How Early Task Success Affects Attitudes Toward Social Robots

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ABSTRACT

While social robots are designed to engage in socially interactive tasks, they may not always establish the intended social connection. We examined how people's experiences of succeeding in completing these interactive tasks influence attitudes toward social robots. People developed more positive attitudes toward social robots when they completed more tasks successfully. These findings highlight potential constraints of complex interactive tasks increasingly implemented in commercially available social robots. A trade-off may exist between early task success and the sustained training of complex social robots by their human social partners.

CCS CONCEPTS

• Human-centered computing~Interaction design~Empirical studies in interaction design

KEYWORDS

Social Robots; Human-Robot Interaction; Attitudes; Task Success

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1 Introduction

Along with the increasing number of commercially available social robots, there is rising anticipation of benefits that social robots may bring into domains, such as health care, education, home, defense and workplaces [1]. Despite this optimistic prospect, however, both short-term and long-term use of social robots in real-world settings remains to be improved [2]. For example, some robots, such as Sony's new Aibo, may need to first collect data about social settings and people around them to fully deploy their social abilities. This baseline data may require significant upfront social investment on the part of the human partner [3]. The current project, therefore, sought to examine what aspects of the early interactions with social robots may encourage people to develop positive attitudes toward the robots. If people could establish positive attitudes toward the robots during these early interactions, they would be more likely to use the robots in the future for extended periods of time and possibly establish a bond with them [4]. We investigated, therefore, when people interact with social robots for the first time, how much their attitudes toward the robots are influenced by their success in completing interactive tasks with the robots. We predicted that more people succeeded in accomplishing the interactive tasks, the more likely they would develop positive attitudes toward the robots.

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2 Methods

Thirty-nine participants (14 female, 25 male, *M* Age = 21.59, *SD* Age = 1.77) were recruited from the U.S. Air Force Academy. Participants first saw either Anki Cozmo (n = 19) or Sony Aibo (n = 20, ERS-1000) and evaluated their respective robots. We administered the Robotic Social Attributes Scale (RoSAS) to measure participants' perception of the robots' warmth, competence, and discomfort [5]. We also measured participants' sense of partnership with the robots by asking, "Did you feel that the robot became your partner/team member/collaborator?" on a 9-point rating scale (1: describes it very poorly, 5: describes it moderately, 9: describes it very well).

After completing the pre-interaction questionnaires, participants engaged in a list of interactive tasks with the robots (e.g., tasks for Cozmo: fist bump, sing, play quick tap; for Aibo: lie down, avoid obstacles, sleep). To match the experiment length of the two robot conditions, we prepared 8 different tasks for the Cozmo condition and 7 different tasks for the Aibo condition. After attempting each task, participants reported whether they succeeded or failed in completing the task and noted their experiences. Lastly, they filled out the same questionnaires administered prior to interacting with the robot.

3 Results

To examine whether the task success rate differed between the two robot conditions, we conducted a mixed-effects logistic regression analysis with robot as a fixed effect and participant variability as a random effect. A significant effect of robot on the task success rate was found, β = -1.67, z = -2.91 p = .004. Overall, participants who interacted with Cozmo (M = 0.88, SD = 0.33) were more successful in completing the tasks than those who interacted with Aibo (M = 0.69, SD = 0.46).

Next, we performed a series of analyses to examine how this difference in task success rate affected participants' attitudes

toward the robots. First, we examined whether participants' tendency to treat the robots as more like animate beings than inanimate objects varied between the two robot conditions. We compared the participants' use of pronouns for inanimate objects (i.e., it/its) and for animate beings (i.e., he/she/him/her/his/hers) in their notes. Participants' use of the two types of pronouns was significantly different between Cozmo and Aibo, $\chi^2(1) = 33.33$, $p < .001$. Of the pronouns that participants used in the Cozmo condition, 42% were "it/its" and 58% were gendered pronouns. By contrast, in the Aibo condition 72% were "it/its" while only 28% were gendered pronouns. Thus, the tendency to treat robots as inanimate objects was more pronounced for Aibo than Cozmo.

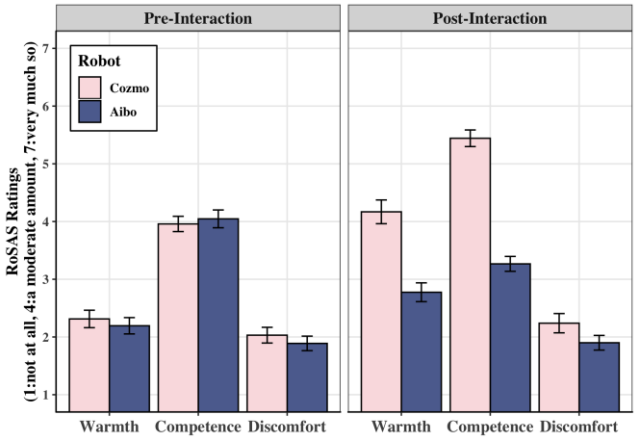

Figure 1: Pre- and post-interaction RoSAS ratings of Cozmo and Aibo.

To test if higher task success rates in the Cozmo condition led participants to form more positive attitudes toward Cozmo than Aibo, we analyzed participants' responses in pre- and post-interaction questionnaires. Five of the 39 participants' pre-interaction questionnaire data were lost. Thus, we conducted one-way multivariate analysis of variances (MANOVA) on the remaining 34 participants' RoSAS ratings. In this pre-interaction questionnaire data set, we found no effect of robot. However, analyses of the post-interaction RoSAS data revealed significant effects of robot, Pillai's Trace = .59, $F(3, 35) = 16.85$, $p < .001$ (Figure 1). Participants rated Cozmo more highly than Aibo on the dimensions of warmth and competence but not the dimension of discomfort (Table 1). These findings demonstrate that before interacting with the robots, participants' attitudes toward Cozmo and Aibo did not differ. But after having positive experiences of successfully completing the tasks with Cozmo, they developed more positive attitudes toward Cozmo than they did toward Aibo.

We also analyzed participants' sense of partnership with the robots. Before they interacted with the robots, there was no statistically significant difference between the two conditions. However, after they interacted with the robots, participants judged Cozmo ($M = 5.28$, $SD = 2.82$) as more like their partners than Aibo ($M = 3.05$, $SD = 2.08$), $t(36) = 2.78$, $p = .009$.

Finally, we explored whether, regardless of the robot type, task success rates were correlated with positive attitudes toward the robots. We found that the higher the task success rate was, the more likely participants were to rate the robots as warm ($r = .33$, $p = .04$) and competent ($r = .29$, $p = .07$).

Table 1. MANOVA results of pre- and post-interaction RoSAS.

		Pre-Interaction			
		M	***SD***	***F***	***p***
Warmth	Cozmo	2.31	1.48	0.12	0.73
	Aibo	2.19	1.47		
Competence	Cozmo	3.96	1.30	0.05	0.83
	Aibo	4.05	1.60		
Discomfort	Cozmo	2.03	1.33	0.22	0.64
	Aibo	1.89	1.31		
		Post-Interaction			
		M	***SD***	***F***	***p***
Warmth	Cozmo	4.17	2.19	7.2	0.01
	Aibo	2.78	1.78		
Competence	Cozmo	5.44	1.53	47.88	< .001
	Aibo	3.27	1.41		
Discomfort	Cozmo	2.24	1.77	0.91	0.35
	Aibo	1.90	1.39		

4 Discussion

In the current project, we found that experiences of successfully interacting with social robots reinforce people to form positive attitudes toward the robots in the early phase of interactions. These findings are consistent with the previous research where ease of use was identified as one of the predictors for short-term use of social robots [2]. Previously, it was also found that malfunctioning robots are perceived as untrustworthy and unreliable, all of which may interfere with the usability of robots [6].

With technological advances, social robots that can carry out complex interactive tasks are increasingly available on the market. This implies that people may need to invest substantial time and effort to train the robots before accomplishing these tasks. However, our findings suggest that this requirement may backfire in promoting further use of social robots. Admittedly, it is possible that once people pass the early investment phase of training the robots, social robots capable of engaging in complex interactive tasks, such as Aibo, may further encourage long-term use. In designing social robots, therefore, it would be important to consider the potential trade-offs between early task success and the sustained training of complex social robots by their human social partners.

In the future, we plan to address a few limitations of the present research. First, as we used two different robots in this project, our findings could have been confounded by the type of robots and the type of tasks assigned to each robot condition. Second, we did not examine alternative factors that might have contributed to people's judgments of the robots. For example, regardless of task success, participants might have more positively rated the robots when they felt the robots were interactive. To address these issues, we plan to use an identical robot and manipulate the task success rate across different experimental conditions in future work.

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