Domestic Robots for Individuals Living with Loneliness: A Long-Term In-Home Interaction Study Design

Rahatul Amin Ananto
University of Manitoba
Winnipeg, Manitoba, Canada
anantor@myumanitoba.ca

Denise Y. Geiskkovitch
University of Manitoba
Winnipeg, Manitoba, Canada
d.geiskkovitch@cs.umanitoba.ca

James E. Young
University of Manitoba
Winnipeg, Manitoba, Canada
young@cs.umanitoba.ca

ABSTRACT

A growing area of human-robot interaction explores how robots, for example as companions, can be used to help people manage loneliness. However, we do not yet have research results indicating if people are ready to accept companion robots in their daily lives, and thus if companion robots can actually be successful broadly in society. We present a novel long-term in-home interaction study design that will explore how people accept these robots in their homes and how the robots impact loneliness.

CCS CONCEPTS: •Human-centered computing ~ Human computer interaction (HCI) ~ HCI design and evaluation methods ~ User studies

KEYWORDS

Social human-robot interaction, companion robot, loneliness.

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1 Introduction

Loneliness is defined as a perceived lack of social connection, and therefore, anyone can feel lonely if their connections and interactions are not sufficient; some people may not feel lonely even if they are socially isolated [1]. Many lonely people get pets as companions, find someone to share their thoughts with, or pick up hobbies to reduce their loneliness. Technology in general can also help people manage their loneliness, for example, as with online spaces or smartphone applications that enable people to chat with others [2], or on-line AI chat bots that simulate social interaction [3]. Similarly, social robots such as the Sony AIBO robotic dog [4] are now available; however, we do not yet know how effective these may be as companion robots for mitigating loneliness.

These social robots are designed to communicate using human- or animal-like techniques (e.g., speech, synthetic emotions, facial expressions; [5]). Social robots can use these techniques to shape a person's feelings [6], mood, and behavior [7]–[9]; most relevant, some research has shown that social robots can reduce loneliness [10]. However, a common caveat with research is using complex social interaction techniques that require a team to orchestrate, often relying on remote operators to secretly control the apparently autonomous robot (the Wizard-of-Oz method [11]). Thus, faked (not autonomous) behaviors are tested that may not be feasible to deploy. In contrast, there is much less research on fully autonomous social robots deployed in domestic environments.

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Figure 1: A person living with loneliness may improve their wellness by interacting with a robotic pet. We present a long-term study design focused on patterns of acceptance.

Moving toward successful domestic companion robots will require better understanding of how households and individuals adopt robots [12]; this will necessitate extensive research to understand the dominant adoption patterns of social robots in homes [12], [13]. Adoption of social robots into homes depends in part on individuals' acceptance of technology in general (i.e., general attitudes, intentions, and behaviors in relation to technology [14]). For example, depending on the individual and the type of robot, the robot could be perceived as a disruptive piece of technology [13] while others might be easily accepted due to their utility [16]. The acceptability of social robots in homes might also involve alternative predictors such as social abilities of the robot (e.g., motivation, communication, friendliness [13]). Further research is therefore needed to explore how people may accept (or not) companion robots into their homes.

We present a long-term study design that aims to analyze the acceptance pattern of a fully autonomous companion robot over time, by placing it in the homes of people who self-identify as being lonely. We will investigate how people adopt the robot, any long-term development of relationships, and, any impact on wellbeing and loneliness.

2 Integrating Robots into Homes

Research has demonstrated how social robots can provide benefits in therapeutic contexts including serious mental health issues (e.g., [17]–[21]), such as by improving communication skills of patients living

with dementia [21]. Social robots have also shown impressive outcomes in clinical settings, for example, decreasing stress and anxiety of older adults [22], and impacting loneliness (e.g., [10], [18], [23]–[27]). This motivates the potential for domestic companion robots to similarly support wellness and reduce loneliness for healthy individuals.

Understanding the dominant acceptance patterns of companion robots can help the process of smooth transitioning from laboratory or clinical contexts into homes. For example, works have shown that, utilitarian factors (e.g., medication reminders, tracking health information) motivate people to continue interacting with social robots [28]. Without these utilities, the primitive social capabilities that current social robots have, may not be enough to convince people to continue interacting with the robots [29]. Longitudinal research often reports that social robots are incapable of engaging users in long-term interactions [29]–[32], hindering long-term acceptance in homes.

Research has demonstrated cases of successful robot integration in homes. Initial work with the vacuum cleaner robot Roomba highlighted its entrance path into homes as a utility, a vacuum cleaner with promise of time-savings [16]. However, some people developed connections with their Roomba over time which helped them enjoy their house chores [33], and improve social dynamics among family members [34]. In a similar vein, work with the Karotz robot showed the importance of social factors (e.g., social interactions, relationships, trust) for accepting robots in homes [28]. Much more work is needed beyond these few examples, because, we still have very little knowledge about social robot acceptance in homes and the underlying challenges and issues (e.g., cost, privacy).

3 Exploratory Study Design

We present a longitudinal exploratory study design that focuses on acceptance patterns and challenges for domestic companion robots. This knowledge is crucial for developing domestic companion robots that people will actually adopt, such that it can successfully support people, and reduce loneliness. Our approach revolves around focusing on phases of acceptance identified in earlier works [28], [35], but anchored in the perspective of how these robots impact loneliness.

We will recruit participants who live alone and self-identify as being lonely. We will conduct a longitudinal qualitative evaluation to assess a social robot's effect on the recruited participant's wellbeing. We plan to conduct the study for at least three months to get an in-depth insight into the trajectory of how people accept robots in their homes and how these robots impact their loneliness.

For our study, we will use the robotic dog AIBO [4] developed by SONY. It is a sophisticated pet-like robot that can sense touch, hear sounds, understand voice commands, and recognize people using face recognition. We selected this robot for our study because of its life-like movement ability and its capability to convey a high quality puppy character [4].

3.1 Phased Study Procedure

We developed a phased study procedure based on previously observed acceptance patterns [28], [35]. We will conduct interviews at all the important phases of the experiment, and regular weekly interviews over the course of the study. The study includes five phases; initial intake, first encounter, ongoing during-study, exit and follow-up.

The interviews will consist of questions on how participants accept social robots in their homes, their perceptions of the robot and the robot's impact on their loneliness.

Initial intake – We will conduct initial intake interviews to first learn about participants' expectation towards the robot. This will provide important context for analyzing and understanding their attitudes toward companion robots before use (rather than attitudes toward the robot from use) and provide insights on the participants' initial expectations towards the robot.

First-encounter – On the first day of the study, we will deliver the companion robots to the participants' homes along with the instructions on how to interact with the robot. After the participants interact with the robot, we will conduct the first-encounter interview session. This interview will give us insights on the participants' thoughts about the robot, their interaction plans, and their expectations from the robot.

Ongoing during-study – We will have interview sessions every two weeks to get updates from the participants. We will consider the novelty effect for the initial few weeks. These interview sessions will consist of questions about the participants' general wellness, interaction process with the robot, and participants' relationship with the robot.

Exit – The companion robot will be collected back from the participant after the study is complete. An exit-interview will be conducted to get insights on the participants' thoughts about the overall study, if they feel any changes in their general wellness and their perception of the robot's impact on their loneliness.

Follow-up - We will conduct a follow-up interview with the participants after a week of the study completion to understand how they feel about not having the companion robot anymore.

After each interview session, participants will get an allocated time to complete some questionnaires related to their general wellness. We will use the UCLA Loneliness scale [36] to measure level of loneliness, the State-trait anxiety inventory to assess level of anxiety at that moment, and the PANAS questionnaire [38] to assess participants' overall mood. We will quantitatively analyze these results to reflect on the impact of a robot pet on general participant loneliness, anxiety and mood. We will further qualitatively analyze the interview sessions to understand how people accept robots in their homes and how it impacts their loneliness.

CONCLUSION

In this paper we present our initial study design that will focus on social robot acceptance and concurrently investigate the social robot's impact on loneliness. We believe that better understanding the acceptance process of social robots in homes will help in better designing novel social robots to be adopted into and positively impact domestic spaces, particularly for lonely people. Further, researchers will be able to leverage this study design to investigate various other wellness challenges like stress, anxiety and depression. Our study will be the first to focus on social robot acceptance in homes that subsequently addresses a wellness challenge.

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