A Methodological Approach to Evaluate Elderly-Robot Interactions

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Abstract

The relevance in the study of interaction between elderly and robots may depend on the choice of activities that robots can be developed to perform and the assessment of their impact and importance for older people. This research requires coordinated research between computer engineers and specialists in the humanities and social sciences. Being a recent research area, it is particularly relevant to carefully select the behavioural variables to be analyzed, the methodology adopted and the instruments that allow for a rigorous evaluation. Based on these assumptions, the present study aims to develop Innovative Initiatives for the Promotion of Active Aging in the EUROACE Region. The authors propose an appropriate methodology and instruments to evaluate the impact of the human-robot interaction in the promotion of a more active aging in a group of elderly in a nursing home. The analyzed variables focus on the involvement of the elderly in the activities, their capacity for initiative and to establish social interactions, indicators of well-being and a proactive attitude. The methodology of the study is mixed (qualitative and quantitative), organized as an exploratory case study. Data collection is based on naturalistic observation but variables are quantitatively assessed in a pre/post-test design.The research design identified the narratives of the elderly and the staff of the institution regarding the needs and interests of each elderly person, classified the participants according to the levels of prevailing social interactions, involvement and initiative in activities, considered important variables for an active ageing and, in this sense, demonstrated its adequacy to be used to evaluate the results of the intervention using social assistive robots.

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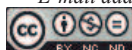
1. Introduction

The world's population is ageing and developed countries are engaged in the implementation of a new aged-care paradigm because an increasing number of older people will require formal long term care as their health and wellbeing deteriorates and they cannot source as much human care and support in the community (Robinson, MacDonald, Kerse & Brodbent, 2013). This reality requires the creation of entrepreneurial services and new responses to the phenomenon of ageing for an inclusive society (Paúl & Ribeiro, 2012; Pires, 2017).

For an older person, admission to an elderly care facility is rarely easy and moving to a nursing home is often precipitated by the loss of a loved one, an inability to look after one self, declining health, and a lack of control over one's life (Nay, 1995). These factors combined with the institutional environment of the elderly care facility may result in the loss of aspects of their lives that constitute life satisfaction and active ageing. Older people in nursing homes often report feelings of helplessness, boredom, isolation and in general, they report a lower quality of life than those residing in the community (Vaz & Gaspar, 2011; Guimarães, Simas & Farias, 2005; Grayson, Lubin & Van Whitlock, 1995).

Liu, Dijst, Faber, Geertman & Cui's (2017) study show that the residential environment is directly associated with older adults' health, and indirectly as well, through a series of significant behavioral, physical and social activities and subjective well-being.

The residential environment affects not only physical but also social aspects older adults' health. In line with the existing literature (Ellen et al., 2001; Northridge et al., 2003; Parra et al., 2010; Phillips et al., 2005 referred to in Liu, Dijst, Faber; Geertman & Cui, 2017), physical residential environment, including housing quality and the access to cultural facilities, is positively associated with physical and mental health. The implementation of good practices promoting quality of life of the institutionalized elderly requires a multidimensional perspective, aimed at ensuring that practices are (more) human, problem-oriented and holistic (Pereira, 2016).

In this sense, new assistive technologies are being mooted for an ageing society; a possible response to the growing needs of older people in the care process and an instrument/tool to promote social interactions and active ageing (Kachouie, Sedighadeli & Abkenar, 2017; Kachouie, Sedighadeli, Khosla & Chu, 2014; Robinson; MacDonald; Kerse & Brodbent, 2013; Kidd, 2006). According Swapna & Šabanović (2017) new developments in Social Robotics envision "family robots" (e.g. Jibo, Buddy) or robots for use by groups (e.g. Baxter), rather than robots for individuals. Research in Human-Robot Interaction has similarly started incorporating inter-group interactions, mostly in the context of small groups such as teams or task groups. As technology advances, multi-user robots could assist in social and public spaces, yet current research does not exploit social robots to create engaging or empowering community interactions.

The relevance and interest in the study of interaction between elderly and social assistive robots may depend on the choice of activities that robots can be programmed to accomplish and the impact and importance for older people. This is a task that requires coordinated research between computer engineers and specialists in the humanities and social sciences (Abdi, Al-Hindawi, Ng, & Vizcaychipi, 2018).

Being a recent research area, it is particularly relevant to carefully select the behavioral variables to be analyzed, the methodology adopted and the instruments that allow rigorous evaluation (Joshi, 2017; Kachouie, et al., 2014).

Kachouie, et al. (2014), in referring to the studies of Oestreicher & Severinson, & Eklundh (2006) and Lohse (2010) on the human-robot interaction, have established the importance of understanding users' expectations as they affect human–robot interaction. The gap between expectations of a robot and its actual function can influence the user's behavior (Komatsu, Kurosawa, & Yamada, 2012). Thus, determining user needs and providing proper technology might increase the rate of acceptance (Kobb, Hilsen, & Ryan, 2003).

Another aspect to take into consideration is the need to listen the opinion of stakeholders and only a few studies included other stakeholders than the elderly. Different stakeholders (e.g. family members, psychologists, cultural animators, managers of nursing homes) have different representations and it is important to consider their perspectives (Broadbent et al., 2009). Brooker (2007), in turn, reinforces the need for research which prioritizes the viewpoints of the elderly.

The design of the present study intends to respond to some of the suggestions mentioned above and is inserted in the EuroAGE project which aims to develop Innovative Initiatives for the Promotion of Active Aging in the EUROACE Region. The analyzed variables focus on the involvement of the elderly in the activities, their capacity for initiative and to established social interactions, indicators of well-being and a proactive attitude.

2. Problem Statement

The study of the role of interactions between the elderly and robots to promote a more active ageing requires a thorough and careful selection of the behavioral variables to be analyzed, and the methodology to be used. This is the objective that the authors propose to contribute in this study.

3. Research Qusentions

Can Social Assistive Robots contribute to a positive impact in elderly well-being and active ageing?

4. Purpose of the Study

The present study is part of the effort to develop Innovative Initiatives for the Promotion of Active Aging in the EUROACE Region. The authors propose an appropriate methodology and instruments to evaluate the impact of the human-robot interaction in the promotion of a more active aging in a group of elderly in a nursing home.

5. Research Methods

The methodology of the study is mixed (qualitative and quantitative) and organized as an exploratory case study. Data collection is based on naturalistic observation, but variables are quantitatively assessed in a pre/post-test design.

5.1. Sample

The sample included the group of elderly residents in a Portuguese nursing home; 10 men and 21 women, aged between 64 and 98 years, in a Portuguese nursing home. According to the objectives of the study, we also included in the sample the psychologist, the cultural animator (specialized technician in the selection and management of activities that promote socio-cultural interaction in the elderly) and the manager of the institution. The sample selection was intentional and did not obey the exclusion criteria since it integrated all of the elderly subjects and professionals.

5.2. Procedures

a) In the pre-test, the team of the Instituto Politécnico de Castelo Branco, one of the partners of the Project EuroAGE, developed their work in the area dedicated to social robotics, having first identified the interests, activities and routines of the elderly in one of the local partner institutions. This process took place during a period of two months of participant observation, focused on identifying the following variables selected by the authors: Daily routines, interests, social interactions, involvement and initiative in activities.

b) At the same time, the Engineering team developed parallel robotic applications for the robot that would interact with the elderly in the partner institution, thus, allowing interaction through the manipulation of objects, the implementation of play activities and autonomous movement.

c) After these phases, in September 2018, the robot will interact with the elderly, in small groups, organized according to the following criteria: groups of elderly with high initiative and involvement; heterogeneous groups based on the initiative and involvement variables and groups with low levels in initiative and involvement.

d) At the end (post-test) the variables considered in the study (initiative, involvement and social interactions) will be evaluated again, identifying the impact of the human-robot interaction on the results in the different categories of groups. The opinions of the elderly, the psychologist, the cultural animator and the manager will also be collected through an interview.

5.3. Instruments

a) Ficha de Observação das Interações e Atividades em Estruturas Residenciais para Pessoas Idosas (Registration form of Interactions and Activities in Residential Structures for Older People – Adapted from Bertran & Pascal, (2009) in the Manual DQP – Desenvolvendo a Qualidade em Parceria. Lisboa: Ministério da Educação). This instrument evaluates three variables that indicate interest and participation in the activities taking place in the institution: *initiative, involvement* and *social interactions*. It has been used to assess quality in different contexts and is validated by Tony Bertram and Christine Pascal (2009) for the observation of Portuguese children in a kindergarten context.

Although, *involvement* may seem to be a subjective property, it is possible to assess the levels of involvement in children and adults. The concept of involvement refers to a dimension of human activity. Involvement is not linked to specific types of behaviour or to specific levels of development. Both the baby in the cradle playing with his or her voice and the adult trying to formulate a definition, both the (mentally) handicapped child and the gifted student, can share that quality (Laevers, 2015, p.2). For this, the "Leuven Involvement Scale" (LIS) (Laevers, 2015) included in the "Ficha de Observação das Interações e Atividades em Estruturas Residenciais para Pessoas Idosas" was developed, encompassing seven variants for different settings, ranging from childcare to adult education. The level of involvement is evaluated on a 5-point rating scale distributed between point 1 (the person is mentally absent) and point 5 (there is total engagement expressed by concentration and absolute absorption by the activity). In relation to the variable *initiative*, the scale can be used to identify 4 levels that are distributed between point 1 (the activity of the elderly was proposed by another / total absence of initiative) and point 4 (the elderly proposes / decides the activity they intend to carry out). The register of *interactions* determines the categories of social interaction prevailing in each subject according to the following categories: Large Group; Small Group; Couple; Individual.

b) Semi-structured interviews with the elderly in order to identify the following parameters: activities developed at the institution, preferred activities, activities and games that they would like to engage in.

c) Semi-structured interview with professionals with the objective of identifying the following parameters: identification of daily routines; activities implemented by cultural animator and psychologist; interaction mode (individual or group); activities preferred by the elderly; evidence of the initiative of the elderly in the proposal of other activities; attitude of the elderly in the activities.

6. Findings

The first phase of implementation of the project, corresponding to the pre-test, identified the following:

- The routine activities organized by the professionals of the institution;

- The activities in which each individual participates on his/her own initiative;

- The interests and suggestions of other activities the elderly would like to participate in interaction with asocial assistive robot.

- The levels of prevailing social interactions, involvement and initiative in activities obtained of each elderly.

Averages obtained of the group of 31 elders in the variables *involvement* and *initiative*, in daily activities.

Table 01. Averages of the group of 31 elders in the variables *involvement* and *initiative*, in daily activities.

Involvement	Initiative
3.2	2.7

- The averages obtained by the group were slightly above the midpoint in the variables *initiative* and *involvement*;

- 29% or less than one-third of the sampled elderly were identified with a level of 2 or less in the "involvement" indicator on a five-point scale;

- 30%, again less than one-third of the elderly presented initiative levels equal to or less than 2 on a four-point scale;

- 30% of the elderly showed good levels of initiative, ability to interaction and involvement;

- It was also possible to identify a relationship in the results obtained in the dimensions *involvement* and *initiative*, that is, the elderly who demonstrate more involvement in both the activities suggested by the professionals and those selected by themselves are also those that show a greater initiative in the regulation and selection of activities performed.

7. Conclusions

7.1 The adopted methodology identified the narratives of the elderly and the staff of the institution regarding the needs and interests of each elderly person and classify the participants according to the levels of prevailing social interactions, involvement and initiative in activities.

7.2 Although it was possible to identify the sample is heterogeneous in terms of the parameters evaluated, the results reinforce the need for mobilizing intervention of higher levels of activity in more than 50% of individuals, responding to the interests of the elderly. Based on these results, some social, cognitive and physical activities were selected to be developed by a socially assisted robot. These activities will be implemented in the next phase of the project.

7.3 The instruments and the evaluation process used in this research methodology allowed an objective characterization of the interest, type, level of activity and social interaction of each elderly person as we triangulated the qualitative (observation and interviews) data with the quantitative (survey instruments) evaluation of the variables considered. The interview data came from the individual interviews of the elderly and to the professionals responsible for the organization of the activities and routines in the nursing home.

7.4 In this sense, the research design established its adequacy to evaluate the social interactions, initiative and involvement in activities considered important variables for an active ageing and which could be used to evaluate the results of the intervention using social assistive robots.

Acknowledgements

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