teatro Greco 84, 95124 Catania, Italy
s.dinuovo@unict.it

Abstract. In the last decades, various researches in the field of robotics have created numerous opportunities for innovative support of the older population. The goal of this work was to review and highlight how social robots can help the daily life of older people, and be useful also as assessment tools. We will underline the aspects of usability and acceptability of robotic supports in the psychosocial work with older persons. The actual usability of the system influences the perception of the ease of use only when the user has no or low experience, while expert users' perception is related to their attitude towards the robot. This finding should be more deeply analysed because it may have a strong influence on the design of future interfaces for elderly-robot interaction. Robots can play an important role to tackle the societal challenge of the growing older population. The authors report some recent studies with older users, where it was demonstrated that the acceptability of robotics during daily life activities, and also in cognitive evaluation, could be supported by social robots.

Keywords: Acceptability, Older people, Social robots.

1 Introduction

1.1 Older people and robots

The growing number of older people living alone in need of care is one of the great societal challenges of the most developed countries (e.g. Japan, USA, Europe, Australia). Indeed, high-income countries have the oldest population profiles, with more than 20% of the population predicted to be over 65 in 2050, when citizens older than 80 will be triple than today. This is likely to increase social isolation and loneliness, which can be associated with several health hazards, e.g. cognitive deterioration, and increased mortality [1].

This is a challenge for the social care systems, which, as of now, are struggling to meet the demand of assistance for vulnerable adults because of limitations in their budgets and, moreover, in the difficulty in recruiting new skilled workers.

The new technologies, and in particular the social robotics, are seen as a way to address human resource and economic pressures on social care systems.
Humanoids robots are capable to provide greater support to older people, because they are able to pick things up, move around on their own, and have a more natural, intuitive way of interaction, e.g. include gestures with the hands and arms. Usually the more advanced humanoid platforms embed additional sensors and devices, like touchscreens, in order to provide easier to use interfaces thanks to multimodality: it has been observed that older users preferred to send commands the robot using speech, because they found touchscreen difficult to use, vice-versa they like to have visual feedback on screen when the robot is speaking. The availability of multiple ways for the interaction is indispensable in the case age related hearing loss or visual impairments which can reduce the ability of the elderly to interact [2].

1.2 Social robots as support to the social care systems

The increasing evidence from scientific research is leading the growth of the robotics market focused on services for ageing well, with robots that are increasingly available to assist and accompany the older users.
To this end, one of the most developed commercial examples is Mobile Robotic Telepresence (MRT) [3] systems that incorporate audio and video communication equipment onto mobile robot devices which can be steered from remote locations. MRT systems facilitate social interaction between people by eliminating the necessity to travel while still providing a physical presence, which has a greater positive influence in the social perception [4] of the interaction. Thanks to MRT technology, relatives can visit more often their older family members and social workers will be able to engage more clients per day, especially in sparsely populated rural areas. MRT from a simple smartphone app, meanwhile the local user is free while interacting with the pilot user who can also use the robot to inspect the home. The freedom for the local user is particularly beneficial in the case of people with disability who can have difficulties in reaching a phone.
However, MRT systems still require a human operator for the social interaction, which can be present only for a limited amount of time during the day, for the rest the current MRT systems risk to remain just a modern piece of furniture with no use.
Another solution could be robot companions, which embody advanced Artificial Intelligence (AI) functionalities to conduct social interaction in complete autonomy.
Nevertheless, such completely autonomous robots are not available on the market yet, but the underlining idea of a robot companion has been extensively investigated with pet-like shape robots, e.g. Aibo, MiRO, or humanoids robot, e.g. Pepper, Care-o-Robot, which resemble the shape of the human body. Pet robots are programmed with limited interaction abilities, but they proved to be as effective or even more than real pets in reducing loneliness [5] for elderly in care homes while overcoming the concerns about live animals.
Humanoid robots are more ambitious systems, which include support for complex functionalities such as dexterous manipulation, advanced navigation and, moreover, a natural, more intuitive interface, which can overcome some of the difficulties currently experienced especially by the elderly, thanks to the multimodality of stimulation given by them [2].

Social robots can provide a solution for the ageing population challenge, in particular, to reduce social isolation and loneliness. Solutions like MTR systems or pet-like companions are already in the market and ready to be deployed soon. More sophisticated humanoid companions with human-like social capabilities are being studied and seem a promising solution for more comprehensive quality care. Nevertheless, researchers and service providers must address public anxiety and make clear that the robots are being designed to improve productivity by assisting the social workers, who will be facilitated in their work and not replaced. Moreover, robot programmed autonomy has to be limited and humans must always be in full control so that any danger or accidental situation can be avoided.

1.3 Acceptance and attitude towards robots

Currently, robots are starting to become a part of working life in many areas including journalism [6], agriculture [7], the military [8], medicine such as surgery [9], education [10], and care [11]. A factor influencing the attitude toward robots may indeed be a concern over the risk of unemployment caused by robots [12], considering certain occupations are even at risk of being replaced by robots or other technology [13].
Apparently, the public has mixed feelings about robots. In several surveys conducted by the Eurobarometer, attitudes toward robots and artificial intelligence were generally positive [14]. In the last European survey [15], 68% respondents agreed that *"robots are a good thing for society because they help people"*, but, at the same time, only 26% of the respondents were comfortable *"with having a robot to provide services and companionship when infirm or elderly"*. The Eurobarometer survey shows also the public concern about robots, a technology that *"require careful management"* (88%), and about replacing humans and stealing jobs (72%). Though, the analysis underlines how the attitude is related to the exposition to information in the last year, which makes more likely to have a positive view of artificial intelligence and robots (75% vs. 49% who have not). In an additional analysis of the Eurobarometer data, Taipale at al. [16] specified further that people are reluctant to use robots in the fields of childcare and elderly care, leisure, and education. Nor did they favour robots for *"jobs that require artistry, evaluation, judgement and diplomacy"* [17]. Along the same lines of thought, in another recent survey [15] only 26% of the respondents were comfortable "*with having a robot to provide services and companionship to the infirm or elderly*" or "*with having a medical operation performed on them by a robot*". This could be related to the common perception that people have of robots. Specifically, they are seen as technically powerful but potentially *dangerous* machines, which are mainly useful in space exploration, in military applications and in industries where human beings are not present. For this reason, the objectives of the recent robotics research focus on the attitude, usability, and acceptability by the users, aspects which are often not correlated [18–22].

2 Studies on social robotics for older persons

2.1 A European project aimed to support the older people

Scientific research is also exploring multi-robot systems to favor independent living, improve the quality of life and the efficiency of care for older people. For instance, this was the case of the Robot-Era project [2] in which a multinational European consortium of academies and industries developed a plurality of complete advanced robotic services, integrated into intelligent environments. The project conducted one of the largest experiment ever carried out using multiple service robots, developing eleven different services to support older users individually at home, or collectively in the building and outside. In summary, the experimental results [23] showed that the robot companions can be effective at home as an instrument to help the family with their care and in case of need (e.g. illness).
Researchers are also exploring the use of multi-robot systems which would enable more independent living for seniors because they are able to coordinate with each other to better perform their tasks, also outside the home.

2.2 Results on the acceptability

The acceptance of robots by older people has been examined in many studies. However, usually, older users have expressed an opinion without interacting directly with a robot, showing a strong limitation in the studies [23].
In a study, a robot was used as a physical exercises coach with 33 older participants. The results showed that most of the users were pleased with the robot as an exercise motivator [24]. In another recent study with 16 adults, the acceptability of robots for partner dance-based exercise was investigated. The results suggested that the robot was perceived as useful, easy to use and enjoyable [25]. In a study with 32 older participants, the authors [26] investigated how the human-likeness of the robot's face could influence the perceptions of the robots. But, no real robots were used in the study and the imagination of the participants was stimulated by robot images. Finally, with interviews and questionnaires, the results showed a greater preference for the human aspect of the robots by older adults.
In European Robot-Era project the results of the experiments indicated that older participants were keen to accept robot companions at home as a way to help the family with their care [2]. Specifically, experiments were conducted in domestic environment, condominium, and outdoor areas. Eleven robotic services were provided by the Robot-Era system, and each service was tested by older adults that extensively interacted directly with three robots to accomplish tasks [23].
The perception of usability, measured using the *System Usability Scale* [27] was very high (the median score for 67 users was 82 out of 100, over the cutoff score of 68), and significantly correlated (.32; $p<.05$) with acceptability, measured using the *Unified Theory of Acceptability and Use of Technology (UTAUT)* questionnaire [28]. More specifically, the *Perceived ease of use* correlated with usability .50 ($p<.001$), more than the *intention to use* (.31; $p<.05$) [2].

Moreover, the actual usability of the system influences the perception of the ease of use only when the user has no or low experience, while expert users' perception is related to their attitude towards the robot [23]. This finding should be more deeply analysed, because it may have a strong influence on the design of the future interfaces for elderly-robot interaction, since it is expected that the number of elderly that possess and use technological devices is growing. Finally, the authors suggest that the positive perception of the robots' aesthetics could play a role in increasing the acceptance of robotic services by older users [23, 29].

2.3 Social robots as assessment tools

Recently, some studies have investigated how social robots could support the clinician during psychological diagnosis. In fact, often the diagnosis is affected by the bias of the subjectivity of the evaluator. Studies indicated that the support of robots could lead to a more objective assessment, guarantee standardized administration and assessor neutrality, especially for gender and ethnicity, and allow micro-longitudinal evaluations [21, 30]. Indeed, robots can be a useful tool for large-scale screening of cognitive functions. This condition requires further examinations by clinical psychologists, who must always be responsible for the final diagnosis. This can occur if the robotic administration of a cognitive test is supervised by a professional expert [30].
In a recent study, 21 Italian elderly participants were involved. The aim was to compare the prototype of a robotic cognitive test with a traditional psychometric paper and pencil tool, and investigated personality factors and acceptance of technology on tests. The authors tested the validity of the robotic assessment conducted under professional supervision. Some factors such as Anxiety (.47; $p<.05$), Trust (-.49; $p<.05$), and Intention to use (.47; $p<.05$) were related to performance in psychometric tests. Finally, the results show the positive influence of Openness to experience on the interaction with the robot's interfaces (.58; $p<.01$) [21].

3 Conclusion

Though research into social robots is just beginning, we know so far that they can provide some solutions to society's ageing population challenge - and might also help in reducing social isolation and loneliness -- if society is willing to adopt them. MRT systems and "pet" companions are already on the market. Humanoid companions are still being studied, but seem like a promising solution for more comprehensive quality care [31].
The literature suggests that young people are more in favor than older people to use robots in caring [32]. Also, differences with males, between countries, and those who live in cities, and more educated are more favorable have been found. Besides the importance of psychosocial variables for user acceptance of social robots and technology in the context of everyday functioning, because the level of psychosocial functioning could either hinders or promotes robot acceptance [33].
The observation of an "uncanny valley", that is a phenomenon in which highly humanlike entities provoke aversion in human observers, has had an important role for the recent researches [34]. To understand the uncanny valley, and the visual factors

that contribute to an agent's uncanniness, the relationship between human similarity and people's aversion toward humanlike robots via manipulation of the agents' appearances was been studied [35]. The authors showed a clear and consistent "uncanny valley", and the category ambiguity and atypicality provoke aversive responding, thus shedding light on the visual factors that drive people's uneasiness [35]. Also, the time and/or exposure to robots is unlikely to mitigate the "uncanny valley" effect, because no relationship exists between people's aversion and any pre-existing attitudes toward robots [35].

In conclusion, the robots' acceptance in intervention and diagnostic evaluation will be essential for employing robots in social purposes, particularly for older users. However, it is evident that the research still in progress and, as usual in the diffusion of innovation, the success is mostly shown with early adopters. For this reason, future studies should focus in managing and acting upon adverse user responses to maximize the effectiveness of robots also with the general population. Furthermore, longitudinal studies would be needed to assess the long-term effects - positive and negative - of how older people perceive social robots.

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