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Gender Representation and Humanoid Robots Designed for Domestic Use

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Abstract Humanoid robots' appearance and behavior provide social cues about their purpose and abilities. However, little is known about how a robot's gender representation will affect users in everyday home use scenarios. This paper presents the results of a study exploring people's expectations of humanoid robots, or androids, designed for home use. Results of this study demonstrated participants' willingness to attribute human roles and tasks to an android, although they did not indicate an overall preference for the robot as a social actor. In addition, following the viewing of video stimulus featuring human-robot interactions, robot gender issues surfaced during open-ended interviews.

Keywords Android · Design · Expectations · Gender · Human · Humanoid · Human-robot interaction · Interaction · Robot · Social · Stereotypes

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1 Introduction

We are entering an age where living and working with robots imbued with functionality and socialness is a reality. Designing humanoid robots for home use requires understanding how people currently feel about robots. One challenge to be considered when designing robots for the home is the representation—intentional or accidental—of the robot's gender. For the purpose of this paper, the discussion of robots centers on androids, or robots with an aspect of humanlikeness portrayed through appearance, behavior, context of use, speech/voice, or a combination of these characteristics.

Gender presentations affect interactions among humans. Central questions for robotics development and design are: How will gendered robots influence everyday use? Conversely, how will a user's gender affect his or her interactions with a gendered robot? Humans often assign gender to inanimate objects; for example, cars and boats are commonly female in Western culture, and dolls are typically designed to be clearly male or female. Some humanoid robots are designed with obvious gender orientation, such as Repliee (Osaka University and Kokoro, Ltd.) while others are less distinct, such as Robovie (ATR Laboratories). Morphology, overall appearance, behavior, voice, gaze, gesture, functionality, context and cultural expectations all impact the user's concept of gendered robots. While it is likely that robots with distinct gender appearance and actions will make human-robot communication more effective in some scenarios, the absence of gender in other robot designs may work better by causing less distraction for the user [8].

Potential research questions include:

- What traits and characteristics do users identify as male, female or neutral in robots?

- What level of gender identification is necessary in overall robot design for the user's ease of communication?
- What is the effect of the user's gender and their willingness to engage with the robot (gendered or neutral)?
- What context and use scenarios require robot gender assignment for effective communication?
- What cultural stereotypes do robots mimic or create by being gendered?
- How is robot gender identified through design?

This paper is a theoretical inquiry about the concepts of gender and humanoid robots based in human-robot interaction, gender studies, cognitive science and design theories, and will present the findings of an exploratory study examining user expectations of social robots developed for the home. We use the findings of our recent study about user expectations of humanoid domestic robots as a springboard for discussion.

Robots are machines without an organic gender or sexuality. However, robots are also rooted in our cultural expectations as servant, enemy, friend, pet, slave, toy, companion, and other roles presented in popular mythology [3, 4]. These roles are loaded with user stereotypes and related expected signifiers. Humanoid robots offer another unique set of issues for the user, who must recognize that a mobile thing with some humanlike morphology, behaviors, and of varying intelligence and autonomy is not natural, but human-made. Haraway [6] refers to this perceptual dilemma as the "distinction between animal-human (organism) and machine" (p. 152). Highly humanlike robot development is on the cusp of becoming invisible machinery; mechanical, yet through humanlike appearance or behavior, triggering a sense of perceived humanness in the user to the point where they respond to the thing as something alive and natural.

Reeves and Nass [9] "computers as social actors" (CASA) theory explains how humans unconsciously ascribe agency, personality, and intentionality to computer-mediated technologies. In humanoid robots, the combination of human appearance and user-projected human intentionality creates a complex mixture of attachment-related responses for users of android products in which the drive to respond to the android as if it was human is at odds with the realization that the android is a machine.

This study incorporated a questionnaire to examine people's perceptions of a robot's overall appearance and behaviors after viewing videos of each robot. Previous studies [4] have used questionnaires as a tool to investigate user attitudes towards domestic robots.

Through a semi-structured interview, participants were also de-briefed about their opinions of the robots and interactions, and their responses were recorded through observation and interview notes. Field notes from the interview portions of these sessions were analyzed using qualitative data analysis techniques [1, 10].

2 Method

Nineteen participants, all students at the University of Washington, completed the study. The mean participant age was 22.8 years ($SD = 4.9$); 53% were women ($n = 10$) and 47% were men ($n = 9$). Two video clips of separate robots, Repliee and Robovie, were the stimulus for discussion. Each robot was contextually introduced as "designed to be a friend or member of the family, offering assistance through social interaction." Participants first viewed the Repliee and the Robovie videos, shown in random order. After watching the videos, participants completed a Likert-scale survey with three questions about their perception of each robot as appearing machine- to human-like, friendly/unfriendly and the comfort level of having that robot in their homes. Participants completed the same questionnaire for each video. They next completed a short demographics survey.

A semi-structured interview protocol was used for the post-study interviews, and two people manually coded the entire data set using Thematic Analysis and an inductive approach [2]. Here, a theme captures something important about the data and represents some level of patterned response or meaning within the data set. The key themes described here (a) demonstrate something important related to gender representation in robots and (b) characterize a prevalent response from participants. Prevalence was counted in terms of the number of different speakers who articulated the theme across the entire data set.

3 Materials

The questionnaire asked about humanlikeness vs. machine-likeness, friendliness and their comfort level of having the robot in the home.

Two video clips were used as stimuli for discussion. Each of the two videos fit the following criteria:

- Time was approximately three minutes long.
- Presented only one robot per video.
- Featured robot was humanoid.
- Demonstrated a human-robot language interaction (in English).
- Showed the robot's entire body at least once in the video.

The robots used in the videos were, as shown in Fig. 1 (Repliee Q2, Osaka University and Kokoro Co., Ltd.) and Fig. 2 (Robovie, ATR) below.

The content of each video varied. Robovie interacted with one primary human actor in an extended scene, conversing about the weather, asking to play games and engaging in simple conversation with the actor. In the video, Robovie moved on its wheeled base and demonstrated its arm and head movement clearly. In the other video, Repliee

Fig. 1 Repliee

Fig. 2 Robovie

acted as a receptionist in a brief opening scene, offering directions to an actor; subsequent scenes showed the robot acting as a journalist, interviewing two different actors separately. Repliee appeared stationary in all scenes, moving its head, arms and torso during interactions.

4 Findings

A one-way repeated measures General Linear Model analysis of variance (ANOVA) test was conducted to determine the differences between participant ($n = 19$) responses to three questions in the post-video questionnaire. Each question was analyzed as a within-subjects factor (response to Robovie vs. response to Repliee). A significant difference was found between participant responses to the human- and machinelikeness question $F(1, 18) = 110.250$, $p < .05$. No significant difference was found for questions regarding friendliness or comfort level of the robot in the home.

However, the *comfort level* approached significance with gender as the between-subjects variable ($p = .052$). Women felt less comfortable having a robot in the home than did men. For Robovie, the mean rating from women was 2.10 ($SD = .738$), while the mean rating from men was 2.56 ($SD = 1.424$). For Repliee, the mean rating from women was 1.90 ($SD = .994$), while the mean rating from men was 2.67 ($SD = .707$). Although these differences are not significant, an increase in sample size could possibly yield a significant result.

Emergent themes from the interviews demonstrated humanoid robots in the home:

- Trigger parallel human gender associations, especially about appearance and socialness.
- Elicit associations of robot use with menial tasks.
- Challenge existing concepts about robots and social interaction.

We will present our findings about user expectations and gender issues surrounding domestic robots with representative comments from cases to illustrate major themes and areas of interest.

Pretty and Comforting: Human Cues Map to Robots

The majority of comments related to robot gender were predictably about Repliee, who is purposely very humanlike in appearance and is modeled after an adult woman. As expected, humanlike indicators in the design of the robot such as voice, clothing and morphology were the key triggers for discussing gender-related issues, and participants revealed preferences for a female robot for in-home use.

"She's pretty because she looks really human and she's slim and she has hair. She just has the human girl features about her." (Repliee)

"That one looks better, a lot better. It looks like a woman. That helps me feel better." (Repliee)

"Well, it's female, so that's a positive. I'd have to say that it's just because of the whole idea of the woman being attractive. Well, attractiveness… I probably shouldn't say that [blushes]. This is where safety comes into play. The feminine form is typified as being weak or fragile in some form, but really inviting and warm and more interactive. Whereas if it were a male robot and masculine design, then there's a safety issue of, 'OK. I gotta protect myself possibly'… you don't know [laughs]. No matter how simplistic or mechanical it is, a male robot just seems more… I don't want to say competitive, but… I'm thinking of the word… A male robot would be not competitive, but it would be a challenge in some way." (Repliee)

"I guess for me, when I'm around girls, I feel like it's special. When you have a girl at home, it's someone you love. Guys can love each other, I guess." (Repliee)

"It's like a child robot. It is quite fun to play with. It would be fun for children to play with because she—I assume it's a lady robot—she likes to say some childish things. Quite superficial and she likes to play, 'touch me,' 'hug me,' 'shake my hand.'" (Robovie)

Servant or Assistant: Expected Robot Roles and Functions

Both robots elicited similar themes in response to the interview question "What would you like this robot to do

for you in your home?" Most participants identified menial tasks as their expectation of robot duties. Chores mentioned most often included such tasks as washing dishes, doing laundry, general cleaning, ironing clothes and heavy lifting of objects. In addition, many participants named specific roles they envisioned the robots fulfilling, such as receptionist, librarian or doctor's assistant. These responses are especially noteworthy since the robots' use was framed as "in the home," yet participants most often named job roles that are not normally done in a domestic setting. Participants were conflicted about roles and functions for the robots that included more intimate or prolonged social contact, such as childcare and companionship. Frequently, participants fluctuated in their opinion, often within sentences, about whether they would want a robot to take care of their child or act in a purely social way.

"I wouldn't want her to answer the phone or interact with children. Anything other than that, cleaning or getting the mail would be fine. Anything that doesn't involve interaction." (Repliee)

"I guess… have it do chores like vacuuming, doing dishes, and cleaning the bathroom. I wouldn't have it take care of kids. I wouldn't have it answer the phone. I wouldn't have it interact with other people, other than adults that knew they were interacting with a robot." (Robovie)

Don't Touch Me: Robots and Social Interaction

As stated previously, the majority of participants indicated they would not like to see either robot in their home with a social purpose. Identified concerns included potential confusion about whether a robot was a machine or organic (especially with children), the robot touching the human in a social way, and the false pretense of a machine expressing humanlike emotions.

"I don't want any kids that are in my home—whether or not they're mine—to really be interacting with someone like that because they might mistake an actual human for a robot like that. They'll be interacting with a piece of machinery with the idea that it's someone who's real." (Repliee)

"I didn't like how it wanted physical interaction… I don't want to see it interact with me personally like that. If I was married, I wouldn't expect that kind of interaction, whereas it's just kind of like, 'Caress or touch me.' If it's a handshake, that's fine." (Robovie)

"Some of the stuff was creepy—like 'touch me' and 'hug me.' That struck me as odd. I can't imagine that the act of touching a robot would have some sort of inherent or not pre-programmed response for the robot. Someone's asking me to do something that's not for them, but it's for me, and they're not getting anything out of it… that makes me uneasy." (Robovie)

5 Discussion

Before discussing the implications of these findings, it is important to note several aspects of this study. This research was based on participants' impressions after watching videos rather than from more prolonged interactions, which might result in participants reframing their initial responses. And, although the videos used in this study fit the criteria listed under *Materials*, they were not necessarily crafted to demonstrate the robot in either a social or service role. In addition, Repliee was more clearly intended to be a female robot while Robovie's gender cues were vague.

Although most participants said in interviews they did not want a robot for social purposes, conflicting opinions emerged from individuals in some cases, bearing further investigation. Some aspects of socialness, such as speech, were preferred for ease of use, while specific behaviors, such as the emotion demonstrated by Robovie, upset people.

People's natural tendencies to categorize others [5]—including humanoid robots—are demonstrated in the findings of this research. Without specific prompting, participants frequently commented on each robot's perceived gender, race or nationality, and social standing within the household. Unlike disembodied computers, robots will be more difficult to claim as simply "feminine, masculine or beyond gender" [11], p. 10. The very nature of a robot with a humanoid form mixed with implied (or real) functionality, the social characteristics of the robot and the context of use are combined with the individual user's cultural expectations and will encourage a set of interaction norms. Von Zoonen concluded [11] that as technologies are integrated into everyday domestic settings, a seamless blending of social structures, symbolic representations of gender and the users' individual identity hails the positioning of men and women. Levy [7] states that "humans attribute others with having minds" (p. 53), and in fact, over-attribute feelings and intentions, such as in the case of the anthropomorphism of pets. Our participant examples shown in the themes above demonstrate the tendencies of both (a) relying on human-human norms to explain humanoid robots and (b) facile anthropomorphism among our study participants when discussing both robots. In addition, the robots are clearly an "other," even if that other is ill-defined in their own minds without real experience with a humanoid robot. It is crucial, therefore, that all of these elements are taken into account when designing and developing humanoid robots because they will directly affect efficiency, ease of use and pleasure in any human-robot interaction. In addition, the gendering of humanoid robots, whether with intentional design cues or not, will likely perpetuate aspects of certain human-human roles and the ideologies that go with them.

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