Robot Gendering: Influences on Trust, Occupational Competency, and Preference of Robot Over Human

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Abstract

This paper presents an investigation into the
differences found in participants' comfort levels with
using new humanoid robots in addition to the tendency
to give a gender to a robot designed to be gender
neutral. These factors were used to examine
participants' perception of occupational competency,
trust, and preference for a humanoid robot over a
human male or female for various occupations. Our
results suggest that comfort level influences these
metrics but does not cause a person to ascribe a
gender to a gender-neutral robot. These findings
suggest that there is no need to perpetuate societal
gender norms onto robots. However, even when
designing for robot gender neutrality people are still
more likely to ascribe a gender to the robot, but this
gendering does not significantly impact occupational
judgements.

Author Keywords

Robot gender; Gender stereotypes; Human-Robot
Interaction' Gendering; Human-Robot Trust;
Occupational Competency

CSS Concepts

• **Human-centered computing~Human computer
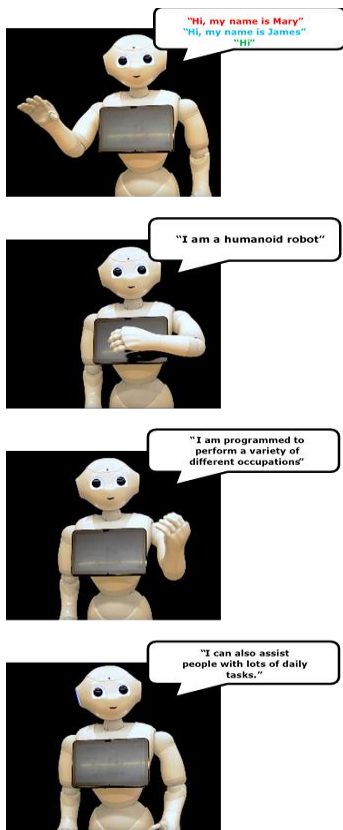interaction (HCI)**;

Figure 1. Script performed by the expressive humanoid robot. On the top, the three lines represent the gendered name manipulation where the first line is performed by the female robot, the second by the male robot, and the third by the gender-neutral robot.

Introduction & Related Works

As social agents, humanoid robots are becoming more prevalent in our society. Understanding the interaction dynamics between humans and robots is thus becoming an important factor when deploying future robots into the workplace. Factors such as physical embodiment [12], gesturing [6], and display of emotions [14] have been shown to have influences on how a person perceives certain attributes and qualities of a robot. One of these qualities, as related to physical embodiment, is gender. Designers and users have been shown to often manipulate the gender of robots in order to provide enhanced experiences [2,3,13]. However, some question the use of gendering due to its potential to perpetuate societal gender biases [7].

Robots are increasingly being used in occupational contexts that help or serve humans [8], and prior work has found that perceived gender of a robot has little influence on perceived occupational competency [1,4,11]. Occupational competency is defined as the ability to complete the tasks associated with a given occupation [5]. A few studies also have investigated the influence of robot gender on how well a person trusts a robot in particular occupations [1,11].

Within the occupational context, a gap that still remains is in understanding whether a person's preference for engaging with the robot over a human impacts their perception with respect to occupational competence or trust. Within jobs pertaining to the domestic care of the elderly, it has been seen that older adults prefer robots over humans for some tasks [9,10], but little work has been done to generalize these preferences across occupations.

As such, this paper presents an initial investigation into if robot gendering has any influence on occupational competency, trust in occupation, and preference for the robot over a human male/female in performing certain occupations.

Methods

Robot Introduction Video
We used the Pepper humanoid robot (Figure 1) in this study. Two separate videos were generated in which Pepper was filmed acting out the script, *"Hi, my name is {James/Mary} and I am a humanoid robot. I am programmed to perform a variety of different occupations. I can also assist people with lots of daily tasks,"* where James and Mary were used for the male and female robot conditions respectively. A third video was also created with a gender-neutral robot and the script "Hi, I am a humanoid robot," omitting the presentation of a formal name, and followed the same script afterwards. Computer-generated male, female, and neutral voices were used in each video, and all vocal clips were of equal length. A small pilot study was conducted beforehand to validate the gender or gender-neutral characteristics of each of the voices.

Occupational Competency, Trust, and Robot Preference Over Human Questionnaire
A questionnaire was used to measure the occupational competency, trust, and preference of robot over a human male or female for 14 different occupations (comedian, firefighter, home health aide, nanny, news anchor, nurse, package deliverer, receptionist, restaurant server, security guard, surgeon, teacher, therapist, tour guide). The questionnaire included an attention check in order to ensure the quality of data obtained. [1] To measure occupational competency for

	Labeled as Male	Labeled as Female	Labeled as Neutral
Shown Male	45	0	5
Shown Female	2	42	6
Shown Neutral	32	3	15

Table 1. Participants' perception of robot gender per experimental group.

each occupation, participants were asked to answer the following question, *"How likely is it that you think the robot could perform the tasks required for the following occupation?"* on a 5-point Likert scale ranging from 1=Very unlikely to 5=Very likely. To measure trust in the robot's occupational competency for each occupation, participants were asked to answer the following question, *"How much would you trust the robot to perform the tasks required for the following occupation?"* on a 5-point Likert scale ranging from 1=Strongly distrust to 5=Strongly trust. To measure preference of robot over a male or female human, participants were asked to answer the following questions, *"Assuming that you needed to hire someone for the following occupation, how likely is it that you would select the robot over a human {male/female}"*, where one question asked about preference over human male and the other over human female. Participants responses were on a 5-point Likert scale ranging from 1=Very unlikely to 5=Very likely. The questionnaire also collected participant demographics (age, gender, race, and education level). Moreover, participant comfort level with new humanoid robots was measured by asking the following question, *"How comfortable would you be interacting with robotic technology, such as a humanoid robot, that you have not used before?"* on a 5-point Likert scale ranging from 1=Very uncomfortable to 5=Very comfortable. Additionally, each participant was asked, "What would you describe the robot in the video as being?" with possible answers of "a male robot", "a female robot", or "neither a male nor a female robot".

Procedure
Participants were randomly assigned to one of three experimental conditions to either be exposed to a robot with a male, female, or gender-neutral voice. Once assigned, participants watched a short 15 second video of the robot introducing itself. Afterwards, participants completed the questionnaire. Each experimental condition {male, female, neutral} contained 50 participants.

Participants
We administered the Qualtrics questionnaire to 150 United States participants aged 22-73 (male = 51%, female = 49%, mean age = 40.02, SD = 11.22) recruited through the Amazon Mechanical Turk platform. 80% of participants self-identified as White, 4.67% as Hispanic or Latino, 8% as Black or African-American, and 6.67% as Asian. When asked about highest level of education, 35% of participants indicated pre-college, 51% selected undergraduate degree, 9% selected master's, doctoral or other professional degree, and 5% identified "other" (the 7 write in answers included trade school and associate's degrees). When asked about comfort level when interacting with new humanoid robots, 3% selected very uncomfortable, 15% selected somewhat uncomfortable, 15% selected neutral, 41% selected somewhat comfortable, and 26% selected very comfortable. All participants passed the attention check. The study was approved by Georgia Tech's Institutional Review Board (IRB).
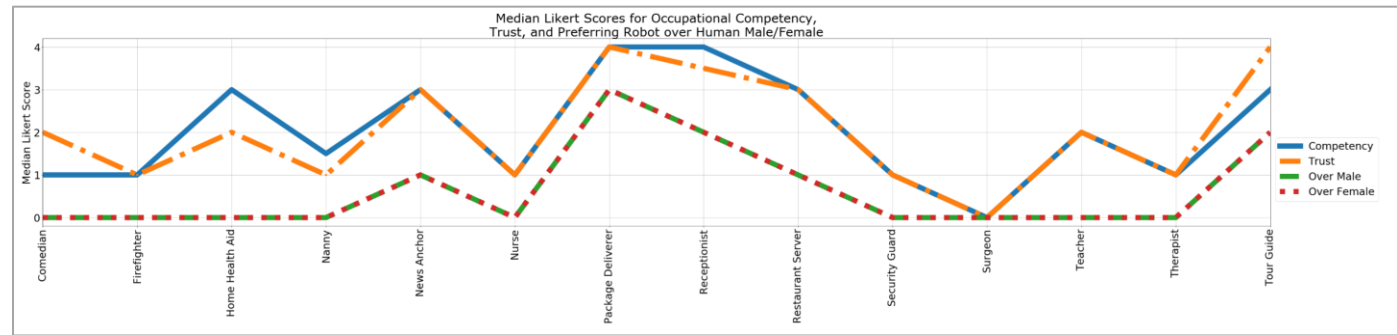
Figure 2. Medians of perceived occupational competency (labeled as Competency), trust (labeled as Trust), and preferring robot over human male/female (labeled as Over Male/Over Female respectively).

Results

Verification of Experimental Group and Perceived Robot Gender

Although a small pilot test was conducted to verify the robot voices to be appropriately male, female, and neutral for each of the experimental conditions, results from this experiment suggest that the choice of voices were not perfectly aligned to what participants perceived. Table 1 shows the participants' perceptions of robot gender for each experimental group. For the male-robot condition, 45 out of 50 participants perceived that it was a male robot. For the female-robot condition, 42 out of 50 participants perceived that it was a female robot. For the neutral-gender robot condition, only 15 out of 50 perceived that it was a neutral-gender robot. Although this neutral-gender perception is low, participants were more likely to label the intended gender-neutral robot as neutral as compared to the intended male and female cases. This suggests that the chosen neutral voice, although not perfectly neutral, elicits neutral-gender perceptions more than the other gendered voices.

General Metric Trends

Figure 2 shows the median Likert values for all participants for all metrics. The Likert values were coded such that 0 represents very unlikely/strongly distrust, 2 represents neutral, and 4 represents very likely/strongly trust. Occupational competency and trust are closely related. Only 5 of the 14 occupations (news anchor, package deliverer, receptionist, restaurant server, and tour guide) had occupational competency and trust median values that were above the neutral point.

In reference to preferring a robot over a human for each occupation, the median scores were the exact same for preferring a robot over a human male or female. Moreover, the only occupation that was likely for the participants to hire over a human was package deliverer. Although participants viewed the robot as capable and trusted that it could do a certain occupation, they did not prefer to replace a human with the robot.

Influences of Perceived Robot Gender
Due to the imperfect alignment of experimental robot gender groups and participant perception of the robot's gender, multiple analyses were performed on different groupings of participants. Analysis 1 mapped participants into their randomly assigned experimental groups. Analysis 2 mapped participants into groups based on the gender they perceived the robot to be. Analysis 3 mapped participants to their randomly assigned experimental groups, but only considered the participants whose perception of the robot's gender matched the intended gender. Because of the non-parametric, categorical nature of Likert data, participant answers were coded into ranks and then Kruskal-Wallis tests were used to examine the differences between robot-gender groups for metrics of occupational competency, trust in occupation, and preference of robot over male/female human for all 14 occupations. For nearly all cases, robot gender did not produce statistically significant differences for any of the metrics. One set of exceptions to this were within Analysis 2 in reference to trust in occupation for comedian (p = 0.02) and preferring a robot over a human female for package deliverer (p = 0.008). The other set of exceptions were in Analysis 3 for preferring a robot over a human female nurse and package deliverer (p = [0.04,0.02] respectively).

Influences of Participant Demographics
Multiple chi-square tests of independents were performed to examine the relationship between participant demographics and occupational competency, trust in occupation, and preference for robot over human for each of the 14 occupations. For occupational competency, there were no statistically significant differences for most occupations between different races, genders, or education levels. Exceptions to this were for participant race and receptionist (p = 0.007), and participant gender and package deliverer (p = 0.006).

For trust in occupation, participant race provided statistically significant differences for firefighters and nanny (p = [0.04,0.02] respectively), participant gender provided statistically significant differences for home health aide, news anchor, and package deliverer (p = [0.02, 0.01,0.02] respectively) , and participant education level provided statistically significant differences for restaurant server, security guard, and therapist (p = [0.03,0.007,0.02] respectively).

In reference to preferring a robot over a human male, the only statistically significant difference was for participant gender and receptionist (p = 0.008). This differs from the significance results for preferring a robot over a human female which provides statistically significant results for participant race and nanny therapist, and tour guide (p = [0.02,0.005,0.02] respectively), and participant education level and security guard (p = 0.009)

Of the presented statistically significant differences, all were weakly correlated (Φ less than 0.3) to their respective metrics.

Influences of Participant Comfort with New Humanoid Robots
Kruskal-Wallis tests were performed to investigate the differences between participant comfort level with new humanoid robots and the metrics of occupational competency, trust in occupation, and preference for the robot over a human male/female.

	OC	T	M	F
Comedian	.75	.48	.59	.28
Firefighter	.64	.01	.20	.11
HH. Aide	.02	.001	.04	.02
Nanny	.19	.006	.04	.07
News	.56	.003	.002	.02
Nurse	.65	.218	.16	.16
P. Deliver	.11	.002	.001	.0002
Recept	.001	.008	.02	.005
Rest Serv	.25	.0003	.01	.01
Sec Guard	.04	.005	.01	.03
Surgeon	.72	.09	.27	.66
Teacher	.13	.001	.04	.25
Therapist	.85	.052	.33	.15
TourGuide	.11	.0002	.03	.004

Table 2. P values for Kruskal Wallis tests for different metrics based on different comfort levels for each occupation. Statistically significant differences shaded. OC = Occupational Competency; T = Trust Performing Occupation; M = Preferring Robot Over Human Male; F = Preferring Robot Over Human Female

Unlike robot gender and participant demographics that presented few instances of differences between groups for each metric and occupation, participant comfort level with interacting with new humanoid robots presented more statistically significant differences. Table 2 holds the collection of p-values resulting from Kruskal Wallis tests examining differences in comfort level on occupational competency, trust, and preferring the robot over a human male/female. Home health aide, receptionist, and security guard all showed significant differences for all metrics in regard to participant comfort level with using new humanoid robots. However, comfort level was seen to be weakly, positively correlated for each metric for all occupations.

Influences of Gendering or Not Gendering Neutral Robot
As stated, 35 out of 50 participants did not perceive the intended neutral-gender robot to be neutral gendered. We wanted to examine if this gendering tendency had any influence over participants ratings of the robot's occupational competency, trust in occupation, or preferring the robot over a human male/female. Through Kruskal-Wallis tests, we found that for most cases, there were no statistically significant differences between those who gendered and those who did not. Exceptions to this were trust in occupation for comedian (p = 0.009) and preferring the robot over a human female package deliverer (p = 0.008). Additionally, we wanted to see if gendering was more apparent for certain groups of races, genders, education levels, or comforts in using new humanoid robots. No significant differences were found within each demographic group.

Conclusion
Prior work in trust relating to occupational competency for robots found that robot gender did not have an impact on user trust when considering a personal healthcare and a security robot [11] and that older adults prefer robots over humans for some tasks [9,10]. The present study expands the prior analysis by including a larger range of occupations in addition to examining influences of comfort level with new technology and participant gendering tendencies.

It was found that the perceived gender of the robot and participant demographics did not provide statistically significant differences over these metrics (which confirms prior work). However, participant comfort level when using new humanoid robots does significantly influence their beliefs and trust in the competency of a robot in particular occupations. It was also found that participants were much more likely to give a gender to robot designed to be gender neutral; however, this gendering did not provide differences in their judgement of the robot and there were no significant demographical differences between those who gendered and those who did not. For all but one occupation (package deliverer), it was found that participants would prefer to not hire a robot over a human male or a human female.

This work is limited by its lack of qualitative information for explaining participant perceptions and judgements. The work is also based in the chosen embodiment of the robot and additional work is needed to explore the generalizability of these findings into different scenarios. Future work plans on collecting these qualitative data to inform robot characteristics that more strongly suggest gender neutrality.

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