Effects of Shopping Robot Warmth on Interaction Comfort and Use Intention

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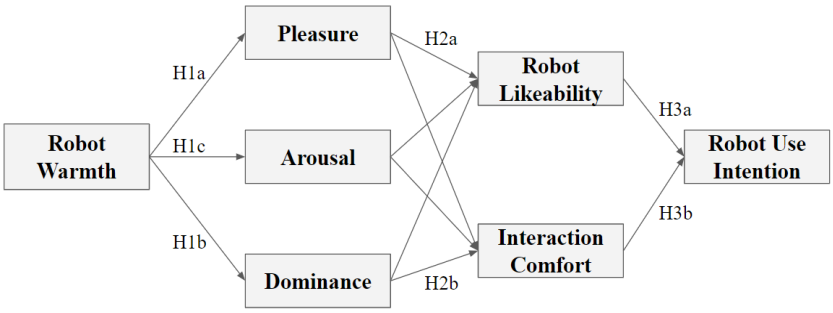
Keywords: shopping robot, warmth, PAD model, consumer-robot interaction

Introduction. A shopping robot is a humanoid service robot infused with artificial intelligence (AI) that resembles human morphology and intelligence to autonomously support consumer shopping services, such as finding products and information in real-time, providing personalized recommendations, and completing purchase transactions (Song & Kim, 2022). Retailers (e.g., Lowes, Currys) have recently begun introducing shopping robots into their stores, but it is unclear whether consumers are willing to use them due to the discomfort and uncertainty of interacting with them. Academic research on shopping robots is in its infancy with a small number of studies investigating consumers' adoption or usage intention of shopping robots (e.g., Song & Kim, 2022). This study explores a step further into questions of robot-consumer interaction quality derived from the perception of robots. Of particular interest is how robots can improve interaction quality through simple design considerations such as warmth. Drawing upon social cognition literature and the PAD model, this study aims to discover the psychological mechanism of the warmth effect on consumers' emotions and interaction responses.
Theoretical Background and Hypothesis Development. Warmth is one of the fundamental factors that determine how humans perceive others in social interactions, and is associated with positive perceptions such as good nature, trustworthiness, and friendliness (Fiske et al., 2007). Because consumers are likely to treat shopping robots that resemble humans as a social interaction partner, people may similarly perceive shopping robots as having socially good intentions when they are warm (vs. cold). These social perceptions of shopping robots are likely to affect consumers' emotional state, which can be identified through the PAD model consisting of three basic emotional states: pleasure, arousal, and dominance (Mehrabian & Russell, 1974). It is reasonable to postulate that, because warm robots are perceived as socially positive, consumers would experience heightened levels of (H1a) pleasure and (H1b) dominance (because they would feel in control). The engaging interactions with shopping robots are likely to induce excitement (i.e., arousal) (H1c). Given that consumers' positive feelings affect relationship quality with the service provider (Lee et al., 2011), the pleasure, arousal, and dominance will positively influence interaction responses, such as (H2a) robot likeability (i.e., the ease with which one can like a social target when interacting with and building relationships (Sandoval et al., 2021)) and (H2b) interaction comfort (i.e., a feeling of relaxation arising from interactions with a social target (Lloyd & Luk, 2011)). Likeability and interaction comfort are also important emotional determinants of technology adoption (Becker et al., 2023; Davis et al., 1992). Thus, it is hypothesized that (H3a) robot likeability and (H3b) interaction comfort positively influence robot usage intention. The theoretical model is presented in Figure 1.

Figure 1. Theoretical Model



Methods and Results. A single factor, two-level online experiment was conducted. For the stimuli, two versions of a short video clip containing a conversation between a shopping robot and a shopper were created. The videos were identical except for the images and the communications style of the robots. To manipulate the warmth, robot stimuli were manipulated to differ in three aspects: appearance (i.e., colors and materials) (Fenko et al., 2010), facial expression (Aronoff et al., 1992), and communication style (Jeong et al., 2019). 173 U.S. female adults were randomly assigned to either the warm (N_{warm} = 86) or cold (N_{cold} = 87) robot condition. Participants first read the definition of the shopping robots and watched the shopping video clip. They then answered a survey questionnaire containing items measuring emotions, interaction responses, and continuance use intention (all measured on a 7-point scale). Collected data were analyzed using SPSS 22.0 and PROCESS macro (Hayes, 2013). Results showed that participants perceived a warm robot (M_{warm} = 5.62) more warmly than a cold robot (M_{cold} = 3.58, p < .001), confirming the successful manipulation. ANOVA results showed that the warmth increased pleasure (M_{warm} = 4.71, M_{cold} = 3.83, p < .001) and dominance (M_{warm} = 3.95, M_{cold} = 3.31, p < .001), supporting H1a and H1b, but not arousal (p = .607), rejecting H1c. Next, mediation analyses (PROCESS model 80) (Hayes, 2013) revealed that pleasure was the only emotion dimension that serially mediated the warmth effect on usage intention. There was a significant serial mediation effect of pleasure and robot likeability (β = -.17, 95% *CI* = -.3569, -.1054) and pleasure and interaction comfort (β = -.29, 95% *CI* = -.5535, -.1056) on robot use intention. The serial mediation was not significant through dominance (robot likeability: β = -.00, 95% *CI* = -.0048, 0062; interaction comfort : β = -.02, 95% *CI* = -.0664, 0082). Thus, H2a and H2b were partially supported and H3 were supported.

Discussion and Implications. Amid the growing adoption of service robots in the retail sector, this study investigated how the social perception of a shopping robot affects consumers' emotional and interaction responses based on social cognition literature and the PAD model. The results showed that interaction with a warm (vs. cold) shopping robot gave consumers greater pleasure, which led to a liking and comfort for interaction with the robot, ultimately increasing continued use intention. Interestingly, arousal was not predicted by the warmth manipulation. This result may suggest consumers do not find shopping robots particularly exciting and engaging as some other social interactions such as interactions between friends that excite them (Niemelä et al., 2019). Dominance was enhanced by the warmth of the shopping robot, but did not lead to interaction responses. This might be because dominance involves a cognitive interpretation and thus is more potent in utilitarian rather than emotionally driven tasks such as

building relationships (Nasco et al., 2008). Overall, this study presents initial evidence that warmth is an important design factor in shopping robot development and calls for additional studies to validate the current findings and further our understanding of the topic.

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