Design of a Social Robot to Understand Caregivers' Perception of Disruptive Eating Behaviors by People with Dementia

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ABSTRACT

To better understand disruptive eating behaviors exhibited by people with dementia, and help caregivers address them by informing the design of interactions with social robot, we enacted vignettes of interventions guided by a social robot in short videos. These vignettes were derived from interviews conducted with formal caregivers in a day care center. From the interviews we uncovered a mismatch in perception of the problem, strategies used, and resources available, between professional caregivers and family members, that we wanted to explore further. As part of ongoing research, the videos are being used to help formal and informal caregivers reflect on how they perceive and deal with these issues and inform the design of the interaction with a social robot to assist in the management of disruptive eating behaviors.

1 INTRODUCTION

As part of our long-term goal of developing social robots that can assist caregivers in different tasks associated with dementia care, we describe an ongoing Research through Design (RtD) study [17]. We use interaction design enacted on a social robot to better understand the challenges facing formal and informal caregivers related to disruptive eating behaviors by people with dementia and how to assist them.

People with dementia (PwD) often exhibit behavioral and psychological symptoms of dementia (BPSD) [13], such as anxiety, depression and repetitive behaviors. These symptoms make dementia care challenging and contribute to caregiver burden [2]. Given that there are no known cures for dementia, most treatments, both, pharmacological and non-pharmacological, aim at improving the quality of life of PwD and their caregivers, by treating the BPSD.

One type of BPSD that we have identified in previous work as taxing on informal caregivers are disruptive eating behaviors (DEB) [3], which include refusing to eat food or being angry and agitated during mealtimes. Some of the disruptive eating behaviors exhibited in dementia include: resisting eating (turning head away while feeding, refusing to open mouth, refusing to swallow), using fingers instead of utensils, spitting food, spilling, and leaving your mouth open allowing food to come out [1, 14]. Other PwD will also require closer supervision, like physical help, and may present problems such as dysphagia or suffocation [15]. Some, in later stages of dementia, forget how to eat, requiring substantial intervention from caregivers on the mechanics of eating [11].

The use of social robots for dementia care has gained increased interest in recent years. Studies have found evidence of their efficacy in dealing with anxiety, assisting activities of daily living, and improving quality of life. Our own efforts in this area have included, as a key methodological component, understanding the needs and perceptions of both PwD and their caregivers [4, 6, 10, 12]. Along these lines is that we aim at understanding the issues associated to DEB as part of the user-centered design of a social robot to help address this behavior with a Research through Design approach.

2 UNDERSTANDING EATING DISORDERS IN DEMENTIA THROUGH THE DESIGN OF A SOCIAL ROBOT

To inform the design of appropriate interactions with a social robot to deal with DEB associated with dementia, we had planned to conduct observations and design workshops at a day care center for PwD. Unfortunately, due to the pandemic, the center closed for several months, and when it reopened, it did so with highly restrictive policies that made it impossible to conduct the study on-site as originally planned. Thus, we opted to conduct on-line interviews with caregivers and other stakeholders and design a social robot to be used as a probe to better understand the issues associated with the phenomena under study, namely, supporting caregivers of people with dementia who experience disruptive eating behaviors. Figure 1 illustrates the methodology we are following, which includes five phases, as described next.

2.1 Literature Review and Previous Studies

From our previous work on technology for dementia care we identified assisting in BPSD, and in particular disruptive eating behaviors, as a problem of interest to support using social robots. This was complemented with a literature review on the topic from which we derived an initial understanding of the challenges and opportunities of designing a social robot to help address this problem.

2.2 Contextual Study

As part of a Rapid Contextual Design approach [8], we conducted a contextual study, for which we interviewed six (6) professional caregivers, four of which work at a day care center for people

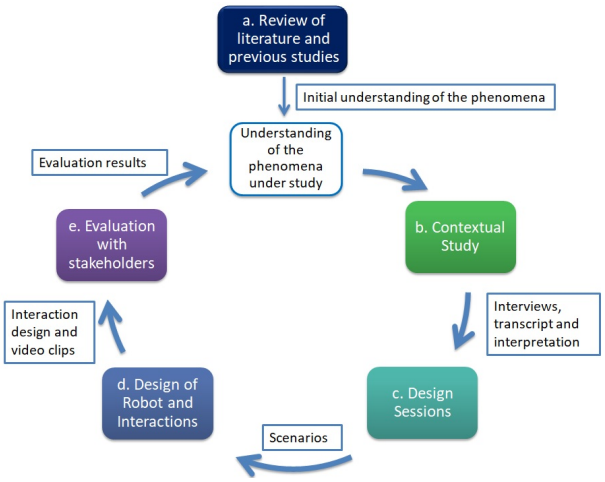

Figure 1: Methodology of the RtD approach being followed

with dementia and the other two at a nursing home. They are all professionals specialized in either Nursing, Psychology, Nutrition or Physical Rehabilitation, and had an average of more than eight years of experience working in dementia care.

The main topics of the interviews were the behavioral problems that PwD exhibit when feeding and the techniques that caregivers use to mitigate them. All interviews were transcribed and interpreted. Emerging themes were grouped in an affinity diagram. This information helped guide the design sessions, which are described in the next section.

A recurrent issue in the interviews was the diverse way in which individuals experience the disease and the need to personalize interventions for each person, stage of the disease, and context. Caregivers described strategies, developed through training and experience, to successfully deal with problematic eating behaviors, most of them based on verbal communication. However, they recognized that family members often lack the time, patience, or resources to apply these strategies and often experience significant burden feeding the people they care for. From the findings of the study we decided to focus our attention on moderate dementia, when eating disorders are often exhibited, but the individual is still fairly independent and is not required to be fed by someone else. In addition, we decided to focus our design efforts on assisting meals taken at home to support informal caregivers. In fact, when we conducted the interviews the day center had reopened at a reduced schedule and those attending the center were no longer having their main meal there, but rather at home, imposing additional demands on the family members that care for them.

2.3 Design Sessions

After having explored and understood the context of the problem, we conducted two design sessions with an interdisciplinary group of participants, to derive design ideas and scenarios. Four people participated in these sessions, with expertise in: human-robot interaction (1), human-computer interaction (1), software engineering (1), and psychology (1). Due to the pandemic the design sessions were conducted via videoconference and using shared documents.

At each session the following dynamic was followed: first, we walked through the affinity diagram so that all participants had shared context. Next, we brainstormed ideas in order to generate design ideas. Then, we cataloged the ideas, and asked participants to rank them by priority.

The highest ranked design ideas included: 1) Verbal stimulation by the robot to help the PwD eat independently, 2) Detection by the robot to notice if the person stops eating, and then providing the PwD motivation to continue, and 3) Playing music to engage the PwD without distracting them from eating.

2.4 Design of the Robot and Interaction

We decided to use the conversational robot Eva [4, 5] as the platform on which to design and implement the interaction. Eva is a conversational robot which includes features such as natural language processing and basic synthesis of emotions, and speech. Eva can work in two modes, autonomous and operated. In the autonomous mode, Eva processes the utterances from users to generate a verbal response, actions (e.g., play music, enact an emotion), or both. In the operated mode, a remote web app is used to operate the robot's behavior, and trigger predefined skills (e.g., telling jokes, completing popular sayings).

Eva includes a depth camera that can be used to recognize the user and some behaviors, such as if they are eating or stand up. An array of microphones is used to capture voice and other relevant sounds and it includes an ring of LEDs that are used to convey emotion and indicate that the robot is listening or talking. Eva has two degrees of freedom, allowing its head to perform up-down and spin movements. Finally, a screen is used to display a facial expression, denoting states such as attention, joy, etc.

Scenarios were derived from the design sessions, and from them, 10 vignettes of short interactions that show challenging eating situations and how the robot can address them. We recorded short video clips (average length of 41s) depicting these vignettes. There is a long tradition of using videotaped interactions with robots in HRI studies as a convenient approach to include more subjects and have more control in the intervention [16]. We had the additional consideration of lockdown restrictions due to the pandemic.

Some of the situations shown in the videos include: Entertaining the PwD while the meal is ready; Conversing with the PwD to increase their appetite; Notifying a family member that the meal is cold or the PwD needs assistance; and convincing the PwD to continue eating after they gets distracted (See Figure 2).

2.5 Evaluation with stakeholders

We have validated the situations shown in the videoclips and the strategy used by the robot with two of the caregivers who participated in the original interviews. They were shown eight of the videos and asked to rate if the situation shown is realistic and the strategy used by the robot seemed adequate. They both agreed that these are common situations with only a couple of suggestions. For instance, in one of the videos the robot asks the PwD which song he wants to hear while eating, and the caregiver indicated that PwD often have difficulties answering these open questions and would be better to suggest a song or let the person chose between a couple of alternatives, simplifying the interaction.

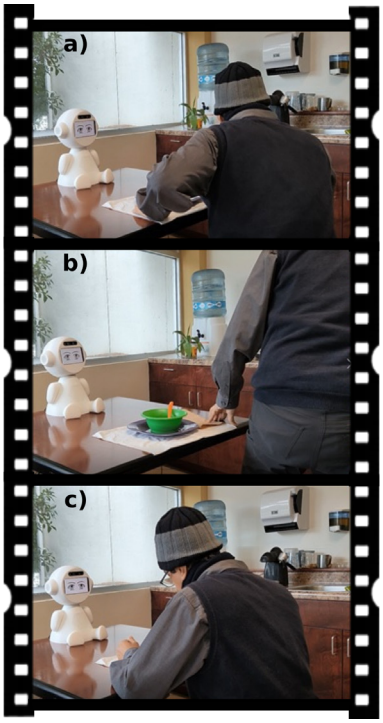

Figure 2: Frames from a video showing the PwD getting distracted (a), then standing up away from his food (b) and the robot convincing him to sit back and continue eating (c).

In addition, we asked 14 questions from the Almere Model to assess the acceptance of assistive social agent technology by older adults [7]. In particular, to assess the constructs of Perceived Enjoyment (PENJ); Perceived Ease of Use (PEOU); Perceived Usefulness (PU); Perceived Sociability (PS); and Intention of Use (ITU). The two caregivers perceived the robot as useful, social, enjoyable and easy to use. The construct scored slightly lower was Ease of Use, since one of the caregivers perceived that she will require some training to use it. Both informants agree that the capabilities exhibited by the robot in the video would be useful for informal caregivers in handling disruptive eating behaviors.

One concern expressed by a caregivers is that some users might be tempted to grab or hug the robot. Also, while we told them that the robot meant to be used at home, a caregiver mentioned that she would like to have it in the day care center assisting people with mild and moderate dementia, so that she can focus on those that might require more assistance.

3 CONCLUSIONS AND FUTURE WORK

Through the design of interactions enacted in a social robot, and videos depicting situations associated to disruptive eating behaviors, we are better understanding the challenges and opportunities of the potential role that social robots can play in supporting caregivers. While we originally planed for the informants to experience the interaction themselves in person, the use of videos has been an adequate alternative as part of our user-centered design efforts.

We plan to make small changes to some of the videos to make the scenarios depicted more realistic, following the caregivers' recommendations. We will then used them to assess the perception of informal caregivers with regards to disruptive eating behaviors and the role of a social robot to assist them in this task. In particular, we aim at exploring the differences in perspectives of formal and informal caregivers and if the strategies recommended by professional caregivers and enacted in the robot are perceived as useful by family members as well. In addition, we want to explore the potential role of the robot to encourage mindful eating [9].

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