Social and Entertainment Robots for Older Adults

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4 authors:

Filipa Correia
University of Lisbon
45 PUBLICATIONS **683** CITATIONS

Patrícia Alves-Oliveira
University of Michigan
105 PUBLICATIONS **1,659** CITATIONS

Sofia Petisca
University of Buckingham
27 PUBLICATIONS **519** CITATIONS

Ana Paiva
Instituto Superior Técnico, Inesc-ID
594 PUBLICATIONS **12,983** CITATIONS

Social and Entertainment Robots for Older Adults

Filipa Correia, Patrícia Alves-Oliveira, Sofia Petisca and Ana Paiva

***Abstract*—Elderly people have specific needs that are often ignored in the way we, as a society, conduct our lives. In recent years, significant technology has been developed to support the elderly, in particular in health care. Yet, when dealing with people that in spite of their age that are still capable of doing their regular daily tasks, some of the problems they face is solitude, and how to occupy their free time with leisure and cognitive activities. This also constitutes a necessity for improving their quality of life. With that in mind, in this paper we describe an autonomous robotic game player that plays a very popular card game among the elderly. The motivation behind developing such social robot was to tackle one of the major issues of older people – social isolation, while promoting new and different ways for them to interact with each other. To study people's responses to the robot we invited older people from a local elder care centre to come to our lab and experiment it. During the lab study, 6 older adults engaged with our social robot in the interactive card game and, through an interview, we asked for their opinions and impressions. The interactive card game scenario with the autonomous robotic player was reported as a positive and enjoyable new version of the traditional game.**

I. Introduction

When we aim to create robots that will interact with older adults, which is yet scarcely explored, previous findings in the Human-Robot Interaction (HRI) field may contrast for this particular population [18]. Therefore, there is a need to further our knowledge regarding how older adults perceive and accept not only social robots, but also technology in general. As for instance, Wilson (2017) reported that technology can encourage elderly users to communicate more, which can consequently have a positive impact on their perception of self-worth, or that difficulties to use technological devices has a negative effect on their self-esteem [22]. Additionally, regarding socially intelligent agents, Fasola and Matarić (2013) pointed to a clear preference by elderly users for an embodied robot over its virtual version in their exercise coaching task [10]. The physical robot was evaluated as more helpful, more socially attractive, and as having greater social presence than the virtual robot.

It is also worth mentioning the work of Alves-Oliveira et al. (2015) that reports results from a focus group, where older adults have discussed their expectations, needs and fears related with robots [2]. The authors presented all the activities they mentioned as possible interactions with robots, from a storyteller to a medication manager, as well as which type of robots they prefer to do each different task. The social isolation aspect was revealed through the social activities they imagine themselves doing with entertainment robots, as for instance: "Cheer people, communicate or talk. The robot should be able to share its own ideas, even when they are different from ours"; or "Play games in general, and cards and domino particularly. It would be wonderful if the robot could just talk with us and be a company in our daily life.". Hence entertainment robots seem to constitute a promising and natural way of integrating social robots into their lives.

Having these needs as a motivation, we developed a robotic card game player, aiming at addressing the elderly population and improving their Quality of Life. Most elderly people like playing games and their primary motivation to do it is to have fun and maintain their social network [1]. Card games allow the elderly to interact with other people and widen their connections. Therefore, a social robotic game player would promote and provide them new ways of communicating and interacting with each other, and reduce their social isolation and loneliness problem.

We have chosen the SUECA card game[1], one of the most played card games among the elderly population in Portugal, to develop an autonomous robotic player and companion. This robot is able to autonomously (1) play the card game, and (2) socially interact with the remaining players. Moreover, its social behaviours were based on observations of older adults playing this game. This particular robotic game player introduced several challenges during its development, such as solving and computing the chosen card to play in the game, or the socially intelligent mechanisms that produce a human-like behaviours, which constitute some of our previous findings [6, 5, 7]. However, previous studies involved only young adults, and therefore the contribution of this paper is to report our first experiment with the target users, the older adults, that in the first instance inspired our work. We invited an elder care centre to visit our lab and connect with some of our social robots. After playing with the robotic card game player, we interviewed them to understand their opinions, considerations, and how they have felt during the interaction.

II. Related Work

In 2009, Broekens et al. have analysed and reviewed the most relevant literature about social robots in elderly care [4]. According to the authors, assistive social robots for elderly can be categorised as service type and/or companion type. While looking carefully at the service type robots, we may found relevant instances such as *Pearl*, *RoboCare*, and *Care-O-bot II*. These three autonomous robots are capable of providing indoor guidance to the elderly and some cognitive support as reminding them about their daily activities [14, 3, 11]. More importantly, a common point in these robots is the fact that they can improve the independence of their owners.

[1] https://en.wikipedia.org/wiki/Sueca_(card_game)

On the other hand, there are also robots more focused on companionship purposes for elderly. For instance, *Paro* is a seal shaped companion used as medical therapy for the elderly with dementia. Since 2003, the user studies using *Paro* in care houses by Wada et al. have shown improvements in the mood, depression, stress levels, and social interactions with other residents [19, 21, 20]. *Aibo* is another companion robot that was used in a study with older adults with dementia [16], where it produced a relevant increase of social actions, emotions and feelings of comfort about past memories in the participants.

Regarding more entertainment activities, Tapus and Matarić (2008) have also developed a robotic music therapist for older adults suffering from cognitive changes related with ageing (e.g. dementia, Alzheimer). Through tasks for practising recall, memory, social interaction, alertness and sensory stimulation, this robot was able to provide elderly users cognitive assistance, motivation, and also companionship [17]. Additionally, in a more recent experiment, Johnson et al. (2016) developed a robotic player for the game of Mastermind, aiming to provide elderly people social support in a form of entertainment activity [13]. Although participants have indeed recognised the robot as having an entertaining associated value, the hypothesis that participants would enjoy more a robot displaying behavioural patterns associated with the game progress when compared to randomly displayed behaviours was not supported.

Entertainment scenarios allow not only to create companion robots for older adults, but also to deepen the study of social abilities robots must embed in order to improve the interaction quality. For instance, social presence was reported as being able to lead to higher enjoyment and higher acceptance scores in older adults [12]. Additionally, De Carolis and collaborators (2017) have analysed how elderly users interpret empathic behaviours of a robot [8]. However, the influence of empathic behaviours on the elderly users' attitudes is still not clear, as suggested by Van Ruiten et al. (2007) where the novelty effect seemed to have a more prominent role [18].

III. Development of the autonomous social robot

The social robotic player of the Sueca card game is an autonomous robot able of both playing competitively the game while interacting with other players in a human fashion. The scenario uses a multitouch table in order to provide a blended game experience where human players can use physical cards while the robot uses virtual ones.

In order to briefly understand the most relevant implementation details of our robotic player, Figure 1 illustrates how the SERA model [15] was embedded in our system. All game events are generated by the *Sueca Game* application and triggered by human players' actions on the *Touch table*. The *Decision Maker* constitutes the core of our robotic game player, which is able to receive those game events and then reacting upon them, by selecting the behaviours for the robot to perform. Each behaviour chosen by the autonomous player is sent to the semi-autonomous behaviour planner – *Skene* – that is responsible for scheduling verbal and non-verbal behaviours to the *Text-To-Speech (TTS)* engine and the animation engine – *NuttyTracks* –, respectively. All the communication protocols among the several modules are granted by the *Thalamus* framework, which together with *Skene*, and *NuttyTracks* are provided by the SERA ecosystem.

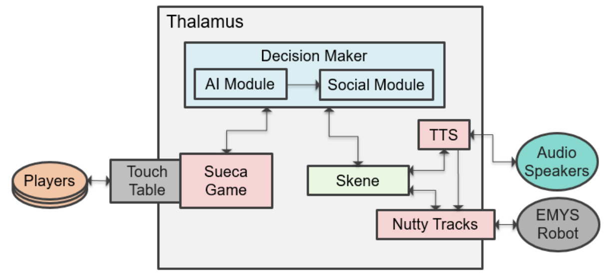

Fig. 1. The architecture of the *Sueca*-playing robot.

The agent's *Decision Maker* is split in two main tasks: to choose a suitable card to play –*AI Module*–, and to interact socially with other players according to the game state –*Social Module*. To illustrate the interaction between the two modules of the *Decision Maker*, consider the moment when a human player plays a certain card, and then the robot should first look at the card and also comment the game move while looking at that player. In this example, the *Social Module* must be aware that someone played a card to index possible social behaviours for that situation. At the same time, the *AI Module* computes the benefit of that move for the robot's team and delivers that information to the *Social Module*. By providing such computations to the *Social module*, the agent is able to produce adequate behaviours in a socially intelligent manner.

A. IA Module

The *IA Module* is mainly responsible for choosing a card to play. It uses the Perfect Information Monte-Carlo algorithm in its deliberation process [7]. This algorithmic approach has obtained remarkable results in similar artificial agents for hidden information trick-taking card games, e.g. Bridge and Skat.

B. Social Module

The *Social Module* produces extremely expressive behaviours based on emotional reactions to the game state. The initial baseline for those social behaviours was fully inspired by human players. We conducted a user-centred study in an Elder Care Centre to analyse older adults playing this card game. We wanted to understand:

- *when* – which game events trigger behaviours,
- *how* – specific verbal and non-verbal behaviours used by participants,
- *why they interact in this particular game context* – extracting semantics from their behaviours.

Afterwards, we created the list of utterances pertaining all the social behaviours of our robotic game player. Additionally, as human players react emotionally upon certain evens, the *Social*

Module also includes an emotional architecture – FAtiMA[9]– in order for the agent to produce emotional responses[5].

IV. Lab study

This study aimed at collecting an observation of older adults interacting with the robotic game player, and ascertain their opinions upon the robotic player and the new interactive card game.

A total of six elderly (3 female) recruited from a a day-home care institution played the Sueca card game in a Lab (see Figure 2). They were instructed to play as many games as they wanted and at the end of the study two researchers performed a semi-structured interview focusing two main points: **experience of playing** (e.g. How was the game? What did you think of this new way of playing? Was there anything strange that did not go so well?); and **the robotic game player** (e.g. What was it like playing with the robot? Did you feel it was good at the rules of the game? Do you think it should learn some rules better?).

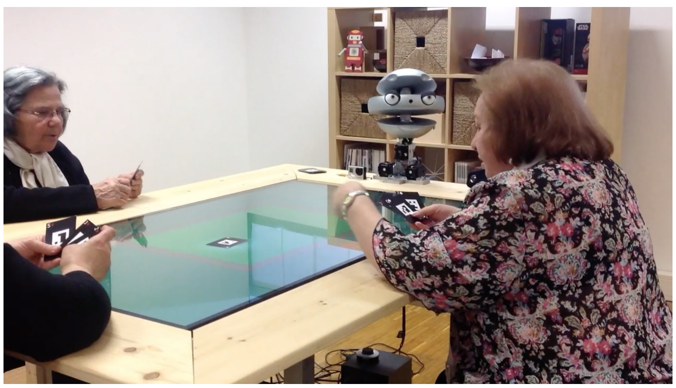

Fig. 2. Participants playing the card game of Sueca with the social robotic player.

The semi-structured interview revealed that participants evaluated the interaction as positive, saying they had *"a good time and lots of fun"*. They also emphasised the good experience of playing in a multi-touch table with a robotic agent. When asked about the game playing, they revealed that *"at the beginning was harder"*, because the participant who partnered with the robotic agent (and thus played in front of it) did not had a good perspective on the virtual cards played by the robot. This problem was attenuated throughout the game as this player understood that the robot verbalised the cards it played, for instance, when it was the robot's turn to play it would say *"I am going for an Ace now"*. It is important to note that these players play Sueca often and are very specific about the perfect conditions of playing the game (such as playing it in a smaller table where players are closer to each other – in contrast with the multitouch table used that is larger). Additionally, they appreciated the robot counting the points at the end of each game, revealing that they *"trusted the robot more than if a person would count the points"*, adding that *"people cheat more than machines."*

Moreover, Sueca is a card game in which players perform cheating behaviour. The cheating behaviour usually occurs between the two partners to signal each other hidden information about their suits in order to benefit the game result, *e.g.,* cheating behaviour can be used when a player wants to signal the partner when to invest (or not) in a good card in a given turn during the game. Usually, partners remain the same when playing Sueca, as they already have a defined cheating behaviour language that eases the message understanding. The participants of this study said it was challenging to perform cheating behaviour when partnering with the robotic agent. They mentioned it was harder because it was the first time they were partners with a robot. Additionally, the robot played with virtual cards which made it harder to decode possible cheating behaviours – cheating behaviours can be expressed by the way partners hold or play their cards (*i.e.,* the speed and aggressiveness they put into the flow and holding of the cards can encode cheating behaviour).

When asked about the possibility of having a system like this in their day-home care institution, they said they *"laughed a lot, maybe even more than when we play with other people, but nothing substitutes playing with a friend"*, hence revealing the importance of social connection. Also, they acknowledged clear advantages of using this system, mentioning how useful it could be for situations in which they lack a player, or even when they play with people that do not master the game rules. In this case, the system would be *"useful to train people in a fun and engaging way."*

V. Conclusion and Future Work

Entertainment robots constitute a relevant and promising area of application in Human-Robot Interaction that needs to address many different populations, including older adults. Yet, for this type of population, the elderly, we believe it is crucial to test the scenarios and the robots in natural situations, and listen to their opinions as they may have special needs or requirements that need to be considered. Therefore, inspired by their requirements we developed an autonomous social robot that plays a card game particularly well-known by the elderly in Portugal. The lab study shows that our social robotic game player was able to play the Sueca card game in a very natural manner. Nonetheless, there is space for improvements and their opinions revealed demanding expectations since they want the robotic partner to include complex social behaviours like what they are used to in other human players (e.g.: cheating signals). Further, in spite of the natural interaction with the robot, the interaction with the multi-touch table required some level of adaptation. As future work we would like to replicate the study of [5] with more participants, and compare how trust towards a robotic partner differs from the trust towards a human partner within this particular population.

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