Perceived Social Norm, Robot use Self-Efficacy and Attitudes Towards Robots

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1. Introduction

The emergence of new-generation robots is transforming postindustrial societies. Different human characteristics predicting successful implementation of novel technologies have been a topic of interest for decades, to which robots make no exception. Examining psychological human factors associated with robot attitudes is of high relevance as people are becoming more familiar with robot technologies. Yet less attention has given to the relationships between psychological factors related to robot attitudes.

Attitudes, relatively persistent positive, negative or neutral estimates of the target (e.g. Haddock & Maio 2015) are formed, as suggested by attitude multicomponent theory, through three main components; cognitive, affective and behavioral information (Rosenberg & Hovland, 1960; Breckler, 1984). Previous technology acceptance models, such as TAM, UTAUT and ALMERE, have identified human attitude as an important antecedent to behavioral intention or actual use of novel technologies, such as robots (e.g. Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003; Heerink, Kröse, Evers, & Wielinga, 2010).

Social influence, drawing upon social information processing theory, suggests that information conveyed by the individual's own social network influences the way he or she views the target technology (Schmitz & Fulk, 1991; Salancik & Pfeffer, 1978). In the context of technology, social norms have been adapted and further studied extending the original TAM to include social influence (Dickinger, Arami, & Meyer, 2008; Im, Hong, & Kang 2011). As people tend to incorporate the opinions of salient others, it's also likely that robot attitudes are partly adopted from one's social circles.

Self-efficacy beliefs – one's perceptions of one's own capabilities to overcome courses of action – introduced by Bandura (1977, 1986, 1997), can be created and strengthened through four main sources of influence: mastery experiences, social modeling, social persuasion, and one's own physiological and emotional states. Robot use self-efficacy beliefs have been recently studied within care work settings showing a significant positive association with different aspects of technology acceptance (e.g. Turja, Rantanen, Oksanen 2017; Latikka, Turja, & Oksanen

2019), but studies considering robot use self-efficacy beliefs and robots more generally are still scarce.

This social psychological study surveys how perceived social norm and robot use self-efficacy are associated with attitudes toward robots. Furthermore, the mediating effect of robot use self-efficacy on the link between perceived social norm and attitudes toward robots is under review. The research questions are as follows:

1) Does perceived social norm have a direct positive association with attitudes toward robots?
2) Does robot use self-efficacy beliefs have a direct positive association with attitudes toward robots?
3) Does robot use self-efficacy positively mediate the link between perceived social norm and attitudes toward robots?
4) Does perceived social norm, robot use self-efficacy, and attitudes toward robots differ among people with and without prior robot use experience?

2. Method

To answers these questions, an online survey sample was collected in April 2019 ($N = 969$) among U.S. respondents. Amazon Mechanical Turk's pool of respondents was used for recruiting research participants. The data was evenly distributed in terms of gender (48.09% male, 50.36% female), and mean age was 37.15 years (SD_{age} = 11.35 years). One-third of the respondents (33.23%) reported having prior experiences of robots, whilst still most (66.77%) were new or unsure if they had previous experiences of using robots. Respondents filled their socio-demographic details after which we asked them about their prior robot use experience, perceived robot use self-efficacy, perceived social norm and attitudes toward robots. For analysis, three composite variables were created showing good reliability; robot use self-efficacy ($\alpha = .87$), perceived social norm ($\alpha = .93$), and attitudes toward robots ($\alpha = .93$).

On top of analyzing descriptive statistics, we ran two linear regression equations; for respondents with ($n = 322$) and without ($n = 647$) prior robot use experience. Two separate regression models, reported with robust Huber-White standard errors, were also addressed to gain insight into the role of previous user experiences. Comparisons of means between the respondents with and without prior robot use experience were run for robot attitudes, social norm and robot use self-efficacy using Welch t-tests for unequal variances. Finally, we analyzed whether the association between perceived social norm and robot attitudes is indirect through robot use self-efficacy. Mediation analysis was conducted with sgmediation command with a 10000-replication bootstrap.

3. Results and discussion

Our results showed that all respondents with prior experiences of robot usage reported more positive robot attitudes, higher robot use self-efficacy beliefs and higher perceived social norm than ones without prior experiences of robot usage. Among respondents with previous robot use experience, the strongest significant positive predictor of positive robot attitudes was perceived social norm, while robot use self-efficacy was moderately associated. Among respondents without previous robot use experience, perceived social norm again indicated a strong positive

association, but now also robot use self-efficacy was strongly positively associated. Besides, general interest in technology and its development was positively associated with attitudes toward robots in both models. As illustrated in figure 1, mediation analysis showed that robot use self-efficacy had a significant effect on the link between perceived social norm and attitudes toward robots, and the bootstrapped indirect effect was .14 (95% CI = .101 – .175).

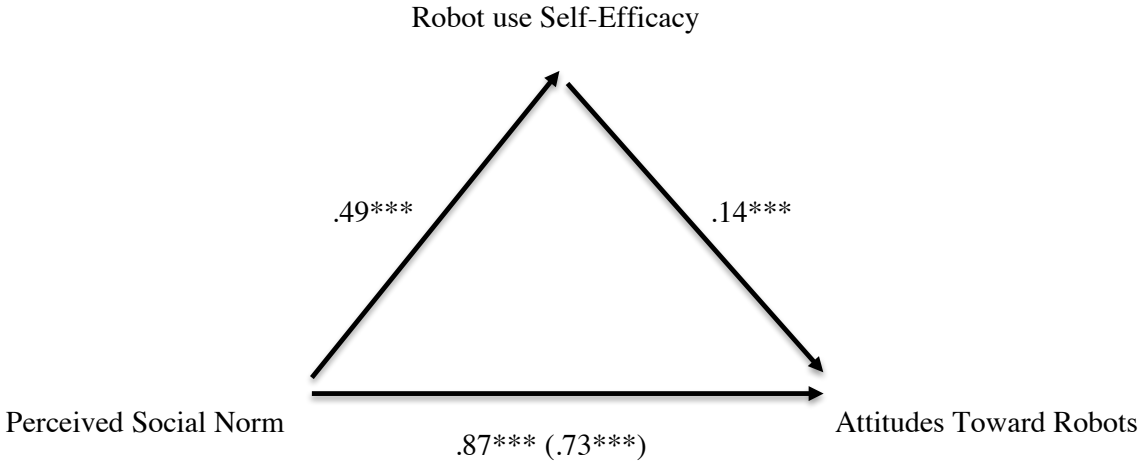

Figure 1. Unstandardized regression coefficients for the relationship between perceived social norm and attitudes toward robots as mediated by robot use self-efficacy among all study participants (N = 969). The unstandardized regression coefficients between perceived social norm and attitudes toward robots controlling for robot use self-efficacy is in parentheses. *** $p < .001$

In addition to prior user experience, our results underline the importance of social psychological factors related to the formation of attitudes toward robots. First, people seem to give high value to how their own social circles and salient others perceive novel technology such as robots. Second, robot attitudes also appear to be influenced by one's judgements of one's own capabilities to use such technology, in other words, robot use self-efficacy beliefs. Finally, mediation analysis provided some evidence for the possible interrelation between perceived social norm and robot use self-efficacy beliefs. Results indicate the importance of social psychological aspects of robot use and their usefulness for professionals implementing new robot technologies.

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