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NEGATIVE ATTITUDES TOWARDS ROBOTS VARY BY THE OCCUPATION OF ROBOTS

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ABSTRACT

The "negative attitudes towards robots scale" (NARS) has been widely applied in the field of robot-human interaction. However, the various occupations and roles of robots have not been discussed when studying negative attitudes towards robots. This study explores whether the occupation of robots could influence people's negative attitudes towards them. For the first time, two types of robots that may be widely used were used in a NARS-related study. We conducted online questionnaire research, covering three separate parts: negative attitudes towards robots, negative attitudes towards service robots, and negative attitudes towards security robots. The results of the online survey collected from 114 participants (54 females and 60 males) highlighted differences among the scores of people's negative attitudes towards service robots and the negative attitudes towards robots or security robots. People showed the lowest negative attitudes towards service robots. There were no significant differences between the negative attitudes towards robots and security robots. This study supports the hypothesis that people show different levels of negative attitudes towards different types of robots in terms of occupational division. These results provide a helpful indicator for the study and design of robots in various occupations in the robotics industry.

Keywords: *robot design, NARS, robot occupation*

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1 INTRODUCTION

Anthropomorphic robots are becoming increasingly popular throughout modern society as an important aspect of robotics. Researchers are gradually refining the design and study of robots, including their production, definition, anthropomorphic perception, social categorization, and emotional experience. It is necessary to determine how people recognize and perceive robots. Some researchers have suggested that the way robots are perceived may depend on basic psychosocial processes, such as social categorization (Fiske et al., 2007).

Occupation, an important social classification, is also a pivotal topic in robotics research. Studies of robots across different occupations within various domains have identified several outcomes related to social classification and robot occupation. The "negative attitudes towards robots scale" (NARS) has been widely used in robot-human interaction studies (Nomura et al., 2006). The effects of gender stereotypes and negative attitudes towards robots on gender appearance preferences vary with human occupation. For some people in certain specific occupations, there was no association between stereotypes, negative attitudes, or gender preferences for robots playing roles in their own fields (Nomura & Suzuki, 2022). It has been demonstrated that people project gender stereotypes regarding human society onto robots with gendered characteristics. When confronted with robots, humans can socially categorize robots based on their "male" or "female" characteristics. The results show that people tend to perceive heterosexual robots as more trustworthy, reliable, and attractive (Siegel et al., 2009).

Robots with male names were perceived to be more suitable for security roles, whereas robots with female names were more suitable for healthcare roles. This suggests that non-appearance factors of gender characteristics also influence people's preferences for robots with different occupations (Tay et al., 2014). Several studies on robots across various professions have found that high anthropomorphism has positive effects — for example, the addition of human forms and interactive features to service robots can promote positive emotional responses from older users (Zhang et al., 2010). However, people's trust in robots does not always increase with anthropomorphism, as it is highly context-dependent (Roesler et al., 2020).

Furthermore, a robot’s task may influence the active response and engagement of the participants (Rau et al., 2010). A cross-cultural study identified factors influencing attitudes towards robots, such as culture, prior exposure to robots through media, and personal experiences of emotions towards robots (Haring et al., 2014). These findings show that there are still uncertain and complex relationships and influences between the robot's occupation and task, the user's personal characteristics, and the user's emotions towards the robot.

Social categorization of robots with different occupations is likely to lead to different negative attitudes towards them; however, there remains a lack of research in industry and academia on attitudes towards robots with different occupational attributes, with a paucity of understanding concerning what attitudes people will have when faced with anthropomorphic robots with different occupational attributes. To clarify these questions, this paper will examine how robot occupation affects people's negative attitudes towards robots when they answer the NARS questionnaire. Service and security robots — as common classes of anthropomorphic robots —

are likely to be widely used in the future. This study uses these two occupations as robotic occupations. Negative attitudes towards robots, service robots and security robots will be revealed and discussed for different age and gender groups.

2 METHODS

2.1 Participants

Questionnaires were distributed and collected online. Two age groups — 20-30 and 60-70 — and two genders — male and female — were selected as the target subjects. A total of 240 questionnaires were collected. After removing subjects who had experience in designing, building, or using robots, in addition to those who failed to answer the trap questions correctly, 114 valid sets of participant data for those aged 20-70 years old (M = 46.29, SD = 19.93) were selected. Valid data sets included 26 women aged 20-30 years (M = 25.38, SD = 2.51), 27 men aged 20-30 years (M = 24.96, SD = 2.82), 28 women aged 60-70 years (M = 64.32, SD = 3.19), and 33 men aged 60-70 years (M = 64.91, SD = 3.52).

2.2 Measurements

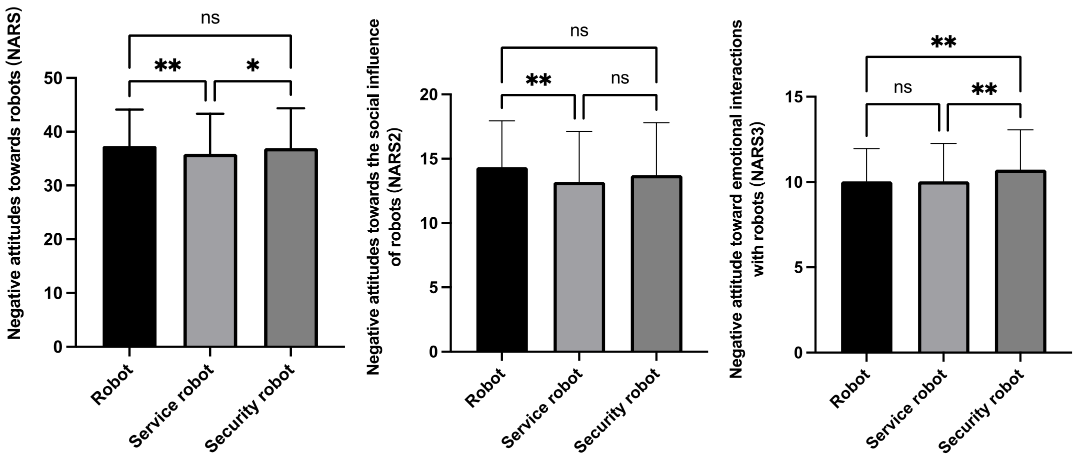
The NARS questionnaire was selected as the primary measurement instrument (Nomura et al., 2006). In this study, service and security robots were selected as the control robot occupations. We made changes based on the NARS to adapt the new questionnaire to the two occupations of service and security robots. The original English version of the NARS (α = 0.803) was revised by three experts, back-translated and proofread by two experts who have proficiency in both English and Japanese. Ultimately, two completed scales were produced: the NARS service robots scale (α = 0.847) and the NARS security robots scale (α = 0.889). We used a web-based questionnaire platform for subject recruitment and collection. Each subject completed the NARS questionnaire separately for the robot, service robot, and security robot. No robot image was shown on the questionnaires, and only the types of robots are different on three NARS scales.

3 RESULTS

Reliability tests were conducted for NARS1 (negative attitudes towards interactions with robots), NARS2 (negative attitudes towards the social influence of robots), and NARS3 (negative attitudes towards emotional interactions with robots) of the three NARS questionnaires, all of which measuring a high degree of reliability ($\alpha > 0.7$). After conducting an RM one-way ANOVA (analysis of variance), we found that there was a significant difference among NARS-service robots, NARS, and NARS-security robots ($F(2, 226) = 6.466$, $p < 0.05$, $\eta^2 = 0.054$) (Figure-1(a)). Tukey's multiple comparison test revealed that the mean value of NARS-service robots was significantly lower than that for NARS ($p < 0.01$, 95% CI [0.4715, 2.493]) and NARS-security robots ($p < 0.05$, 95% CI [-2.116, -0.094]). However, we did not observe a significant difference in participants' negative attitudes towards robots and security robots.

As per the Friedman test, we did not find significant differences in NARS1 for the three different robot occupations. The Friedman test revealed that there was a significant difference between the NARS2 values of service robots (M = 13.21, SD = 3.91) and the NARS2 value of robots (M =

14.34, *SD* = 1.9; $F(2, 226) = 9.40$, $p < 0.01$, $\eta^2 = 0.077$) (Figure-1(b)). Dunn's multiple comparisons test showed that the NARS2 score of the service robots was significantly lower than the NARS2 of the robots ($p = 0.0025$). The Friedman test showed a significant difference between the NARS3 scores of the security robots (*M* = 10.72, *SD* = 2.32), robots (*M* = 10.04, *SD* = 1.90), and service robots (*M* = 10.04, *SD* = 2.21; $F(2, 226) = 10.35$, $p < 0.01$, $\eta^2 = 0.084$) (Figure-1(c)). Dunn's multiple comparisons test showed that the NARS3 of security robots was significantly higher than that for robots ($p < 0.01$) and service robots ($p < 0.01$). According to the results of the two-way ANOVA, no interaction effect was found among robot occupation, subject's gender, and subject's age.



(a) (b) (c)

Figure 1. Negative attitudes towards robots, service robots, and security robots. *p<0.05, **p<0.01.

4 DISCUSSION

Some researchers have suggested that the gender and personality of social robots interact with their corresponding role stereotypes in influencing users' perceptions of social robots (Tay et al., 2014). The robot occupations in our study had highly differentiated occupational characteristics and task categories. The occupational attributes of robots and people's occupational stereotypes may also influence the NARS results. The effects of gender stereotypes and negative attitudes towards robots on gender appearance preferences were discussed (Nomura & Suzuki, 2022). This study's groundbreaking finding that negative attitudes towards robots change with robot occupations has important value for research related to robot occupations. Researchers may not be able to use the original NARS to address robotics research in various types of occupations and usage scenarios. Some researchers have also found that personality dimensions affect how individuals perceive the robots with which they interact (Kaplan et al., 2019). This implies that the subjects' personalities may also influence the results of the NARS, especially NARS1 and NARS3. Therefore, repeated measures and screening of subjects should be considered in NARS-related studies.

Compared to security personnel, service workers have stronger emotional interaction attributes in their occupational stereotypes and assume that they consider service robots to be consistent with the occupational stereotypes of service workers in human society; it is easy to understand that service robots have significantly lower NARS3 than security robots (Koenig & Eagly, 2014). The highly negative attitude towards emotional interaction with security robots, along with the lowest negative impression of service robots, may be related to the bias against the occupation itself (Tay et al., 2014). This study attempted to examine robot occupation, subject age, and gender using the NARS instrument; however, no interaction was found. This may be due to the insufficient number of valid subjects, or may be indicative that no interaction exists, and that no definite conclusion can yet be reached. The present study did not find significant results related to NARS1, demonstrating the need to expand the subjects and introduce more diverse robot occupations as a research goal. In studies related to NARS, researchers have suggested that both identity threats and realistic threats significantly increase negative attitudes towards robots (Huang et al., 2021). Robot occupation as an important element of identity was purposefully explored in this study, and we will conduct more in-depth research in the future regarding the link between perceived threats and robot occupation.

5 CONCLUSION

This study has found that people's negative impressions of robots change with the robot occupation. Users' negative impressions of service robots are significantly lower than those of robots and security robots. This study reveals, for the first time, that negative attitudes towards robots vary with the robot’s occupation. This study provides important guidance for future research and the design of robots for diverse occupations.

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