Towards a Study to Assess Conversation-based Interaction between People with Dementia and Robots

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ABSTRACT
Socially Assistive Robots (SAR) promote social interaction to provide cognitive, social and emotional support to people who interact with them. Therapies and interventions supported by SAR technologies for people with dementia (PwD) have found promising applications. Since a conversation is one of the most important strategies for social interaction with PwD we propose the use of a robot to enact a personalized conversation to calm, distract and relax people who suffer from dementia. However, a PwD-robot interaction has many differences with respect to an interaction between a robot and a person without dementia. Thus, to achieve our goal we propose a study to explore the adoption of a conversational SAR by PwD. In this work, we propose an exploratory study to answer open questions about PWD-robot interaction related to engagement, adoption factors, and communication strategies. We expect to answer these questions using common metrics used for human-robot interaction (HRI) and dementia research. With this study, we expect to determine which issues influence the adoption of a SAR by PwD. Moreover, this study will allow us to better understand how a PwD can interact with an autonomous conversational robot.

CCS Concepts
• Computer systems organization → Robotics • Human-centered computing → Interaction design → Empirical studies in interaction design

Keywords
Human-Robot Interaction; People with Dementia, Conversation, Socially Assistive Robot.

1. INTRODUCTION
The prevalence of dementia including Alzheimer's disease will only increase as the aging population continues to grow [12]. Troubles with memory and orientation are related to dementia in elderly people. These problems create concern for the individual's safety and ability to look after themselves [6]. Moreover, people with dementia (PwD) experience behavioral and psychological symptoms, such as anxiety or aggression that can put them, or their caregivers, at risk [13]. This dependence on others may lead to caregiver burden, psychological issues, physical health problems and increased stress for the caregiver and the family because the person who suffers dementia requires a great amount of surveillance [11].

Non-pharmacological interventions aim at reducing the incidences of problematic behaviors, and ultimately stimulating definite changes in behavioral patterns in PwD and their caregivers. Thus, and taking into consideration recent advances in robotics, where the aim is not only to provide physical assistance but to stimulate participants through their interaction with a robot [15], the use of robots to support non-pharmacological interventions has taken relevance on the research field. Particularity, Social Assistive Robot (SAR) systems have been used to support interventions based on companionship and social interaction, physical and mental activity, and activities of daily living. The application of SARs in the care of people with dementia is a field with important opportunities for further research [10].

We aim at assisting caregivers that cannot provide effective assistance to a PwD 24/7 with the design of a robot that enacts strategies for effective social interaction. This robot could be used to ameliorate problematic symptoms of dementia and lessen caregiver burden. To achieve this long-term goal, our first step was to conduct a contextual and qualitative study to discover and understand needs and opportunities to manage problematic behaviors [4]. Thus, we discovered that the main social interaction strategy – to deal with problematic behaviors such as depression, anxiety, and aggression - is to enact a personalized conversation with the residents. Caregivers often use this strategy to calm, distract, and relax the residents. Thus, we envision an autonomous SAR that can enact a conversation based on the personality and preferences of each PwD.

However, to achieve our goal it is necessary to better understand the issues affecting the adoption of conversational robots by PwD. Moreover, this kind of study can lay the basis and groundwork for an iterative design of our autonomous SAR. In this work, we propose a study - based on a Wizard of Oz setup - to measure and understand the PwD-SAR interaction based on a personalized conversation.

2. STUDY DESIGN
Our goals are to better understand how to engage PwD in a conversation with a robot, as well as identifying scenarios for which a conversational SAR can help distract, calm or relax the PwD. We have three main goals for this study: First, investigate the adoption of a conversational SAR by a PwD. Secondly, determine which aspects of conversation-based interactions are crucial to engage a PwD. Finally, we are interested in discovering potential scenarios where the robot can support an intervention to deal with problematic behaviors from PwD.

We propose a study based on a Wizard of Oz setup. The use of "the wizard in the loop" experimental setup allows experiments to be both less constrained - through the use of improvisation or the operator's expressiveness and more systematically constrained - by cutting out the limitations of an automated system - than would be possible with a real computer-operated system [5]. Given its

versatility, we opted for a Wizard of Oz setup as an appropriate platform to examine interactions between PwD and a robot.

The cycle of interaction includes a person with dementia, an operator, and the robot. In addition, a test facilitator is included to provide help and support to participants during the evaluation.

2.1 Research questions

PwD-robot interaction has many differences with respect to an interaction between a robot with a person without dementia. To achieve our long-term aim -a robot that can enact a conversation, first we need understand many aspects related to engagement, conversation strategies, and other aspects related to the adoption of a conversational robot.

Social robots may need only to produce certain experiences for the user, rather than having to withstand deep scrutiny for "life-like" capabilities [16]. Thus, we want to know if it is likely to enact a conversation between a robot and a person who suffer from dementia. Thus, we aim at finding evidence about the viability of conversation-based interaction, and propose the first research question:

Q1: Is it possible enact a conversation between a person with dementia and a robot?

In the moderate stage of dementia an individual is still able to participate in a meaningful conversation and engage in social activities [14]. However, she or he may repeat stories, feel overwhelmed by excessive stimulation or have difficulty finding the right word. The Alzheimer's Association has proposed guidelines for successful communication with people with dementia [2]. Some of the recommendations for successful communication include: speak directly to the person, given the person time to respond, avoid criticizing or correcting, avoid arguing, speak slowly and clearly, and ask one question at a time. Therefore, we propose the second and third research question:

Q2: How effective are these strategies for the PwD to engage in a conversation with the robot?

Sometimes the emotions being expressed by a PwD are more important than what is being said. Even, the presence is most important to the person [2]. There is a strong relationship between social presence, enjoyment and engagement [8]. Thus, we propose our third and fourth research question:

Q4: Can a conversational robot have a social presence during an interaction with a person who suffers from dementia?

Q5: Can a person with dementia enjoy an interaction with a conversational robot?

2.2 Participants

Each person experiences dementia in a different way, even the same person can experience the disease in distinct ways during the same day. Thus, our proposal is based on a small group of PwD (4-5 participants) because each interaction with the robot must be personalized. To measure the interaction and adoption of our conversational SAR, it is useful to have access to conversations with returning users, thus each participant will converse with the robot at least two times per week over one month. This will allow us to assess if overtime the PwD interaction with the robot improves on some of the variables of interest described in 2.5.

The participants of the study will be PwD who live in a geriatric residence. However, not all residents are viable for the study hence we define inclusion and exclusion criteria. Inclusion criteria: 1) a rate of 10-20 (moderate impairment) in the Mini-Mental State Examination (MMSE) [7], 2) between 60 and 85 years, 3) capacity of speaks, 4) admissible diction level, and 5) be sociable. Exclusion criteria: 1) frequent aggression, 2) tendency to experience delusions. The screening of participants will be performed with the assistance of the caregivers and personal of the geriatric residence.

2.3 Study task

The Alzheimer Association has guidelines for activities aimed at stimulating PwD [1]. Many of these activities are based on verbal communication. These activities include: inviting the person to tell you more when he or she talks about a recent memory; reminiscence about pleasurable stages of her life (school, activities, summer, work, etc.); completing famous sayings, ask the person about her favorite hobby (or her family, sports hero, favorite pet, cities).

Based on the information obtained from caregivers, we will select two main topics that seem appropriate for each participant. The task of completing famous sayings will be used for all participants. With this selection, we aim to sparks an active conversation between the participant and the robot.

2.4 Study setup

Before the study, we propose to have an initial session to familiarize the participants with the robot. During a group session, the test facilitator motivates interaction with the robot through activities such riddles, jokes, and famous sayings. We aim to promote the participants to speak with the robot, so they could perceive the robot as capable of engaging in a conversation.

All participants will be under same condition including as place, time, and terms of interaction. The participant will interact with the robot in a room at the geriatric residence where they live. A facilitator will be in the same room but his participation in the interaction will be limited only for respond to direct questions and doubts from the participant. The participant will seat in front of the robot. The interaction will begin by the robot via a small talk - an informal talk for introduction, to start later a conversation in accordance with topics selected for the participant.

All interactions will be recorded by two video cameras; the first camera for recording both of them, and the second placed in the robot and focused to the participant (see Figure 1). When the session time (maximum 10 minutes) has elapsed, the test facilitator terminates the interaction.

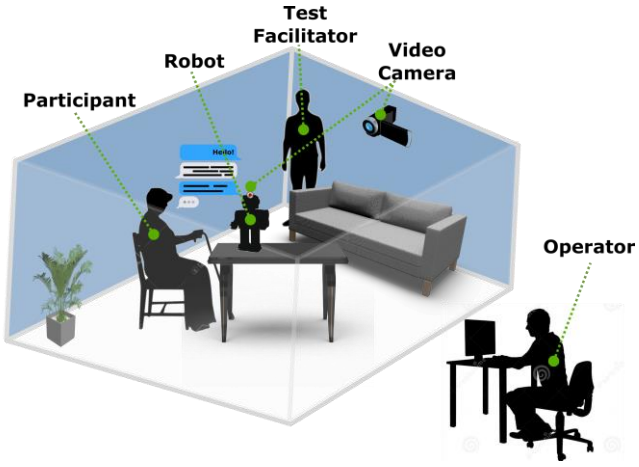

Figure 1. Wizard of Oz setup for the study.

2.5 Variables of interest

For this study, we propose to employ common metrics used for human-robot interaction (HRI) [16]. These measures were selected according to the research questions postulated in the previous section. Furthermore, we complement these measures using metrics related to the interaction and engagement used in the scope of dementia [9,14]. Also, we propose a measure to understand how the use of recommendations for successful communication affect the conversation between the participant and the robot. An assessment based on questionnaires is inappropriate for this study since the answers provided by PwD might not provide realistic information about the interaction. Thus, we will base our evaluation on observations.

Interaction: The robot interacts only through verbal communication. Frequency and duration of the participant's utterances are the main parameters to be measured. Furthermore, turn-taking is used to measure the frequency of the conversation. Also, we propose a metric based on appropriateness of responses - we will log if the participant completes correctly the famous saying.

Social presence: Social presence is the moment-by-moment awareness of the co-presence of another sentient being accompanied by a sense of engagement with the other (i.e., human, animate, or artificial being) [3]. It is particularly relevant to our study because we want to assess if people can perceive a robot such as a partner with whom to interact. Thus, we propose to use the following parameters: body response to the object (robot or phone), turn body or move toward the object, motoric feedback to the object.

Engagement: A long-term goal of our research is to develop a robot that supports dealing with problematic behaviors from PwD. Our vision is to develop a robot that can enact a natural conversation to calm, distract and relax people who suffer from dementia. Engagement is a relevant measure in this sense. We base our measurement of engagement on the Affect Rating Scale (ARS) for PwD proposed by Lawton et al. [9]. ARS define indicators (cues) by which each emotion may be identified by an observer. Emotions defined by ARS are pleasure, anger, anxiety/fear, sadness, interest, and contentment. For this case, we will use the indicators for interest emotion: eye-contact with the robot, visual scanning, eye contact maintained.

Enjoyment: We expect that having a conversation with the robot can be an enjoyable experience for a person with dementia. Thus, enjoyment is an important metric to measure. We propose to use the ARS [9], particularly cues for pleasure emotion : smile, laugh, touching, nodding, singing, arm or head outreach, open-arm gesture, eye crinkled.

Conversation recommendations: The protocol of the conversations are based on the guidelines put forward by the Alzheimer's Association [2]. We plan to evaluate the effectiveness of these recommendations by how the PwD reacts to them. For instance, in each session we will use a set of conversation recommendations, and we will observe how PwD react in terms of Enjoyment and Engagement.

2.6 Analysis method

We will obtain eight videos per participant. Each video will be coded based on the parameters (cues from participants) defined for each measure - interaction, social presence, engagement, enjoyment, and conversation recommendations. Each log will be counted to obtain occurrence, frequency, and duration (if applicable). With these data, we would obtain descriptive statistics (mean, standard deviation, distribution) about the measures.

We propose a qualitative analysis to understand the data gathered. For Q1, we will base our answer on interaction and engagement variables defined in section 2.5. Q3 will be answered based on the evidence of which communication recommendations have a positive impact during the PwD-robot conversation. Using the variable of social presence, we expect to answer Q3. Finally, gathered data referred to enjoyment will be used to answer Q4.

3. EXPECTED RESULTS

In this work, we propose a study for measuring the conversation-based interaction between PwD and a SAR. First, we propose to employ common metrics used for HRI as well as some commonly used in the scope of dementia for assessing interactions and engagement. With this approach, we expect to explore the issues influencing the adoption of a conversational SAR by people who suffer dementia. Moreover, this study will allow us to better understand how a PwD can interact with an autonomous robot with these features. This information is relevant to establish guidelines for the design human-robot interactions based on a conversational agent, and help caregivers deal with problematic behaviors.

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