Therapeutic Robots for Older Adults: Investigating the Potential of Paro

Sean A. McGlynn, Shawn C. Kemple, Tracy L. Mitzner, & Wendy A. Rogers
Georgia Institute of Technology
School of Psychology
Atlanta, GA 30332
(404) 894-8344
smcglynn6@gatech.edu

ABSTRACT
As the population ages, there is an increasing need for socio-emotional support for individuals as they age. Older adults are an important potential user group given that by 2030, as they are expected to comprise nearly 20% of the U.S. Population [1]. Most robots that are being developed to aid older adults are designed to compensate for normal age-related declines in physical capability. Less attention has been given to robots that might support social or emotional issues that can emerge with aging. Living alone due to bereavement or by choice can lead to shrinking social networks, which then may be causing an increase in feelings of social isolation and loneliness [2]. Attempts to use commercially available robots as animal-assisted therapy agents have yielded promising results [3], but a systematic investigation of their ability to provide socio-emotional support to the normally aging older adult population is required.

1. INTRODUCTION
Advances in robotics offer a number of opportunities for providing support for individuals as they age. Older adults are an important potential user group given that by 2030, as they are expected to comprise nearly 20% of the U.S. Population [1]. Most robots that are being developed to aid older adults are designed to compensate for normal age-related declines in physical capability. Less attention has been given to robots that might support social or emotional issues that can emerge with aging. Living alone due to bereavement or by choice can lead to shrinking social networks, which then may be causing an increase in feelings of social isolation and loneliness [2]. Attempts to use commercially available robots as animal-assisted therapy agents have yielded promising results [3], but a systematic investigation of their ability to provide socio-emotional support to the normally aging older adult population is required.

1.1 Pet Therapy: Animals and Robots
Pet Therapy or Animal-Assisted Therapy (AAT) has been used in a variety of contexts and has shown a positive effect on well-being and quality of life [3]. However, owning a pet is not a realistic option for everyone. Pet robots may be a viable substitute to owning a live animal, as they are likely to be allowed in most environments, are less demanding, and may elicit similar health benefits as dogs and cats.

Participant and study setting information for selected robot therapy studies can be seen in Table 1. Dementia patients showed decreased levels of stress-related hormones after 1-hour interactions with Sony’s robot dog, AIBO, and reported reduced loneliness after 20 sessions over a 7-week period. In addition, interactions with NeCoRo, a robotic cat, increased feelings of pleasure in nursing home residents (for a review, see [3]). These therapeutic benefits are intriguing, but these robots were not designed for therapeutic purposes, and may not sufficiently promote interaction with participants over the long term.

The Paro (Figure 1) was designed specifically for therapy, and its unfamiliar, seal-like appearance allows users to interact with it without pre-existing notions that occur with robots modeled after common pets. Interaction with Paro has been shown to increase happiness and decrease depression and stress in older adult residents of a care facility [4]. However, most pet robot and Paro research has focused on patients with dementia, and less so on normally aging adults (for a review see [5]).

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Participant Information</th>
<th>Dementia Status</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamura et al. (2004)</td>
<td>1 male, 12 females; mean age 84 yrs.</td>
<td>Severe</td>
<td>Japan; nursing home</td>
</tr>
<tr>
<td>Wada &amp; Shibata (2007)</td>
<td>1 male, 11 females; ages 67-89</td>
<td>Dementia and non-dementia subjects</td>
<td>Japan; care house</td>
</tr>
</tbody>
</table>

Table 1: Previous robot therapy studies [3][5].

Figure 1: Paro’s range of motion.

1.2 Overview of Study
The primary objective of this study is to assess the effect of framing on attitudes, emotions, and engagement with a therapeutic robot. To do this, we will frame Paro as either a pet, robot, or toy when we first introduce it to the participant. Because Paro has robot functionality, but a furry, stuffed-animal like appearance, we believe these three conditions encompass varying points on the spectrum of how people might initially perceive Paro. Furthermore, we will determine whether attitudes and emotions change after interaction with this robot, and are also interested in general thoughts about Paro’s potential role in the home. While previous studies on Paro focused mainly on older adults with dementia and sometimes lacked equal gender distribution, this study will sys-
tematically investigate healthy, independent living older adults’ interactions with Paro. In doing so, we hope to support to previous findings as well as contribute new knowledge regarding factors influencing acceptance, emotions and engagement with this robot.

2. METHODS
2.1 Participants
Forty older adults (65-80 years) will be recruited from the metro community in Atlanta, GA, USA. They will be independent living and in generally good health.

2.2 Stimuli and Materials
2.2.1 Paro
Paro is a robot designed by Takanori Shibata of the Intelligent System Research Institute of Japan’s AIST. Paro has ubiquitous tactile sensors on its endoskeleton, which is covered in soft fur to promote interaction. Paro has sensors for touch, light, sound, and posture. Paro is able to move its neck vertically and horizontally, its front and rear fins, and its eyelids [4].

2.2.2 Questionnaires and Measures
Attitudes toward Paro will be assessed using the perceived usefulness and perceived ease of use scales, which will be adapted from a measure of technology acceptance (TAM) [6]. The Positive Affect Negative Affect Schedule (PANAS) will be administered to assess participants’ emotions before and after interaction with Paro [7]. Engagement with Paro will be determined by the frequency with which participants speak to and touch Paro. We will also administer a short interview pre- and post-interaction to assess peoples’ general opinions about Paro and its potential role in the home.

2.2.4 Equipment
Participants will be monitored using a Sony HDR-CX380 digital video camera for the duration of the study.

3. PROCEDURE
![Figure 2. Experiment procedure.](image)

4. RESULTS
Data collection for this study is ongoing. Selected responses from the first few participants are provided in Table 2. We have seen both positive and negative reactions to Paro thus far, but most of these participants have recognized the potential benefits of Paro for themselves and for others. However, once data collection is complete, we will determine if the trends seen are representative of the normally aging older adult population. The effects of framing, as well as pre- and post-interaction measures will also be assessed following data collection.

<table>
<thead>
<tr>
<th>Positive Reactions</th>
<th>Negative Reactions</th>
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<tbody>
<tr>
<td>“It’s really something you could just play with for an indefinite amount of time, making him react to you…”</td>
<td>“I don’t know what function it has. I’m not into cat and furry creatures.”</td>
</tr>
<tr>
<td>“It’s just affectionate…after a while you begin to think it’s a real being, it shocked me when it opened its eyes…”</td>
<td>“It’s eyes are disconcerting…reminds me of cats and I don’t care for cats…It’s eyes are too big.”</td>
</tr>
</tbody>
</table>

Table 2. Sample experiment quotes.

5. DISCUSSION
Based on the results of the first few participants, a potential coding scheme can be seen in Figure 3.

![Figure 3. Possible coding scheme.](image)

By taking a systematic approach toward investigating the therapeutic effects of Paro, we hope provide insight into the factors that influence interactions with therapeutic robots as well as possible considerations for increasing acceptance in the healthy and independently living older adult population.

6. ACKNOWLEDGEMENTS
This research is supported by the National Institutes of Health (National Institute on Aging) through: (1) the Ruth L. Kirschstein National Research Service Award Institutional Research Training Grant (T32AG000175); and (2) Grant P01 AG17211, the Center for Research and Education on Aging and Technology Enhancement (CREATE; www.create-center.org). We appreciate the loan of the Paro from Dr. Aaron King and DTI Robotics.

7. REFERENCES