**Making Robots Relatable: The Role of Self-Efficacy in AI Adoption**


## Abstract

This study investigates how anthropomorphic perceptions of AI service robots influence consumer adoption, emphasizing the mediating role of technology attachment and the moderating role of robot use self-efficacy. Data were collected from 380 U.S. participants via an online survey panel. Participants evaluated anthropomorphism, robot use self-efficacy, technology attachment, likelihood of AI usage, and decisions about AI adoption. Using a moderated mediation model, the findings reveal that anthropomorphism increases the likelihood of AI usage and AI adoption both directly and indirectly through technology attachment. The indirect effect depends on self-efficacy—when consumers report higher robot use self-efficacy, anthropomorphism strongly predicts technology attachment, which enhances AI usage likelihood and AI adoption; at low self-efficacy, this relationship weakens. These results extend Computers Are Social Actors (CASA) paradigm and self-efficacy theory by illustrating the psychological mechanisms underlying consumer responses to AI in services. Practically, anthropomorphic AI design should be paired with efforts to enhance user self-efficacy, such as tutorials, guided trials, and support. Overall, this research integrates anthropomorphism, attachment, and self-efficacy into a unified framework explaining consumer adoption of AI service robots, contributing both theoretical depth and actionable managerial insights.



*Keywords: Anthropomorphism; Technology Attachment; Robot Use Self-Efficacy; AI Service Robots; Consumer Adoption; Computers Are Social Actors (CASA); Human–Robot Interaction; Moderated Mediation Model*

## Introduction

AI service robots are becoming increasingly common in hospitality, retail, and healthcare, where they perform tasks once carried out by frontline employees. For example, Hilton Hotels introduced *Connie*, an AI-powered concierge robot, to greet guests and provide local recommendations, blending novelty with service efficiency (Sahota, 2024). In retail settings, SoftBank's humanoid robot *Pepper* is used in stores (e.g., by Pizza Hut in Singapore) to greet customers, answer questions, and assist with basic service interactions (Worstall, 2016). While such deployments illustrate the promise of AI-enabled services, their success ultimately depends on whether consumers are willing to engage with robots as part of their service encounters. Understanding the psychological drivers of this adoption is therefore critical for both market researchers and managers, as consumer perceptions directly shape return on investment.

A central factor in adoption is anthropomorphism—the attribution of humanlike qualities to nonhuman entities (Epley, Waytz, & Cacioppo, 2007). Anthropomorphism is already evident in widely used technologies such as Amazon's Alexa and Apple's Siri, which employ conversational cues and humanlike voices that encourage users to treat them as social partners rather than mechanical tools (Coughlin, 2018). When applied to AI service robots, anthropomorphic design cues can increase approachability and trust, thereby reducing consumer hesitation to adopt these technologies.

The Computers Are Social Actors (CASA) paradigm provides the theoretical foundation for this process. CASA argues that when computers and robots display social cues, people naturally apply human–human interaction rules to them, often responding as though they were social agents (Reeves & Nass, 1996; Xu et al., 2022). This perspective suggests that anthropomorphism can be a powerful driver of consumer adoption in service contexts.

However, anthropomorphism alone may not be sufficient (Złotowski, J et al., 2015). Research in human resources and services marketing shows that anthropomorphic cues can increase approachability, trust, and compliance with robot recommendations, but effects are context-dependent (Reeves & Nass, 1996; Epley, Waytz & Cacioppo, 2007; Wirtz et al., 2018). Consumers must also form a sense of *technology attachment*, the emotional bond that occurs when technologies become integrated into one's self-concept (Schifferstein & Zwartkruis-Pelgrim, 2008). Beyond social responses, attachment to technologies and products—i.e., the extent to which they become part of the self—predicts stronger loyalty and continued use (Thomson, MacInnis, & Park, 2005; Schifferstein & Zwartkruis-Pelgrim, 2008). Importantly, these effects depend on *self-efficacy*—the belief in one's ability to interact successfully with robots (Bandura, 1977). Field and lab studies demonstrate that humanlike voices, gestures, and social presence cues promote social responses to robots and voice agents, yet these benefits can attenuate when tasks are high-stakes or when users feel uncertain about their own capabilities (de Graaf & Allouch, 2013; Longoni, Bonezzi, & Morewedge, 2019). A complementary stream highlights self-efficacy as a prerequisite for translating positive perceptions into usage. Technology-specific efficacy reliably predicts intention and behavior across IT adoption models (Compeau & Higgins, 1995; Venkatesh et al., 2003). In AI service encounters, higher interaction self-efficacy reduces anxiety and cognitive load, enabling users to benefit from anthropomorphic design (Gursoy et al., 2019). Conversely, when self-efficacy is low, anthropomorphic cues may be insufficient to produce attachment or usage and can even raise concerns about controllability.

Collectively, this work implies a process in which anthropomorphism fosters technology attachment, but the strength of that pathway—and the downstream effect on adoption—depends on users' robot-use self-efficacy, aligning with the moderated-mediation logic tested here. This

study develops and tests a moderated mediation model linking anthropomorphism, technology attachment, AI usage likelihood, and AI adoption, with robot use self-efficacy as a boundary condition. By integrating CASA, attachment theory, and self-efficacy theory, the research advances understanding of how and when anthropomorphic design fosters consumer adoption, while offering actionable insights for managers implementing AI in service contexts.

## Theoretical Background and Hypotheses

### Anthropomorphism and AI Usage

Consumers often apply humanlike traits to nonhuman entities, a process known as anthropomorphism (Epley et al., 2007; Blut et al., 2021). According to the Computers Are Social Actors (CASA) paradigm (Reeves & Nass, 1996; Gupta & Nagar, 2024), when technologies appear humanlike, consumers interact with them as social partners. In service contexts, anthropomorphism can increase approachability and reduce uncertainty, making consumers more willing to use AI robots (Velasco et al., 2021). This suggests a direct positive effect of anthropomorphism on usage likelihood. Formally stated:

*H1: Perceptions of anthropomorphism in AI service robots positively influence consumers' likelihood of AI usage and AI adoption.*

### Technology Attachment as a Mediator

Drawing on attachment theory (Bowlby, 1969), individuals form emotional bonds not only with people but also with possessions and technologies (Schifferstein & Zwartkruis-Pelgrim, 2008). In marketing context, attachment has been shown to predict stronger loyalty, repeated usage, and resistance to switching (Thomson, MacInnis, & Park, 2005). In the case of AI service robots, anthropomorphism may trigger technology attachment by encouraging

consumers to perceive robots as social partners rather than impersonal machines. Indeed, a meta-analysis by Velasco, Yang and Janakiraman (2021) demonstrates that anthropomorphic appeals in marketing are particularly effective when consumers face uncertainty, as they help humanize and personalize the technology. When consumers perceive AI robots as more humanlike, they are more likely to integrate these technologies into their identity, strengthening technology attachment. This attachment, in turn, fosters willingness to adopt and use AI service robots.

**The Moderating Role of Robot Use Self-Efficacy**

According to self-efficacy theory (Bandura, 1977), individuals' confidence in their ability to perform a task shapes their engagement and persistence. In technology adoption research, self-efficacy has consistently been identified as a key determinant of behavioral intention (Compeau & Higgins, 1995; Venkatesh et al., 2003). In the AI service context, robot use self-efficacy reflects consumers' confidence in their ability to successfully interact with robots. High self-efficacy enables anthropomorphic design cues to translate more effectively into attachment, since confident consumers can engage with the robot without anxiety or hesitation. Conversely, when self-efficacy is low, even highly anthropomorphic robots may fail to elicit attachment, as consumers doubt their ability to navigate the interaction. Thus, we argue that self-efficacy moderates the indirect pathway from anthropomorphism to usage through attachment.

*H2: The positive effect of anthropomorphism on AI usage and AI adoption decision operates indirectly through technology attachment, and this indirect effect is moderated by robot use self-efficacy, such that the mediating role of technology attachment is stronger among individuals with higher robot use self-efficacy.*

**Methodology**

Three hundred and eighty U.S.-based participants (mean age = 56.14, 52% female) were recruited via the marketing research agency Centiment to complete an online study on the Qualtrics survey platform. First, participants rated their perceptions of the humanness (anthropomorphism) of AI social service robots using a series of 5-point semantic differential items (e.g., "I personally feel AI social service robots are: machinelike/humanlike, fake/natural; $\alpha = .90$; see Web Appendix for all study measures). Participants also evaluated their self-efficacy in interacting with AI social service robots with four items on 5-point Likert scales (e.g., "I know how to interact with the AI robot in services," "I could interact with the AI robot if someone showed me how to do it first"; 1 = strongly disagree, 5 = strongly agree; $\alpha = .88$). Next, participants' sense of technology attachment was assessed using three items measured on 5-point Likert scales (e.g., "I feel that the AI robot technology is a part of me," "I identify strongly with the AI robot technology"; 1 = strongly disagree, 5 = strongly agree; $\underline{\alpha} = .95$). Higher scores reflect greater perceptions of anthropomorphism, robot self-efficacy, and technology attachment.

Next, participants completed the two focal dependent variables. First, participants reported their likelihood of using AI on a 7-point scale (1 = not at all likely, 7 = very likely). Second, participants made an AI adoption decision, a consequential binary choice, regarding whether they wanted to access a list of beginner-friendly AI tools and resources (1 = yes, 0 = no). Together, these measures capture both participants' stated intentions toward AI adoption and actual behavior. Finally, age and gender were indicated.

## Results

### Usage Likelihood

First, we conducted a moderated mediation analysis (PROCESS Model 7; 5,000 bootstraps; Hayes 2017) to examine whether technology attachment explains the relationship between anthropomorphic perceptions of AI and likelihood of AI use via technology attachment, and whether this indirect effect varies based on robot use self-efficacy. The index of moderated mediation was significant (effect = .15, 95% CI [.0932, .2149]).

Results indicated that the relationship between anthropomorphism and technology attachment depended significantly on robot use self-efficacy. Anthropomorphism alone did not significantly predict technology attachment ($b = –0.01$, $SE = 0.13$, $t = –0.08$, $p = .93$), nor did robot use self-efficacy ($b = –0.03$, $SE = 0.08$, $t = –0.31$, $p = .75$). However, the interaction between anthropomorphism and robot use self-efficacy was statistically significant ($b = 0.18$, $SE = 0.03$, $t = 5.28$, $p < .001$, 95% CI [0.1151, 0.2516]). Specifically, individuals with higher robot use self-efficacy (4.50) demonstrated a stronger positive relationship between anthropomorphism and technology attachment ($b = 0.81$, $SE = 0.05$, $p < .001$) compared to those with lower robot use self-efficacy ($b = 0.36$, $SE = 0.07$, $p < .001$). Both anthropomorphism and technology attachment ($b = 0.81$, $SE = 0.09$, $p < .001$) independently contributed to greater reported likelihood of using AI.

[Insert Figure 1 here]

**AI Adoption Decision**

Hayes' PROCESS Model 7 (5,000 bootstrapped samples; 2017) was used to test a moderated mediation model in which anthropomorphism influences AI adoption through technology attachment, with the indirect effect moderated by robot use self-efficacy. AI adoption was treated as a binary outcome (coded as 0 = yes, 1 = no), and all predictors were continuous. The index of moderated mediation was significant (effect = .12, 95% CI [.0667, .1981]). While neither anthropomorphism ($b = –0.01$, $SE = 0.13$, $t = –0.07$, $p = .94$) nor robot use self-efficacy ($b$

= –0.03, *SE* = 0.08, *t* = –0.31, *p* = .75) were significant predictors of technology attachment independently, the interaction between anthropomorphism and robot use self-efficacy was significant (*b* = 0.18, *SE* = 0.03, *t* = 5.31, *p* < .001, 95% CI [0.1154, 0.2510]), indicating that the relationship between anthropomorphism and technology attachment depends on levels of robot use self-efficacy. In turn, the effect of technology attachment on AI adoption was also significant (*b* = 0.66, SE = .13, *p* < .001, 95% CI [.4148, .9052]).

To further probe the anthropomorphism and robot use self-efficacy interaction, conditional effects were examined at two levels of self-efficacy. Results showed that the effect of anthropomorphism on technology attachment increased as robot use self-efficacy increased. Specifically, at a low level of robot use self-efficacy (2.00), anthropomorphism was a modest predictor of attachment (*b* = 0.3567, *SE* = 0.0719, *p* < .001). This effect was stronger at a high level of robot use self-efficacy (4.50; *b* = 0.8147, *SE* = 0.0513, *p* < .001).

[Insert Figure 2 here]

Taken together, these results suggest that anthropomorphism leads to stronger technology attachment, and consequently higher AI usage likelihood and AI adoption, particularly among those with high robot use self-efficacy. When robot use self-efficacy is low, the path from anthropomorphism to technology attachment is weakened, thus attenuating the indirect effect on AI usage likelihood and AI adoption.

**Theoretical Implications**

This study advances the literature on consumer–AI interactions in several ways. First, we extend the CASA paradigm by demonstrating that anthropomorphism alone does not guarantee adoption; instead, its effect on usage is explained through the psychological mechanism of technology attachment. Second, we integrate self-efficacy theory to show that

anthropomorphism's influence is conditional: consumers high in robot use self-efficacy are more likely to translate anthropomorphic perceptions into attachment and usage. Finally, we connect attachment theory to AI adoption, highlighting how emotional and identity-based bonds with technology provide an important pathway to acceptance. Together, these findings offer a more nuanced understanding of how and when anthropomorphic design cues affect consumer behavior.

**Practical/Managerial Implications**

For practitioners, the findings highlight clear strategies for improving consumer adoption of AI service robots. First, practitioners need to design for anthropomorphism with purpose. Humanlike cues such as natural movement, conversational tone, or expressive features can enhance perceptions of anthropomorphism, which in turn builds attachment. However, anthropomorphism is not effective in isolation. Secondly, practitioners should focus on building user self-efficacy. Companies should complement anthropomorphic design with initiatives that make consumers feel confident in interacting with robots. This can include onboarding tutorials, guided demonstrations, "try before you use" kiosks, or customer support channels specifically dedicated to AI interactions. Lastly, practitioners should position AI as part of consumers' identity. Marketing communications can emphasize personalization and integration ("your AI companion" rather than "a machine"), helping consumers view AI technologies as tools aligned with their self-concept. In combination, these approaches ensure that anthropomorphic design cues translate into meaningful technology attachment and eventual usage, thereby maximizing return on investment in AI-enabled services.

**Limitations and Future Research**

This research has several limitations that suggest avenues for future work. First, the study relied on a U.S.-based online sample, which may limit generalizability across cultures where perceptions of AI and technology attachment differ. Future research should examine cross-cultural samples. Second, the design was cross-sectional and relied on self-reported usage likelihood, which may not fully capture actual behavior. Field experiments and longitudinal studies would provide stronger causal evidence. Third, our study examined AI robots in general service contexts; future work could test whether these relationships differ by industry (e.g., healthcare vs. hospitality) or by type of AI interface (voice assistants, chatbots, humanoid robots).

## Conclusion

This study shows that consumer adoption of AI service robots is shaped not only by how humanlike the robots appear but also by consumers' sense of attachment to the technology and their self-efficacy in interacting with it. Anthropomorphism enhances AI usage likelihood and AI adoption, particularly when it strengthens technology attachment among consumers who feel confident in using robots. The findings contribute to theory by integrating CASA, attachment theory, and self-efficacy into a single framework, and they provide actionable insights for managers seeking to accelerate AI adoption. As AI service robots become more prevalent, organizations that design with both anthropomorphism and consumer confidence in mind will be best positioned to capture value from this technological transformation.

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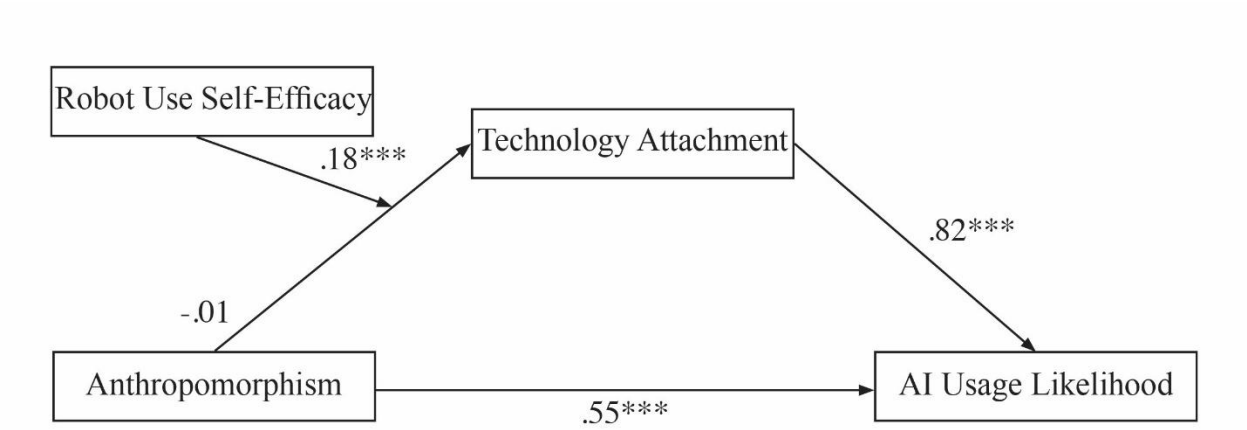
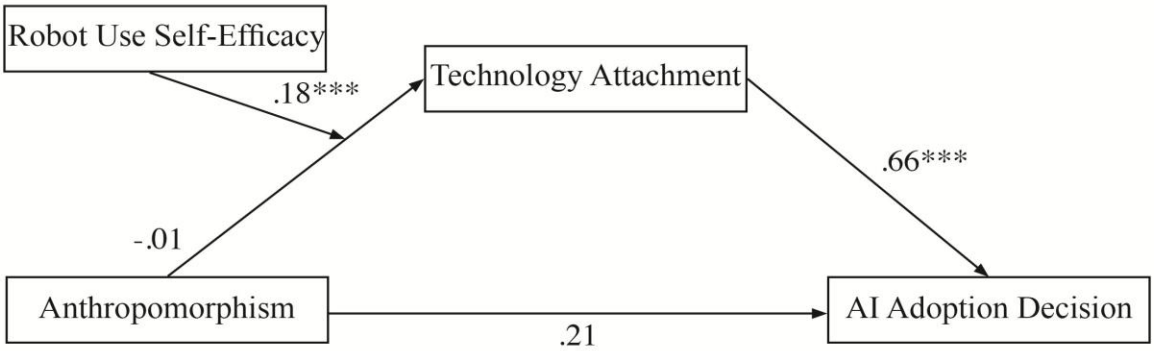
**Figure 1: Conceptual Framework with AI Usage Likelihood as Outcome**




*Note: All coefficients reported are unstandardized effects.*
* $p < .05$, ** $p < .01$, *** $p < .001$

**Figure 2: Conceptual Framework with AI Adoption Decision as Outcome**




*Note: All coefficients reported are unstandardized effects.*
* $p < .05$, ** $p < .01$, *** $p < .001$

# WEB APPENDIX

**Robot Use Self-Efficacy (α = .88)**
I know how to interact with the AI robot in services.
I could interact with the AI robot if someone showed me how to do it first.
I could interact with the AI robot if I could call someone for help if I got stuck.
I could interact with the AI robot if I had seen someone else using it before trying it myself.

**Anthropomorphism (α = .90)**
I personally feel AI social service robots are:
Machinelike/Humanlike
Fake/Natural
Unconscious/Conscious
Moving Rapidly/Moving Elegantly

**Technology Attachment (α = .95)**
For each statement below, please select the one option that best applies to you:
I feel that the AI robot technology is a part of me.
I identify strongly with the AI robot technology.
Using AI robot technology says a lot about who I am.