

A Sociable Robot to Encourage Social Interaction among the Elderly

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Abstract—In this paper, we present evidence that although current models for introduction of robotic companions stress individual encounters, a social community alternative is promising. This argument emerges from an experiment we conducted with a small interactive robot at two local nursing homes. Here we give a brief introduction to the robot and our experience at the homes. We compare the robot used to a semi-robotic toy whose use initially suggested to us the benefits of social community models in the presentation of robotics to the elderly. We find that even where individual encounters are significant, sensitivity to social dimensions improve the benefits of these encounters.

I. INTRODUCTION

Sociable robots are being constructed to be used in a variety of situations, including entertainment, security, and health care. Companies around the world are manufacturing and marketing robots for these markets. We have used one of these robots, the Paro “mental commit robot” which is designed to “interact with human beings and to make them feel emotional attachment to the robots” [1]. The Paro robot is depicted in Figure 1. Its basic capabilities are that it can sense a user’s touch, can recognize a limited amount of speech, expresses a small set of vocal utterances, and can move its head and front flippers. More details on the robot itself can be found in the publications of Shibata, et al. [2].

The company that is developing and selling Paro is marketing it as a robot for use by an elderly person in a nursing home. Paros are meant to be companions to their owners, creating a relationship by being able to react, if only in a limited way, to their owners spoken and physical actions. Here we interrogate the one-on-one model for its use and suggest that a more social model is often more suited to the goal of engaging the elderly in gratifying interactions with such artifacts. This discussion is situated within the context of our research that looks at both individual and social encounters with an interactive robot.

In *Emotional Design*, Don Norman states that “good behavioral design should be human-centered, focusing upon understanding and satisfying the needs of the people who actually use the product” ([3], p. 81). In the study of nursing homes, patients have diverse needs, both for individual companionship and for social encounters. Human-centered design needs to respond to both. Social needs are in danger of being overlooked if too much emphasis is placed on the one-on-one.

Earlier work, such as that of Kahn, et al. [4], builds on research showing the benefits that animal companionship provide to people (see [5] for a good overview of human-pet relationships). They focus on the psychological and emotional responses of people to robotic companions and suggests that “robotic pets may accord the elderly some degree of comfort and companionship.” Our work looks more closely at the underlying nature, the sociology, and psychology of this comfort and companionship.

In previous work in these nursing homes, Turkle, Taggart, and Dasté [6] presented a semi-robotic toy to residents, Hasbro’s My Real Baby. Based on the prototype Bit developed at iRobot, My Real Baby responded to simple sensory input and programmatically evolved its exhibited personality traits over time. This doll elicited strong emotional and attachment responses from patients in the nursing homes. After concluding this work, three of the My Real Baby dolls were left at the nursing homes. The nursing staff chose to purchase three more and a model was gradually developed for how to integrate the dolls into the home. It is notable that the model they developed stressed social, collective responsibility for the dolls, a theme we take up in this paper.

We now turn to those aspects of our work at the homes that explore the individual versus social interactions with the Paro.

A. Experimental Design

Studies that would make sense of the interactions with a robot like the Paro are only now beginning. Clinical observations show that elderly individuals interacting with the Paro seem to be animated. One study by Wada, et al. [7] placed the Paro in nursing homes in Japan. Their work used a “regular” and “placebo” robot to attempt to delineate the effects that come from the interactive capabilities of the robot. They claim that the result of the study is that either version of the Paro will alleviate depression in the elderly users. While on the surface this would seem a discouraging finding, the study was a very short duration, so it is possible that the novelty effects of even the placebo Paro masked the effects of the actual Paro as a robotic creature.

We hypothesized when we began this work that the Paro might actually be useful beyond the one-on-one interaction envisioned by the creators of the robot. This was in light of the



Fig. 1. Paro, the robot used in our work.

nursing home's experience with My Real Baby. In the nursing homes that we visited the elderly would often be gathered in the same room, but there would be little social interaction occurring among members of the group. Thus we wanted to explore the Paro as an impetus to conversation and interaction in a group.

In the remainder of the paper we describe an experiment that explored our hypothesis. We found some support for this hypothesis, but in the course of conducting the experiment, many issues emerged with this particular robot that suggest how design changes that could be incorporated into future robotic creatures would entail a fuller exploration of the power of robotics for social interaction in social settings.

B. Experimental Protocol

We created a placebo versus interactive robot comparison in order to measure whether robotic interactions generated more social activity. We worked with about 23 patients at the two nursing homes (16 at home A and approximately 7 at home B^{1,2}). We visited each home approximately once every two weeks over a period of 4 months for a total of 8 visits to home A and 4 visits to home B. During each session we interacted with multiple groups of residents.

We began each session by setting up a table around which residents and a caregiver would gather. We also placed two video cameras on opposite sides of the room to allow us to videotape much of the interaction that took place. At this point, a group of residents were invited into the room. The premise

¹To protect the identity of residents, employees, and owners, we do not name the nursing homes at which this study was carried out.

²As discussed in section II, activities at home B were not organized well enough that we could get a group of people together. The number of patients from home B were those that interacted with us or the robot for at least a short period of time.

for the invitation was to have some snacks and talk with one another and a visitor. (Consent was received during the initial visit for all residents with high cognitive function and by the responsible family member for others.)

The Paro was placed out of sight while residents entered the room and took their seats around the table. At this point a short introduction was read to the group of participants introducing the experimenters and explaining that they may have brought something about which we would like their opinion. After the introduction, one of three things happened: the Paro was brought out, placed on the table, and turned on; the Paro was brought out, placed on the table, and remained turned off; or the Paro was not brought out. If the Paro was introduced, residents were told:

We have brought something for you to see today. [Experimenter places Paro on the table.] This is Paro. Paro was given to us by someone in Japan. We're curious to see what you think of this object. You are free to play with Paro in any way that you like. After about fifteen or twenty minutes we will ask you some questions about the object. Feel free to pick Paro up, or pass it around.

Groups consisted of 3 residents, 1 caregiver and 1 experimenter seated around a table. After the introduction, the experimenter withdrew from any leadership role in ensuing interactions. What followed was in the hands of residents and caregivers. The experimenter would make small talk at times, but when the robot was present, only responded to residents' questions about the robot and avoided otherwise directing attention to it. Since a goal of the experiment was to see what interactions might arise experimenters attempted to not unduly influence the potential course of these interactions.

After a period of about twenty minutes, the experimenter concluded the interaction period. This was done by thanking the residents for joining in the group. At this point, members of the group were asked to fill out a very short questionnaire (most questions are listed in Figure 2) and were verbally asked several open-ended questions about the interaction.

II. EXPERIMENTAL OBSERVATIONS

The experiment was originally set up in two nearby nursing homes, A and B. Differences between the two homes soon emerged, in particular many residences in home B had diagnoses of schizophrenia and/or senile dementia, whereas most residents of home A were high-functioning. At home A, there was a full-time staff member with two part-time assistants; home B seemed to be run by an overworked single staff member. There was little time for this person to work on patient activities. A social support network is so important to the success of a social support robot that we could not continue our work in nursing home B.

A. Characteristic Interactions

During our sessions, conversation between subjects was not extended. Sessions where the Paro was present and turned on were quieter than sessions where dialog was prompted by

Social Interaction Questionnaire Subscale

- Q.1: Did you play with the toy we brought more or less than other people?
Q.2: Did you want to share the toy we brought with other people?
Q.3: Did you enjoy talking about the toy we brought with other people at the table?
Q.4: Did you talk to other people during our session more or less than you usually would?
Q.5: Do you want us to come back with the toy again?

Play with Robot Questionnaire Subscale

- Q.1: Do you feel like the toy we brought likes to be played with?
Q.2: Did you want to play with the toy we brought?
Q.3: Would you like to have a toy like this to play with whenever you want?

Fig. 2. Subset of questions asked to participant after each session

an experimenter, but any of these sessions were more lively than many of the other activities in homes, which were often marked by silence. For example, almost every nursing home has what is commonly referred to as a TV room. TV rooms are quiet except for the sound of the television itself. Residents do not converse in TV rooms; very often residents are “parked” in these spaces by the staff and left without supervision or any significant stimulation other than what is provided by the television.

There were interactions when Paro was turned on. Many of the interactions were dominated by short exchanges such as “would you look at that [...] how about that [...] isn't he cute?” Occasionally, the subjects will ask one of the observers questions like “how does it work,” “is this all it can do,” or “is it a seal or a dog?” Interactions frequently did not continue without caregiver or experimenter intervention. Paro is not the ideal interaction partner, but is clearly better than silence.

A few of the residents seemed to believe that Paro was a real animal. But most didn't care about the real/machine distinction. One subject said, “I don't care if it's real, I love him.”

Some nursing home residents expressed a special attachment to Paro. They spoke to it as one would a pet, giving it a nickname (one resident who renamed the robot “Perry” after initially mishearing its name, decided to stick with the renaming). They engaged it in (one-sided) conversations. They derived meaning from its every squeak and squawk. These, we might hypothesize, would be the most likely long-term users of the robot, but represent only a small minority of all residents (roughly a third of those with whom we interacted). These users generally began a relationship with Paro in which they saw it as dependant on them. Very often they are or were pet owners. Paro was assimilated into other pet relationships.

Our questionnaires revealed that Paro did effectively evoke memories of pets. In fact, many conversations about Paro turned into discussions about other animals, often cats and

dogs. For one woman, Paro reminded her of her dog. Another subject said that Paro reminded her of her many cats.

B. Inhibitors to Relationship

When we consider in detail the interactions that we observed and what factors seemed to stand in the way of greater social interaction with the Paro, several issues seemed particularly important. Paro presents itself as a baby seal. Many of our subjects have expressed their desire to put Paro in water and see if it can swim. Contemporary roboticists (for example, the work of Breazeal [8]), working to circumvent the problem of mismatched expectations (expecting a robot to act like one would expect a certain animal to act and having the robot fail to match those expectations), create robots that mimic unfamiliar animals (as is the case with Paro), or fantastic figures. In the case of Paro, however, people do know that seals are marine mammals and that they swim and live in and around water. Subjects have said that the way Paro moves his flippers makes it look like it is attempting to swim, but is stranded on land. “It is trying to swim to you,” one subject said when Paro appeared as if it was trying to “swim” across the table. Paro moves its flippers, but they are neither powerful enough nor designed to actually produce any sort of locomotion. Many subjects quite rationally think that perhaps the Paro would do better in water. So in the case of Paro, trying to circumvent the problem of mismatched expectations leads to a critical problem. Actually placing the robot in water would be dangerous and would in fact destroy the Paro.

Second, seals are wild, non-domesticated animals. Using a wild animal as a platform may give users a heightened sense of caution in initial interactions. Seals are not animals that people normally “play” with, and even though Paro is designed to evoke a “baby” (vulnerable) seal, it is still an object that some subjects approach with caution. This seemed to be more of a problem for older and less mentally astute subjects. A few subjects worried that Paro would bite them, saying, “I think he is going to bite me [...] he scared me.” Paro doesn't actually have teeth of course and most of these subjects, after being reassured by fellow residents that the robot would not hurt them, responded well to Paro.

Third, the Paro is too heavy to be picked up and moved about. Our subjects are, for the most part, frail and elderly. They cannot hold the Paro to act out scenarios with it as they might do with a doll, or as we have seen other older persons do with My Real Baby. Because Paro is so heavy and large, its usefulness as an inanimate doll is very limited. We have observed healthy adults complain of its size and bulkiness; our subjects are much less capable.

C. Questionnaire Responses

While our most important data is observational, we report on two scales from the brief questionnaire that was given to participants following each interaction session. We note that our subject pool's responses to our Likert-scale questionnaires were almost all at one extreme or another, calling their accuracy into question. However, we do note that there was a

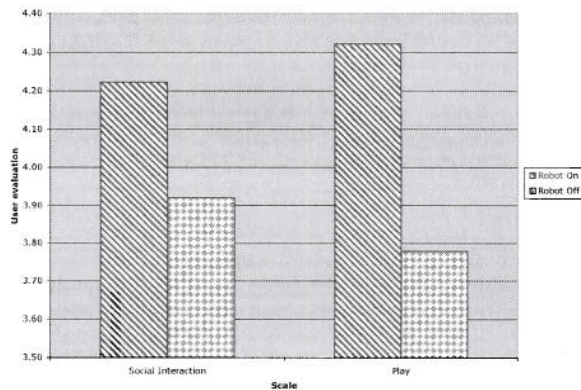


Fig. 3. Data from participant questionnaires.

tendency for participants to prefer conditions where the robot was turned on and interacting with them. Figure 3 shows user responses to the two main scales: a scale to measure the amount of social interaction, or how much users felt encouraged to interact with one another and a scale of play behaviors that measured how much users wanted to play with the robot and whether they wanted to continue to do so in the future.

III. LESSONS FROM ANOTHER INTERACTIVE OBJECT

After our research team introduced My Real Baby to nursing home A three years ago, the home purchased several more to use with a few residents. The director told us that when she sees certain resident express intense anxiety, she will fetch one of the My Real Baby dolls, turn it on, and then give it to the resident. These are used to soothe individuals, but the model of ownership is a collective, social one. The doll helps to quell the resident's anxiety. After a period of time (usually less than an hour), she will return to the resident, take back the doll, and return it to her office. Often, when she takes the doll back, its mouth is covered in oatmeal, the result of a resident attempting to feed it. The reason that she takes the doll back, she says, is that "caring" for the doll becomes too much to handle for the resident.

The Paro does not easily turn on and off because its switch is hidden between its split tail fins and residents could not master it. With the My Real Baby, residents felt more empowered because of the ability to control the doll. Further, for those residents who could not turn off the My Real Baby, the caretakers had to take back the doll, turn it off, and calm the resident.

My Real Baby, like Paro, makes its relational purchase by initiating a social dynamic based on the perception of dependency. That is, through its screams, cries, and utterances,

My Real Baby makes it plain that it "needs" the care of its user. Paro, as we have seen, works in much the same way. Our observations have demonstrated that to the extent that people "understand" Paro, they understand that it needs their attention. It may be that some people cannot or do not wish to take on the perceived responsibility of caring for these robots.

Some residents simply felt that "toys are for kids" and that playing with them is inappropriate. Others don't like animals or are so severely mentally impaired that it is hard to truly gauge how they are feeling. But for those who do enjoy playing with the toy but tell us that they do not want to own one, it may be the case that the question we asked of them: "Would you like to have a toy like this to play with whenever you wanted?" is like asking them if they want to adopt a baby or acquire a pet. This is a big responsibility, and maybe something that they are not up to, something that they do not feel they are necessarily prepared to undertake.

The best model for the use of these biomimetic robots in eldercare facilities may be the one that the director is already employing with My Real Baby in the home. Collective, shared care of these objects may be the most socially realistic and psychologically sound way to introduce these robots into eldercare facilities – as shared objects, with the responsibility for caring for it dispersed across several individuals, with no single person charged with its care. This approach is also used at one of the homes for the care of the house cat – while several residents play with the cat, and the cat even sleeps with a few of the residents, care of the cat is seen as a communal responsibility, with ultimate responsibility for its care falling on the staff.

More discussion of the nursing home setup and some interactions with the residents are described in a previously published paper of ours [9].

IV. ASPECTS OF A SUCCESSFUL SOCIAL INTERACTION

There are numerous factors that determine what the social interaction with the robot will be like. Aspects of the robot such as the way it appears to users, how its movements are interpreted, and how responsive it is to users actions will all change the way users perceive their interactions with the robot. Other factors will relate to how the robot fits into the larger network of a users social interactions and the products and devices they utilize on a daily basis.

In section II, we described the TV room that is common to many nursing homes. What we found in our work is that the Paro (in the on or off condition) is an improvement over this setting. In the off condition this seems to be a novelty effect that wears off over time. In the on condition, *with a caregiver present*, there is continuing interaction with the caregiver and with other residents. Paro works when there are people present who will engage in conversation. To put this evaluation into an existing framework, we can say that we see some first-order (individual) effects and some second-order (social and cultural) effects as described in the 2004 paper by Forlizzi, et al. [10]. We believe that the second-order effects would

be greatly enhanced if problems with the robot's design were corrected; we discuss these in our Conclusion.

As we noted above, the My Real Baby was given to residents in times of trouble and taken away when necessary. These factors reinforce Cobb's point that interactions are more effective when people are receiving social support through the object [11]. From this comes an important design goal in creating robots that are designed and intended to interact with people: when considering how a robot will interact, it is important to consider the overall social support network, not only interactions with a single individual. In the case of robots meant to interact with an elderly person in a nursing home, one significant dimension is between the robot and the individual, but another is the interaction among individuals that comes about as a result of the robot's presence as an impetus towards social interaction.

V. CONCLUSION

We observed that the robot Paro, like My Real Baby, has features that can increase social interactions. This effect is increased in the presence of caregivers or experimenters who are willing to participate in the interactions. These kind of interactions provide not only pleasing, feel-good experiences, but also provide evocative experiences for the residents. The robot, for all its limitations, communicates that it enjoys being handled, thus its robotic nature can set up a connection based on the attributes of dependance and nurturance that are read from interactions with it.

My Real Baby evokes similar feelings, though it is a much less sophisticated device. The conversational characteristic of some of these interactions is interesting, given that both Paro and My Real Baby are capable only of emitting proto-linguistic utterances and not complete sentences or thoughts. Still, these utterances are interpreted as meaningful by some participants and people attribute intention and emotion to these deeply evocative objects.

While these robots are not suitable for some subjects, our three-year experience with the My Real Baby has shown that this kind of interaction can work best in a supportive, social setting. A challenge is that some potential users of such a robot are either not capable of providing or not willing to provide the kind of care that they themselves believe the robot requires. Thus, although some residents may enjoy a sense of individual, private ownership, sociable robots may be most effective in eldercare settings if they are introduced as shared artifacts. They may be introduced as belonging to the collectivity, thoroughly social from the outset.

These technologies require real maintenance (cleaning, re-charging, storage) as well operational assistance (in the case of Paro, turning the robot on or off). But perhaps most importantly, skilled caregivers are needed to manage the amount of time and the extent to which individual subjects interact with the robot, as "caring for" one of these objects may become too much to handle for those elderly who are especially frail, vulnerable, or cognitively impaired.

As a result of our controlled and our unstructured observations, we believe that a robot like Paro would be better if it were smaller and lighter, thus able to be more easily manipulated by a user. The user should also have the ability to more easily turn the robot on and off. These changes would give a heightened sense of control over interactions with the robot. We observed that the seal was perceived as strange and therefore scary to some users, so a more neutral form should be adopted. We noted earlier the tendency for residents to desire to place the Paro in water. This is a clear shortcoming of the particular robot, but these kinds of associations need to be clearly thought through and studied before introducing such a robot to users.

With these caveats, Paro and My Real Baby provide stimulation that nursing home residents found manageable and desirable. These robots are certainly entertaining to many and provide a distinct break in the routine, often very dull or diminished, social setting of an eldercare facility. They gave residents something to talk about with each other and a sense of sharing a social experience that was worthy of conversation. In this setting, feeling oneself as engaged with an object worthy of conversation provided some residents with feelings of importance and positive self regard.

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