Social Shaping of Interactions between Older Adults and the Seal-Like Robot PARO

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Abstract. We use the framework of social shaping of technology and society, and ethnographic observation to study human-robot interaction (HRI) between various social actors in a nursing home (e.g. nurses, older adults, family members) and the socially assistive robot PARO. For the purpose of our study, PARO was placed a public space in the nursing home where participants could interact with it freely. We were particularly interested in understanding the factors that contributed to failures and successes in interaction. Our results show that PARO's interactive cues by themselves were often insufficient for generating interaction with older adult, but that interventions by staff and family members led to context-specific social shaping of the robot which led to more successful interactions. Our finding suggest that the open-ended, long-term study of HRI in situated contexts can provide new and valuable perspectives to understanding the implementation and effects of socially assistive robots.

Keywords: Companion robots, Elderly care companion robots, Human-robot relationship, Social acceptance of robots, PARO, Older Adults, Dementia, Socially Assistive Robot, Social Shaping.

1 Introduction

The social shaping of technology framework suggests that, understanding the adoption, use, and consequences of technology requires a shift of attention away from technology alone to focus on the interactions of technologies and actors within the broader social context. In their seminal work in science and technology studies, Bijker et al. [1] suggested that technological development is socially and culturally constructed through the actions and interpretations of various groups of relevant stakeholders, users [2], and even invisible social actors [3]. We adapt this perspective to the study of socially assistive robotic technology by analyzing interactions between various users and robots as they are situated within the broader social and cultural context. Our results suggest that understanding how social coupling between robotic and human interaction partners is successfully achieved "in the wild" requires looking how the social contexts scaffolds human-robot interaction.

In order to understand the social shaping process of human-robot interaction, we performed an observational study of PARO, a seal-like socially assistive robot designed for mental therapy for older adults, in the nursing home of a local retirement community in the United States. Our main aim was to understand how people interact with and make sense of the robot in voluntary free form interaction that is not guided by researchers, and how the robot's

actions are construed as being social in this environment. In line with previous studies on the social shaping of technology, we particularly focused on how the attitudes and behaviors of different groups of actors (e.g. nurses, families, residents) towards PARO and others in the environment were constructed. During the study we also noted and explored the "interpretative flexibility" of the robot, which allowed different actors to decide how to interpret and use the technology [3] in different ways, and had come to our attention in prior research with the robot [4].

Our research contributes further evidence to the relevance of adopting socially situated perspectives on human-robot interaction research and design, particularly when it comes to understanding attributions of sociality or feelings of social connectedness between users and robots, in line with prior studies. In one such study of Roomba in the home, the robot's meaning changed to fit the social environment, while the behaviors of the householders changed through interaction with the robot [5], demonstrating the co-construction of the robot, the users, and the home environment. In another study, Alač et al. [6] show that a robot's acceptance as a social actor is not defined by its own action and characteristics, but by the relational actions of people in its environment, which have consequences for both failures and successes in human-robot interaction. In our study, we document that PARO's open-ended interaction design provides users with the opportunity to flexibly interpret its behaviors in ways that enable successful interaction. While prior PARO studies [7] had provided rich evidence of the PARO effect in reducing the anxiety and increasing the social interaction, researchers have also pointed out that PARO is only effective when used in particular ways and circumstances [8]. Our study uses the social shaping perspective to identify factors in the broader social contexts that affect how PARO is implemented and made sense of within the nursing home.

2 Study Design and Preliminary Results

We conducted a three-month-long observational study of PARO in a local eldercare institution. The institution serves both long-term residents with cognitive impairment and temporary residents staying for occupational rehabilitation after hospitalization. Before the observational data collection with PARO started, we conducted a two-week-long pilot study to get an overall understanding of the environment and its inhabitants, their work routines and daily activities in the public areas (lobby and activity area) of the nursing home. During these two weeks, we noted that residents and staff generally occupied the activity area, while family members quickly passed by these public spaces and sometimes stayed in the lounge chatting with residents.

For the study, we made PARO available for interaction on a table in two public areas, the lobby and an open activity area next to the main hallway, two or three times a week for an hour. We observed the interactions between residents, staff, and family members in the open area where PARO was and interviewed some of the participants both directly and indirectly.

Of all the interactions, the interactors preferred non-physical interactions with PARO, such as looking (average 9.03 interactors/session), talking about (average 6.26 interactors/session), interact, than physical ones, such ad petting (average 3.20 interactors/session), holding (average 0.29 interactors/session). We recorded the interaction in signal minute interval. However, the results showed that the interaction duration was not long. Of the most frequent

interaction type, looking at PARO, the average frequency of each interacter (2.81 times/interactor) was less 3 times.

2.1 The Failure of Generating Natural Interaction

During our pilot study, we found that staff usually seated residents with cognitive impairment, such as dementia, in the public area in the daytime. Some residents with dementia and mobile capability also wandered around the hallways or public spaces in their wheelchairs. Because of the progress of dementia, most of the residents settled in the public areas were sleepy, inactive, and unsocial. They usually fell asleep, or were idle and staring blankly at TV or the hallway. We therefore knew that potential interaction partners for PARO were available in the space.

There were, on average, 47 people present in the field site during each session. Our observations showed that staff members were present in the space most frequently (55.12% of people present), and there were not as many residents (19.32% of people present) coming to the field site as expected before the study. The staff most frequently interacted with PARO in an indirect way (e.g. looking at or talking about PARO). Based on previous studies in which PARO had been used in eldercare institutions [7], we expected there would be a significant amount of social interaction between the residents and PARO. In our study, however, the robot failed to generate spontaneous and continuous interaction in the majority of cases. All categories of participants ignored PARO more often than not, whether they were residents, staff, or visitors. Through our observations, we noticed that this was partly due to the cognitive impairments of the older adult participants, and partly due to PARO's behavioral limitations.

Most of the residents in the institution we studied were older adults and many of them had vision and hearing problems. The public setting in which PARO was situated was also quite noisy. We noticed this caused some residents to fail to notice the robot as they passed through the public area. For example, one female resident walked through the hallways multiple times per day for rehabilitation. She showed up in our study for weeks as a passerby without recognizing PARO's presence, until one day toward the end of the study she noticed PARO and interacted with it in an excited fashion. When we interviewed participants, some people mentioned that they had first thought PARO was a stuffed animal before they saw it moving. In contrast to interactions in the lab or in controlled activities with the robot, we therefore found that in an open area, PARO had difficulties catching people's attention, especially in the case of older adults with vision and hearing impairment.

Another problem we noticed through our observations was a negative effect of PARO's failures to deliver appropriate social cues during interaction. While some older adults were interested in interacting with PARO, despite its interpretively flexible minimal design, PARO often failed to behave in a socially comprehensible manner and confused the residents. Resident E (R-E) showed great interest in PARO since the first time she saw it, such as having a long talk with the robot in her first spontaneous approach to it. Unfortunately, in her second interaction with PARO, she was confused by PARO's head movements and gaze. She kept checking the direction PARO was looking in, asking, "What are you looking at?" "Are you looking at the light? Why?" After trying to make sense of PARO's behavior for a while, she got frustrated and asked, "Are you mad at me?" "Do you want me to leave?" Other similar examples suggest PARO's social cues performed out of context were detrimental to

continuing the interaction because the residents were not able to make sense of the robot's behavior.

2.2 The Group Situated Interaction -- Successes

While the cognitive limitations of study participants and PARO's contextually inappropriate social cues led to interaction failures, we also found that mediation by other human actors (including staff, family members, and other residents) generally had a positive effect on the resident's propensity to interact with PARO. In both our pilot study and three-month observation, we identified that residents with dementia were generally passive to environmental stimuli. Even when they noticed PARO, they were often hesitant to interact with it in the public setting without someone to guide them. After gaining an understanding of what PARO is and how it can be used by asking researchers and observing some interactions between residents and PARO, staff members started approaching residents who were near PARO and talking to them about it or showing them how to pet the robot. For example, resident M (R-M), who was in late stages of dementia and had severe hearing loss, was initially not interested in PARO. After the staff showed her how to interact with PARO by petting it and talked to her about the robot's gaze and movements, she started to pet and look at PARO. Her interest in PARO increased as she interacted with it more and more. In a later session, R-M's family saw PARO and encouraged her to interact with it. R-M started to talk to PARO and even discussed PARO with other residents around the table. Although her hearing problem caused her conversation about PARO to be short, the other residents also started interacting with the robot after the conversation. Similarly, resident R (R-R), who had dementia and memory loss, took an occasional look at PARO but swiftly shifted her attention elsewhere. She would show her interest in PARO mainly while other people talked to her about it or there was someone to talk to and PARO could become a conversation starter topic.

The effect of other people's interactions with PARO was not seen only directly, when staff and family spoke to residents, but also became apparent when residents interacting with PARO modeled appropriate interactions for new users. For example, R-E's interaction with PARO led other residents to change their impressions of PARO and start interacting with it. R-E enjoyed talking to PARO. She usually approached it and talked to if it was a real animal, even though she had spoken to researchers about it being a robot. One day, a newcomer saw PARO for the first time and displayed negative attitudes when her family introduced it to her. R-E came later and started talking to PARO. The new resident observed her interaction, and told her, "You are a nut!" R-E smiled and didn't respond. After R-E left, the newcomer looked at PARO for a while and stopped the staff in the hallway and talked to them about PARO. Then, she approached PARO, and started petting it and talking to it in introductory terms, saying, "Who are you?" "Where do you come from?"

As the abovementioned examples show, the interactions we observed in the study were usually affected by the broader social context they were situated in. The relationships the residents built with the robots were dependent not only on the capabilities of the robot and interactors, but also on the behaviors of other people in the scene and their interactions with the robot.

3 Discussion and Conclusion

Our findings showed that the interaction between the residents and PARO didn't depend only on them but also on the social context. PARO initially failed in raising the interest of the residents because its social cues were not designed to take into consideration the cognitive limitations of the residents, such as the hearing loss, or because the robot's cues did not make sense within the context of the interaction, such as in the case of incomprehensible gaze behavior. While PARO's interpretive flexibility might allow users to develop a narrative understanding of the robot that will make it compelling for them, our results suggest that the timely and appropriate delivery of social cues is still an important component and challenge for the robot's design, particularly if it is to achieve some semblance of social coupling with users. Furthermore, while interaction with PARO was rarely spontaneously triggered by the interactors and robot alone, we found the behaviors of people in the broader social environment constructed the way users perceived PARO through the intervention of family and staff—the relationship between users and the robot was therefore built up in the context of the larger social group they belonged to. Our findings align with Alač's [5] conclusions that the success of social interaction and the interpretation of robots as social actors are quite dependent on the social environment. We therefore emphasize that, in future HRI studies and designs, we need to make sure to explore the coupling of human and robot behaviors within the context of the social group and environment to identify important factors for robot use and adoption.

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