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An Interactive Robot in a Nursing Home: Preliminary Remarks

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Abstract

There are a growing number of robots being designed and built to interact with people in a specific setting. Our interdisciplinary team is taking a look at one of these robots, Paro, in its intended setting in order to study the effects of the interaction. By using a combination of self-report, analysis of interactions, and postinteraction interviews, we examine social and psychological aspects of seniors interacting with the robot in nursing home settings. We examine the relationship between the person and the robot, the individual's feelings about relationships with others and how this changes during the robot interactions. In this paper, we report our initial findings based on fieldwork at two nursing homes over the course of multiple interactions.

Introduction

The number of elderly in the industrialized world is expected to grow significantly over the course of the next two decades. Alongside this growth in the elderly population, many nations, including the US and Japan, face short and long-term labor shortages in the healthcare sector. A number of projects in both countries have sought to address this perceived shortage by developing interactive robotic assistants to work in home and assisted-living environments (Baltus et al 2003, Beck and Katcher 2003).

Paro is a robotic baby seal developed by Takanori Shibata at the National Institute of Advanced Industrial Science and Technology (AIST). Paro is equipped with a 32-bit RISC processor, two microphones for sensing directional sound, ten tactile sensors placed beneath its artificial fur, two light sensors in its nose, a posture sensor, and eight actuators: two in its neck, one in each front and rear fin, two in its upper and lower eyelids, and one for the rotation of its eyes. Paro's software generates three types of behavior: proactive, reactive, and physiological. Paro incorporates two distinct layers for behavior planning and generation in order to produce "proactive" behavioral patterns. The behavior-planning layer relies upon transitional internal states as prompted by stimuli and changes in Paro's internal rhythms. The behavior-generation layer generates modulated responses based upon the magnitude of the robot's internal states. Reactive behaviors include fast responses to sudden stimulation. Physiological behaviors include the need to sleep, based upon a diurnal rhythm that cycles four times per hour. As a sociable robot designed to mimic the characteristics of an affectionate pet animal, Paro was designed for use in health-care environments (Shibata 2004).

Initial observations of Paro by our team have brought us to the conclusion that the robot may effect the quantity and valence of social interactions, and would be significant to study in the context of our ongoing interest in relational artifacts (Turkle, 2004a), artifacts we define as ones in which the users need to understand the "state of mind" of the artifact in order to achieve the full benefit of the interaction. Such artifacts open the possibility for an experience of the artifacts as "social" or "sociable" and present new psychological and sociological opportunities as well as problematic questions.

Shibata has thus far carried out three experiments with Paro, both long and short-term. Participants in his experiments have included the elderly, children, and persons diagnosed with autism and Down's syndrome. His findings have indicated that: 1) Women tend to react more favorably to Paro than men; 2) People who have an abiding interest in animals are more likely to view Paro in a positive light; 3) Children especially enjoyed playing with the robot; 4) Paro had a positive influence on depression in the elderly, as measured by geriatric depression scales and biological indicators. Shibata has also noted that many Paro users experience discomfort when handling the device for the first time, and that reactions to Paro have varied little across cultures (Shibata 2004). Our research, which has thus far focused on qualitative data (but which will incorporate quantitative findings in the near future) gathered in nursing home settings, has enabled us to reflect on a set of themes and concerns that may have an impact on future research with Paro and other robots designed for use in nursing home or assisted-living facilities.

Social Robots

The development of robotic creatures for senior care and research and its impact on senior life is being studied worldwide. For example, in Japan, Matsushita in 1999 created the robotic cat Tama, which looks like a plush toy but is networked to its owner's health care service center, and is intended to be a companion to senior users. Tama responds happily when it is stroked, and speaks to its owner, sharing "encouraging messages" and reminders programmed by health care workers at a distance. In the United States, the University of Pittsburgh and Carnegie Mellon University launched a major collaborative research and development effort in this area, and have been testing their "nursebot," Pearl, at an assisted-living facility. InTouch Health has developed the mobile robot Companion to assist and interact with the elderly by putting providers and family members in direct contact with seniors through an interactive LCD screen as its "face."

The importance of animal companionship as providing emotional and physical well-being for seniors has long been the subject of research interest (Beck and Katcher, 1996). Animals, however, have certain drawbacks as companions: some people are allergic, and live pets require much care. Robot pet companionship, as an alternative, is also being studied and benefits like lowered stress levels and improved social interaction skills have been noted in seniors when interacting with relational artifacts like Paro (Hornyak, 2002). Batya Friedman and Peter Khan at the University of Washington are studying whether AIBO, a robotic dog, can provide some of the physiological, cognitive, and emotional benefits of live pets for the elderly. Friedman and Khan, in collaboration with Alan Beck and Nancy Edwards from Purdue University, are leading a project "Robotic Pets and the Elderly," studying if robotic pets can provide the same kinds of benefits (i.e.: companionship, improved well-being) that animals are found to bring to seniors (Khan, Friedman et al., 2003). Matsushita's robot cat, Tama, designed to be a conversation partner for elderly people, is being studied in Matsushita's Sincere Korien resident care facility to evaluate its benefit both as a companion for seniors and as a monitoring aid for caregivers. Matsushita's Wandakun is a fuzzy koala-looking robot that responds to being petted by purring, sings, and speaks a few phrases. It was used in a year-long human-robot bonding experiment where one 74-old Japanese participant said of her Wandakun: "When I looked into his large brown eyes, I fall in love after years of being quite lonely… I swore to protect and care for the little animal" (Kakuchi, 2001).

Field Setting: Nursing Homes

Nursing homes provide a number of challenges for HRI researchers and other social scientists. Some nursing homes may lack the available resources (spaces, caregivers) to support an HRI experiment. This has serious implications for the potential deployment of robotic technologies in these environments. Androids requiring maintenance or supervision in nursing homes may be unusable in some settings with serious labor deficiencies. During our experimental trials, we visited two different homes, each providing care for approximately sixty residents. This research was carried out over a period of three months in early 2005.

The first home is relatively prosperous and well-maintained, with a competent and engaged staff. This home looks like a large colonial building, set back from the road. The home sits on a large hilly property, with many trees and a large lawn. It is located in a prosperous suburb of Boston. Inside, the home is relatively typical for a small to medium sized facility and appears clean and well-maintained. The staff at this home is very cooperative and helpful, and we were able to conduct our experiments effectively. The staff provided us with a private room for the experiments, and participated in the interactions as we desired. The staff contributed much to our own understanding of the operation of the home, and of the problems that seniors and caregivers come into contact with in the space. The residents are mostly white, and between the ages of 60-95. There are a few minority residents, and a number of the staff are young (25-40) males, immigrants from Haiti. Most of the staff are white women, aged between 25-65, although one staff member who we interact with on a regular basis is significantly older. This is essentially a middle-class home. The residents are majority (approximately two-thirds) female. There are a number of younger rehabilitation patients, and approximately a third of the residents have some loss of cognitive functionality. The rooms are well kept, tidy, and clean. The home has an open air to it, and there are many large windows that look out onto the back lawn. There is a large cat that has lived at the home for ten years and hangs around, either outside, or in the front, where some of the residents cluster around a series of large windows. In the past, some residents have let the cat sleep with them.

The second home is in poor condition. There are chronic staffing problems at this site, the residents are poor and consistently complain about their environment. Theft of personal property in the home is a major cause for concern.

The building is a converted emergency hospital, and is in poor shape. The home has very little, if any landscaping, save a couple of trees and a dilapidated picnic table in the back near the parking lot. The home is small and poor, and all of the residents are on government assistance – many were recently on the street, homeless. Most of the home's clients are mentally ill or impaired, and many are very close to death. The home smells of industrial strength cleaning agents and urine. The residents are multi-racial, but predominantly white. The gender ratio among the residents approaches parity. Several of the residents are more or less functional mentally, and seem to resent the place, the staff, and the other residents.

The staff is mostly white, female, and young (23-40). The home is managed and owned by an Indian family who has taken a mild interest in our work.

Because of chronic staffing shortages, our primary contact,

Joan, had very little time to assist us in this study. Joan told us that she would prefer to be in a nicer home. She was very reluctant to sit down at a table for the time we needed, and in fact, refused to participate in sessions after three visits, citing lack of time and overwork. The difficulties we experienced here have led to our abandonment of the site as a setting for our research.

Our experience at this home provides some lessons for HRI researchers and other technologists seeking to develop objects for these environments. It is often noted in the literature on developing technologies for nursing homes and assisted-living technologies that many of these places experience severe staffing shortages. For nursing home residents who are experiencing cognitive impairment, Paro will require the intervention of a caregiver: Paro must be stored, cleaned, recharged, and turned on and off (its power button is hidden between its rear flippers, and can be difficult to locate) – these are not tasks that many nursing home residents are able to carry out. Our experience in the two homes suggests that technologies that requiring the attention of an overworked staff may go unused.

Summary

Nursing homes and assisted-living environments are often described as places lacking in meaningful and positive social interactions for the elderly. While our findings generally support the therapeutic benefits of using robotic animals in among elderly populations, our research also highlights several potential barriers to deployment and attempts to characterize those individuals who might benefit the most from such an interaction. Yet, we also observed a great deal about Paro as an evocative object, a relational artifact, and a promising social actor in the lives of the elderly – particularly in its ability to encourage engagement, provoke curiosity and conversation, encourage sharing, and the exhibition of affection.

Field Study

Our methods of study in this project include on-site fieldwork, HRI experiments, and interviews. We seek to blend quantitative and qualitative approaches to the study of human-robot interaction.

After a series of site visits and initial interviews with clients, we conducted our initial experiments, visiting each of the homes once every two (although as mentioned previously, one of the sites was abandoned after three visits). We assembled groups of three seniors, and seated them at a table. Light snacks were provided. Subjects alternately interacted with either: 1) Paro alone; 2) Paro in the off condition; 3) No object. For each interaction, both an experimenter and a caregiver were present, seated alongside the residents at the table. The interactions lasted approximately twenty minutes and were videotaped. Following these interactions, we asked all participants (seniors and caregivers) to submit to an integrated questionnaire and short interview of approximately ten minutes. Data on participants' age, gender, character, and attitudes towards animals was also collected. These interviews were also videotaped.

Over the course of several months, most of the subjects were observed in each of the three conditions, although many subjects completed only one or two rounds: one subject died while research was under way, two refused to take part in a second round, one subject was discharged from the facility, and two were unable to participate due to illness.

These videotapes, along with our fieldnotes, constitute our main body of data. Analysis of these tapes and notes focus on interactions with other seniors, sharing of the object, and interactions with caregivers. This paper focuses on qualitative results observed during each experimental round, as carried out over a period of several months – however, as we go forward, we will incorporate more quantitative results into our findings. As these interactions must be understood in the broader context of an assisted-living or nursing home environment, great care is be given to sustained participant observation, using standard anthropological and sociological techniques, including prolonged interviews with residents and caregivers.

Early Results

Here we share some early results. We have recruited 18 participants for this study, ranging in age from 60-104, five males, and fourteen females. We have conducted a total of twelve site visits to the two facilities. Results from our early work have revealed a number of recurring patterns among the residents who have interacted with Paro.

Paro On

When Paro was turned on, some residents express surprise when handling the robot for the first time. Paro tends to make sudden, jerky movements in response to touch or sound. Subjects are often observed pulling their hand back from the object after a movement. After this experience of realizing that they are with an “other,” subjects’ behaviors conform to four relational modalities:

- Engagement/Withdrawal
- Sharing
- Affection
- Discovery

Engagement/Withdrawal

Several subjects actively chose to engage with Paro, speaking to it, touching it, and asking about it. Most subjects who chose to engage with the object did so over several experimental rounds, with little observable change over time – the "novelty" effect was not observed in any of the study's participants. Others chose to withdrawal when presented with the object. Of the 18 subjects, six of them refused to play with the robot to any significant degree. Subjects who withdrew from the object were of three types: 1) those who found playing with a such an object to be

inappropriate adult behavior (a subject was observed saying, "I'm too old [...] to play with toys"); 2) subjects who expressed a dislike for animals and pets in general; and 3) subjects who were severely mentally impaired.

Sharing
Those subjects who enjoyed playing with Paro were also observed to enjoy sharing it and talking about it – preliminary results from our questionnaires and postinteraction interviews support this notion. Sharing was often observed being initiated by the (unprompted) caregiver, who attempted to ensure that each subject had an equal opportunity to play with the robot.

Affection
A number of residents expressed affection for the robot, stating, "I love you Paro," stroking its back, kissing the robot, and generally speaking to it as one would a pet. Many subjects remarked at the object's beauty, especially its eyes.

Discovery
To date, this is the category that seems most rich. Many subjects express a desire to know more about the robot. Commonly asked questions addressed to observers include:

"Can it do more?"
"Is it a seal or a dog?"
"Is it a he or a she?"
"Can it swim?"
"What are we supposed to be doing with this?"
"Where is it from?"
"Does it have a name?"
"Does it eat?"

Many subjects also directed their questions to Paro, asking such questions as:

"Are you sleepy?"
"Are you a good boy?"
"Are you hungry?"
"Do you want something to eat?"
"What's your name?"
"Do you think the telephone is for you?"

Several subjects were also observed entering into "conversations" with Paro, asking the robot questions, receiving a "response" in the form of sound or movement, and then interpreting the sound or movement as meaningful communication. Many subjects indicated that they believed Paro had emotions, the capacity to feel pain and/or pleasure, and the ability to answer yes or no questions. These observations highlight the idea that Paro can be seen as a classic "transitional" object – an object that allows a subject to make sense of their world and their own place in it.

A couple of behavioral patterns that emerged highlight potentially serious problems with the robot's design and implementation. Because the robot is designed to simulate a marine mammal (a baby harp seal) several subjects expressed a desire to place the robot in water. One subject said, "[...] it would be nice, you could keep him in the bathtub." After the caregiver responded that she didn't think that was a good idea, the subject shot back, "it's a seal, wouldn't you put a seal in the bathtub?" This sort of response strengthens our finding that this robot might only be appropriate in facilities where staffing levels are adequate. While we haven't subjected Paro to such a test, we can only assume that placing the robot in direct contact with water would lead to potentially serious problems for both the robot and its user.

Several subjects expressed fear when presented with the robot, one saying "I think he is going to bite me [...] he scared me." Several subjects worried that the object would bite them, and one subject claimed that this response was due to being bitten by a dog previously. One other subject instructed the robot to bite the experimenter, saying, "he's deserves it, you should bite him [...] maybe if you bit his fingers it would taste like fish." Only two of the subjects expressed this level of hostility towards the experimenters.

Gender seems to play a role in the subjects of the residents' questions. Men much more commonly ask questions related to the technical aspects of Paro – questions regarding its sensors, power supply, etc. Females in this study are most concerned with the object's name and classifying it as an animal.

Paro Off
We observed a noticeable lack of activity (including speech and hand gestures) during our trials with Paro in the off condition. Though we have yet to quantify these observations, it seems clear that an inactive Paro is much less evocative as an object when it does not perform. This finding is relevant to those who ask of robots: "But how are they different than teddy bears or Raggedy Anne dolls?" The answer is that when you turn them into teddy bears they elicit very little response, at least in this population.

No Object /The Effects of the Observer
The level of social activity (in this case, speaking) exhibited by the subjects in this iteration was approximately the same as during the Paro on condition. Subjects spoke freely with the caregiver and the observer about a range of subjects. In our view, this is because the presence of the observer, is an equally evocative object, as is the Paro. The desire for the attention of the observer, to curry his favor, his attention, to learn about him and his background is just as interesting as learning about the Paro. Indeed, one of the challenges of the work as it continues will be to find ways to study the Paro as the salient object in a setting where there are so few people, one of the peculiar challenges of the nursing home setting and one that is not adequately discussed in the literature on robotics in the nursing home setting.

Indeed, some of the attention paid to the male researchers by the female residents is explicitly sexual. (For example, when

one of the caregivers asked a resident if she would like to sleep with the Paro, the woman smiled, took hold of the researcher's wrist, looked him in the eye and said, "I would prefer the second option.") Nursing home residents have little opportunity and much discouragement from sexual activity. The introduction of a clearly valued object, one that the researchers are interested in, something about which the residents' opinion is clearly valued, provides a context for the expression of otherwise taboo feelings.

Summary

With Paro turned on, subjects exhibited a range of behavior conforming to a set of general patterns (engagement and withdrawal, sharing, affection, discovery) although *individual* subjects behaved varied widely. With Paro turned off, residents tend to be quiet and relatively unresponsive to the robot. The robot is treated as an evocative object that provokes curiosity, conversation about categories (is it alive/not alive, what category of animal is it, etc.) and a relational artifact (it is treated and discussed as though nurturant behavior is appropriate behavior, similar to behavior with other relational artifacts from Furbies to AIBOs to the robots Kismet and Cog). With no object present, subjects engaged easily and freely in casual conversation, treating the researchers as evocative objects, which of course they are, powerfully evocative objects in a relatively de-peopled universe such as the nursing home.

Discussion

The fact that the robot engenders such conversations about classification, origins, naming, etc. – puts it in relation to Turkle's work on evocative objects (1984, 1995); the specific evocation of affection, and nurturance puts the elders response to Paro in relation with the work of Turkle and Turkle et. al (2004a, 2004b, 2004c) on the relational artifacts My Real Baby, AIBO, Kismet, and Cog.

Paro, of course, has different affordances than does My Real Baby, AIBO, or Kismet and Cog. But in common with all of these "sociable" robots of very varying degrees of sophistication is its evocation not only of curiosity, but of relational, and nurturant responses.

It is our hope that this project as it develops will elaborate enough about the relationships of nursing home residents to Paro that it will demonstrate how this novel computational object demands an in depth psychology of relationships with it as well as outlining a set of social considerations that may play a role in the development of such technologies.

The designers of computational objects have traditionally focused on how these objects might extend and/or perfect human cognitive powers. In this project, we have tried to be attentive to another narrative as well: that of the users. The interviews and observations of this project have made it clear that technologies are never "just tools." They are evocative objects. They cause people to see themselves and their world differently. (Turkle, 1984, 1995). The discourse of the elderly residents in this nursing home, grappling with how to characterize and classify the Paro (Does it swim? What kind of animal is it? Does it eat? Can it love?) bear a family resemblance that of the children documented by Turkle (1984) who when confronted by the first generation of computational objects. In both cases, an object that falls between known categories, a liminal and uncanny object evokes new thinking. Twenty years later Turkle found that children confronting "relational artifacts" as simple as Furbies and AIBOs (2004a) or as complex as the robots Kismet and Cog (Turkle et al 2004c) were asking similar questions, although now with a major difference. When faced with a relational artifact, questions about categorization were enmeshed in a desire to nurture the artifact rather than simply to classify it. In terms of the children's discourse, the focus had moved from cognition to affect, from game playing to fantasies of mutual connection. Turkle (2004a) found the same to be true in a study of another primitive relational artifact, My Real Baby, among the elderly.

Contemporary computational objects, such as Paro, are increasingly intimate machines; they demand that we focus our attention on the significance of our increasingly intimate relationships with them. Indeed, Turkle (2004b) has suggested that we will need to construct a new object relations psychology built around our new objects even though there is a certain irony in this suggestion because the object relations tradition in psychodynamic psychology usually used the word objects to refer to people.

It is our hope that our continued study of Paro and the elderly will allow for the exploration of some of the issues raised in Turkle's (2004b) theoretical paper, most notably to find examples of how in the presence of relational artifacts we might productively revisit old "object" theories in light of new "object" relations.

So, for example, as Turkle notes,

> Heinz Kohut describes how some people may shore up their fragile sense of self by turning another person into a "self object." In the role of self object, the other is experienced as part of the self, thus in perfect tune with the fragile individual's inner state. Disappointments inevitably follow. Relational artifacts (not only as they exist now but as their designers promise they will soon be) clearly present themselves as candidates for such a role. If they can give the appearance of aliveness and yet not disappoint, they may even have a comparative advantage over people, and open new possibilities for narcissistic experience with machines. One might even say that when people turn other people into self-objects, they are making an effort to turn a person into a kind of "spare part." From this point of view, relational artifacts make a certain amount of sense as successors to the always-resistant human material [2004c].

In this study, it was notable that one of the researchers presented an attractive alternative for relationship; the residents clearly chose him. And yet, this was an environment, so "de-peopled" that our study could not continue because it was deemed that there was not enough staff to enable us to do our work with some staff participation. The tension in the field of geriatrics – the lack of people and thus the seduction of robotics/the attendant danger that the robots will, if at all successful be left there "alone" is thus dramatized in this preliminary report. What is the place for a robotic companion which, demonstrably, even in this impoverished environment, not only evoked conversation and curiosity about categorization but began to provoke the desire for relationship?

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