Master's Thesis of Business Administration

Robots That Fit
- The Impact of Service Robot on Anthropomorphism, Robot Type, and Consumer Preferences -

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Abstract

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This thesis examines how robot appearance (anthropomorphic vs. non-anthropomorphic) and service robot type (social vs. functional) influence perceptions of warmth, competence, and purchase intention.

The findings show that, while anthropomorphism has no direct impact on purchase intention, it does considerably increase perceived warmth, which mediates the association between appearance and buy intention. Furthermore, the interaction research found that anthropomorphized social robots were seen as the most friendly, whilst anthropomorphized functional robots were connected with the highest levels of competence.

These findings underscore the importance of anthropomorphism in robotic design. Future research could look into how varying amounts of anthropomorphism are preferred based on the sort of service robot. Exploring how differences in robot appearance influence human perception and acceptance could provide useful insights for optimizing robot design and improving user experience.

Keywords: anthropomorphism, types of robots, warmth, competence, purchase intention
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Chapter 1. Introduction

1.1. Study Background

Robots are becoming an increasingly important aspect of everyday life as technology advances, functioning as both social and functional companions. Automated assistance is revolutionizing entire industries, including customer service, healthcare, education, and domestic care. In addition to their practical capacities, robots are evolving into entities capable of actively interacting and communicating with people, introducing new dynamics into the human-robot connection. This evolution necessitates a greater understanding of how robot features and designs influence client attitudes and behavior.

One critical factor shaping these perceptions is anthropomorphism—the attribution of human-like characteristics to robots. Anthropomorphic robots often evoke emotional responses such as trust, warmth, and engagement, which enhance user acceptance and satisfaction (Epley et al., 2007; Li et al., 2010). Research suggests that these robots are perceived as more approachable and capable of fostering connections, making them particularly well-suited for social roles like caregiving and companionship (Abdi et al., 2022). In contrast, non-anthropomorphic

robots prioritize efficiency and reliability, often favored for functional roles where emotional connection is less important (Banks et al., 2008). These distinctions highlight the significance of anthropomorphism in shaping perceptions of competence and warmth, two key mediators that influence purchase intentions.

The type of service robot also moderates consumer responses. Social robots are designed to mimic human social behaviors and cues, fostering meaningful interactions and emotional engagement (Duffy, 2003). They excel in roles requiring empathy and communication. In contrast, functional robots focus on performing practical tasks with efficiency, often thriving in structured environments where productivity is the priority (Dawe et al., 2019; de Visser et al., 2016). Understanding the interaction between anthropomorphism and robot type is critical to predicting how users respond to these technologies.

Demographics, particularly age and personality traits such as loneliness, further shape human-robot interactions. Older adults may prefer anthropomorphic or social robots for their ability to enhance social engagement and alleviate loneliness (Broadbent et al., 2009; Scopelliti et al., 2005). Meanwhile, younger consumers, more accustomed to digital technologies, may respond more flexibly to both social and functional robots (Hinds et al., 2004). These demographic factors act as covariates, influencing the effectiveness

of anthropomorphic designs and their impact on consumer purchase intentions.

1.2. Purpose of Research

To further understand how these elements influence consumers' impressions of warmth, competence, and buy inclinations, this thesis investigates the links between robot appearance and type. This study seeks to discover major predictors of trust and acceptance in human-robot interactions by investigating the mediating roles of competence and warmth, as well as the moderating impacts of robot type. The findings are intended to help guide the development of service robots that cater to a wide range of user preferences and expectations, allowing for more successful, meaningful, and contextually appropriate interactions in both social and functional situations.

Chapter 2. Theoretical Backgrounds

2.1. Anthropomorphism in Service Robots

Anthropomorphism refers to the process by which individuals attribute human traits and characteristics to non-human entities, such as robots, cars, and machines (Aggarwal & McGill, 2007; Epley et al., 2007). When entities are anthropomorphized, users often apply human cognitive frameworks to evaluate and interact with them as if they were human (Aggarwal & McGill, 2007; Kim et al., 2016; May et al., 2017). For instance, service robots with human-like features—such as friendly facial expressions or naturalistic movements—are often perceived as more intelligent and reliable than those without such characteristics. This perception is particularly significant in domains like healthcare and hospitality, where a robot's empathetic engagement can enhance feelings of safety and trust (Bartneck et al., 2009; Breazeal, 2003).

Human-like service robots are especially skilled at navigating social interactions and effectively responding to user needs (Li et al., 2010). These attributes lead to increased user satisfaction and stronger rapport between users and robots. Such robots are perceived as sociable and capable of fostering user connections, reducing anxiety, and promoting psychological comfort (Blut et al.,

2021; Broadbent et al., 2013; May et al., 2017). Consequently, human-like robots are often viewed as more mindful and engaging compared to their machine-like counterparts.

In contrast, non-anthropomorphic robots are preferred in scenarios where functionality and efficiency take precedence. Research suggests that for tasks such as cleaning or industrial operations, users gravitate toward simpler, machine-like designs that clearly communicate their purpose (Hoffman & Ju, 2014). Non-anthropomorphic robots are often perceived as more reliable for specific functions because their lack of human-like traits reduces ambiguity regarding their primary purpose (Nomura et al., 2006).

For service interactions like deliveries, users typically favor straightforward designs that prioritize efficiency over human-like appearances (Lee & See, 2004). Furthermore, aesthetically pleasing, non-anthropomorphic robots with clear, task-oriented designs can improve user acceptance and satisfaction by emphasizing functionality over social interaction (Bartneck et al., 2009).

H1. Robots with an anthropomorphic appearance will lead to higher purchase intentions than non-anthropomorphic robots.

2.2. Warmth and Competence in Service Robots

Warmth, a fundamental dimension of social perception, plays a pivotal role in how individuals evaluate robots. Warmth reflects perceptions of friendliness and positive interaction intentions (Fiske et al., 2007). Research has demonstrated that warmth is also a critical underlying dimension in robot perception (Ho & MacDorman, 2010). In the context of social robots, warmth is conveyed through behaviors such as eye contact, nodding, responsive communication, signaling empathy, attentiveness, and interpersonal engagement (Broadbent et al., 2009). These behaviors foster perceptions of social connection, making robots appear more relatable and approachable, thus strengthening emotional bonds between users and robots (Čaić et al., 2018).

Beyond relational aspects, warmth perceptions contribute to broader service values in human-robot interactions. Empathic robots enhance emotional service value by creating enjoyable interactions and reducing feelings of impersonality (Morales, 2005; Nijssen et al., 2016). Furthermore, warmth can influence perceived value by signaling that a robot's social qualities allow it to meet user needs better (Bitner et al., 2000). Warm interactions enhance social value, as users feel appreciated and respected, boosting self-esteem and emotional satisfaction (Cuddy et al., 2007; Fiske et al., 2007).

The significance of warmth is particularly pronounced among older adults, who often prioritize emotional connection and social interaction when adopting social robots (de Graaf et al., 2019). Warm behaviors, such as showing care and attentiveness, have been shown to increase trust and engagement among older users. However, cultural norms and individual differences influence perceptions of warmth, highlighting the need for robot designs tailored to diverse user expectations (Gnambs & Appel, 2019).

Competence, on the other hand, refers to a robot's technical and cognitive ability to execute tasks effectively and efficiently—a quality highly valued in functional service roles (Banks et al., 2008). Robots perceived as competent instill trust, fostering confidence in their ability to fulfill assigned tasks. Robots that achieve a balance between high task competence and trust-enhancing design features are often more readily accepted by diverse user demographics (Kim et al., 2016).

Together, warmth and competence serve as the primary drivers of impression formation in both human and robot judgments (Carpinella et al., 2017). These factors influence user trust, satisfaction, and adoption intentions in practical scenarios. For instance, in healthcare, robots with high perceived competence are entrusted with caregiving responsibilities, while in hospitality, robots

displaying warmth and reliability achieve greater acceptance by creating comfortable environments for interaction (Kraus et al., 2024).

Therefore, fostering favorable customer perceptions requires including warmth and competence into robot design. Each component is unique: competence guarantees technical dependability and efficiency, while warmth cultivates emotional connection and trust. When combined, they affect customer satisfaction and the propensity to buy or use robots for a range of uses.

H2. The effect of an anthropomorphic appearance on purchase intention will be mediated by warmth.

H3. The effect of a non-anthropomorphic appearance on purchase intention will be mediated by competence.

2.3. Types of Service Robots

Service robots are generally categorized into two types: social and functional, each serving distinct roles in various service environments. Social robots are designed to engage in meaningful interactions, often used in contexts where empathy and communication are essential, such as healthcare companionship and personal assistance (Duffy, 2003). These robots are equipped with

human-like features, including eye contact, facial expressions, and speech, to create a more relatable experience for users. Social robots rely on emotional intelligence and responsiveness to support relational engagement, build rapport, and enhance the quality of user interactions (Broadbent et al., 2009).

In contrast, functional service robots are task-focused, emphasizing efficiency, accuracy, and productivity. They are commonly deployed in service settings such as healthcare, hospitality, and domestic environments (de Visser et al., 2016). Unlike industrial robots, which are designed primarily for manufacturing and often intended to replace human labor, functional service robots assist humans by performing specific tasks—such as cleaning, delivery, or food preparation—that improve service efficiency and lower operational costs (Čaić et al., 2019; Grewal et al., 2020). Functional service robots are designed primarily with practicality in mind, rather than for social interaction, and thus exhibit fewer anthropomorphic characteristics.

The difference between social and functional robots affects not just how they are designed but also how users view and accept them. While functional robots prioritize usefulness and task performance first, social robots are usually made to seem very much like humans. This classification is consistent with the concept Lu et al. (2020)

presented, which divides service robots into two categories: emotional-social and cognitive-analytical. Research suggests that for customers to accept automated service technologies like robots, they must perceive value in both functional performance and, where relevant, the ability to meet social-emotional needs (Fernandes & Oliveira, 2020).

H4. The effect of an anthropomorphic appearance on warmth will be stronger for social service robots than for functional service robots.

H5. The effect of a non-anthropomorphic appearance on competence will be stronger for functional service robots than for social service robots.

2.4. Age of Consumers

Age significantly influences consumer attitudes toward service robots. Research indicates that older adults often value anthropomorphic and social robots for the companionship they provide, which can help alleviate feelings of loneliness and foster a sense of connection (Scopelliti et al., 2005). In contrast, younger consumers tend to adapt more readily to a wider range of robot designs, including non-anthropomorphic ones, due to their greater familiarity with technology and digital devices (Hinds et al., 2004). As

such, age acts as a moderating factor that affects preferences for robot types and the degree of anthropomorphism in design.

Furthermore, studies have shown that younger individuals generally express more positive attitudes toward robots compared to older adults, who are often less willing to embrace robotic technology (Scopelliti et al., 2005). Scopelliti et al. (2005) also found that older adults tend to have lower trust in robots, which may stem from their limited experience and reduced recognition of the potential benefits that robots can offer. However, it is important to note that some studies exploring the relationship between age and comfort with robots have found few significant differences between younger and older adults (Kuo et al., 2009; Syrdal et al., 2007).

2.5. Personality Characteristics

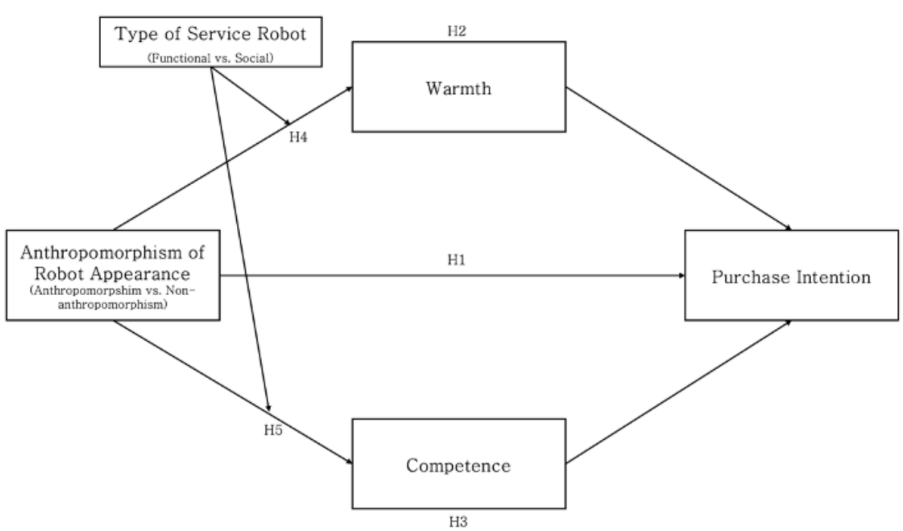
Personality traits significantly influence how individuals perceive and interact with robots in service contexts. Extroverted individuals are generally more welcoming to robots, often engaging with them more closely than their introverted counterparts (Park et al., 2012). Extroverts tend to be more tolerant of personal space invasions, which facilitates closer interactions with robots (Syrdal et al., 2007). In contrast, individuals high in conscientiousness are typically less inclined to allow robots to operate nearby, reflecting a

preference for maintaining personal boundaries (Syrdal et al., 2007). Additionally, Walters et al. (2005) discovered that people with proactive personalities are more willing to let robots approach them closer than those with less proactive features.

These findings emphasize the necessity of taking personality traits into account when studying human-robot interactions, as they have a significant impact on attitudes and behaviors toward robotic systems. Openness to experience and concern about technology can have a big impact on how people perceive and embrace service robots. Individuals that are open are more likely to respond positively to social and anthropomorphic robots, whereas those who are anxious about technology may choose simpler, functional designs (Bartneck et al., 2007).

Figure 1

Conceptual Model



Chapter 3. Study 1

3.1. Overview

The major goal of this research is to investigate the impact of robot appearance (anthropomorphic vs. non-anthropomorphic) on consumer purchase intention, with a particular emphasis on the mediating roles of warmth and competence, as well as the moderating effect of robot type. The study seeks to examine whether anthropomorphic robots lead to higher purchase intentions than non-anthropomorphic robots. It is proposed that warmth mediates the association between anthropomorphic appearance and buy intention, whereas competence mediates the relationship between non-anthropomorphic appearance and purchase intention.

This study also looks at how robot type (social vs. functional) influences these interactions. The study uses robot type as a moderator to evaluate if the influence of anthropomorphic and non-anthropomorphic appearances on warmth, competence, and purchase intention differs based on the robot's intended role.

3.2. Method

A total of 560 participants were initially recruited for the study through the online survey platform "Surveasy" and various

communities in South Korea. Twelve participants were excluded due to incomplete responses or failing the attention check, resulting in a final sample of 548 participants (207 women; Mage = 41.05, SD = 15.48). The study employed a 2 (Anthropomorphism of Robot Appearance: Anthropomorphic vs. Non-anthropomorphic) × 2 (Type of Service Robot: Social vs. Functional) between-subjects design.

3.2.1. Manipulation of Appearance and Robot Type

Participants viewed a picture of the robot, which either included or excluded human-like facial features depending on the assigned condition. The scenario for the social service robot emphasized its role as a companion by highlighting its ability to communicate with humans and provide emotional support. In contrast, the scenario for the functional robot focused on its ability to perform practical tasks, such as assisting with household chores or organizing daily activities. To further reinforce the manipulation of anthropomorphism, the study incorporated first-person language in the anthropomorphic condition, while using third-person language in the non-anthropomorphic condition.

To ensure the effectiveness of the anthropomorphism manipulation, participants were asked to evaluate the extent to which the robot seemed like a real person using a single item adapted from

Han et al. (2023): “Evaluate the extent to which the robot seemed like a real person” (1 = “Not at all” to 7 = “Very much”). This measure aimed to confirm that participants in the anthropomorphic condition perceived the robot as more human-like compared to those in the non-anthropomorphic condition.

Additionally, a manipulation check was conducted to verify participants’ perceptions of the type of service robot. Two items adapted from Grewal et al. (2020) were used: “The robot is responsible for functional tasks” and “The robot is responsible for interaction with you” (1 = “Not at all” to 7 = “Very much”). These items ensured that participants accurately distinguished between functional and social service robots based on the assigned scenario and description. By employing these manipulation checks, the study sought to validate the experimental conditions and ensure that participants’ perceptions aligned with the intended manipulations.

3.2.2. Evaluations

Participants evaluated their purchase intention using two items (e.g., “The probability that you would purchase the product is”), rated on a 7-point scale (1 = unlikely, improbable; 7 = likely, probable; α = .85; MacKenzie et al., 1986).

3.2.3. Warmth and Competence of the Robot

Participants then indicated the extent to which they believed the robot appeared warm and competent using six items for each factor (e.g., “How closely are the words below associated with the robot?”), rated on a 7-point scale (1 = definitely not, 7 = definitely associated; Carpinella et al., 2017). The items comprising the warmth factor were: feeling, happy, organic, compassionate, social, and emotional (α = .91). The items comprising the competence factor were: knowledgeable, interactive, responsive, capable, competent, and reliable (α = .92).

3.2.4. Age and Loneliness as Covariates

Age and loneliness were included as variables to assess their potential impact on consumer preferences for service robots. This feature allows for a more in-depth assessment of the impacts of robot type and anthropomorphism on perceptions of warmth, competence, and purchase intention, regardless of demographic or psychological characteristics. It also provides a more sophisticated picture of how loneliness and age groups influence requests for service robots. Even though age and loneliness are not key components of the hypotheses, including them allows a more robust

analysis by accounting for individual variances in these variables.

3.2.5. Manipulation Check

An independent samples t-test was conducted for the manipulation check. The results revealed a significant difference between the anthropomorphic and non-anthropomorphic conditions. Participants in the anthropomorphic condition (M = 4.12, SD = 1.89) rated the robot as more human-like compared to those in the non-andromorphic condition (M = 2.86, SD = 1.69). These results suggest that the anthropomorphism manipulation was effective, as participants in the anthropomorphic condition perceived the robot as significantly more human-like than those in the non-anthropomorphic condition.

The manipulation checks also assessed the impact of the type of service robot (social vs. functional) on participants' perceptions. The results indicated significant differences between the social and functional robot conditions. Participants rated the social robot (M = 5.10, SD = 1.53) as more sociable than the functional robot (M = 3.41, SD = 1.61). Conversely, participants in the functional robot condition rated the robot as more functional (M = 5.67, SD = 1.41) compared to those in the social robot condition (M = 3.53, SD = 1.59).

Table 1

Manipulation Check for Anthropomorphism (Independent Variable)

Variable	Group	N	Mean	SD	SE Mean
Anthropomorphism Manipulation	0 Non-anth.	328	4.12	1.890	0.104
	1 Anth.	328	4.12	1.890	0.104

Table 2

Manipulation Check for Robot Types (Moderator Variable)

Variable	Group	N	Mean	SD	SE Mean
Functional Robot	0 Functional	296	5.67	1.406	0.082
	1 Social	252	3.53	1.593	0.100
Social Robot	0 Functional	296	3.41	1.611	0.094
	1 Social	252	5.10	1.534	0.097

3.3. Results

3.3.1. Direct Effects of Anthropomorphism on Purchase Intention

To test the direct effect of anthropomorphism on purchase intention, an ANOVA was conducted. The analysis revealed a significant effect of anthropomorphism on purchase intention. Specifically, participants exposed to anthropomorphic robots reported a higher purchase intention (M = 4.370, SE = 0.093)

compared to those exposed to non-anthropomorphic robots, who reported a lower purchase intention (M = 4.018, SE = 0.114). These results indicate that anthropomorphism significantly influences participants' purchase intention.

Table 3

Estimated Marginal Means for Purchase Intention by Anthropomorphism

Direct Effects of Anthropomorphism on Purchase Intention

Dependent Variable: Purchase Intention				
			95% Confidence Interval	
IV	**Mean**	**Std. Error**	**Lower Bound**	**Upper Bound**
0 (Non-anth.)	4.018	.114	3.794	4.242
1 (Anth.)	4.370	.093	4.187	4.554

3.3.2 Mediating Role of Warmth and Competence

The analysis examined the mediating roles of warmth and competence in the relationship between anthropomorphism and purchase intention using Hayes (2017) Process Model 4. The results revealed that anthropomorphism had a significant positive effect on warmth (β = 0.3967, p = .0016), indicating that robots with higher anthropomorphic features are perceived as warmer. Additionally, warmth significantly influenced purchase intention (β = 0.3128, p < .001), suggesting that greater warmth increases the likelihood of

consumers engaging with the robot. The indirect effect of anthropomorphism on purchase intention through warmth was significant (Effect = 0.1241, BootSE = 0.0428, 95% BootCI [0.0474, 0.2133]), indicating that warmth partially mediates the relationship between anthropomorphism and purchase intention. In other words, the effect of anthropomorphism on purchase intention is, in part, driven by the perceived warmth of the robot.

In contrast, the relationship between anthropomorphism and competence was not significant ($\beta = 0.1321$, $p = .2583$), suggesting that anthropomorphism did not directly affect perceptions of competence. However, competence still significantly influenced purchase intention ($\beta = 0.2725$, $p < .001$). Despite this, the indirect effect of anthropomorphism on purchase intention through competence was not significant (Effect = 0.0360, BootSE = 0.0339, 95% BootCI [-0.0250, 0.1087]), indicating that competence does not significantly mediate the relationship between anthropomorphism and purchase intention.

Table 4

Model Summary for Mediators and Dependent Variable (PROCESS Model 4)

Outcome Variable	R	R^2	MSE	F	p-value
Warmth	0.1343	0.0180	2.0677	10.0226	0.0016
Competence	0.0484	0.0023	1.7935	1.2808	0.2583
Purchase Intention	0.4094	0.1676	2.4099	36.5234	<0.001

Table 5

Direct Effects of Anthropomorphism on Purchase Intention

	Effect	SE	t	p-value	LLCI	ULCI
Direct Effect	0.1922	0.1365	1.4076	0.1598	-0.0760	0.4603

Table 6

Indirect Effects of Anthropomorphism on Purchase Intention via Mediators

Mediator	Indirect Effect	SE	LLCI	ULCI
Total	0.1601	0.0616	0.0435	0.2841
Warmth	0.1241	0.0440	0.0449	0.2180
Competence	0.0360	0.0338	-0.0243	0.1100

3.3.3. Interaction of Robot Type on Warmth and Competence

A two-way ANOVA was conducted to examine the interaction effects of robot appearance (anthropomorphic vs. non-anthropomorphic) and robot type (social vs. functional) on perceived warmth and competence. The analysis revealed a significant interaction effect between robot appearance and robot type on warmth, $F(3, 544) = 9.459$, $p < .001$.

The estimated marginal means showed that social robots with an anthropomorphic appearance ($M = 4.146$, $SE = 0.124$) elicited higher perceptions of warmth compared to social robots with a non-anthropomorphic appearance ($M = 3.751$, $SE = 0.129$). Similarly, functional robots with an anthropomorphic appearance ($M = 3.693$, $SE = 0.101$) elicited higher perceptions of warmth than functional robots with a non-anthropomorphic appearance ($M = 3.143$, $SE = 0.142$).

For perceived competence, a significant interaction effect was also found between robot appearance and robot type, $F(3, 544) = 18.359$, $p < .001$. The estimated marginal means revealed that functional robots with a non-anthropomorphic appearance ($M = 4.729$, $SE = 0.129$) were perceived as more competent than functional

robots with an anthropomorphic appearance (M = 4.863, SE = 0.091). In contrast, social robots with an anthropomorphic appearance (M = 3.957, SE = 0.112) were rated higher in competence than social robots with a non-anthropomorphic appearance (M = 4.074, SE = 0.116).

Figure 2

Anthropomorphism and Purchase Intention by Robot Type

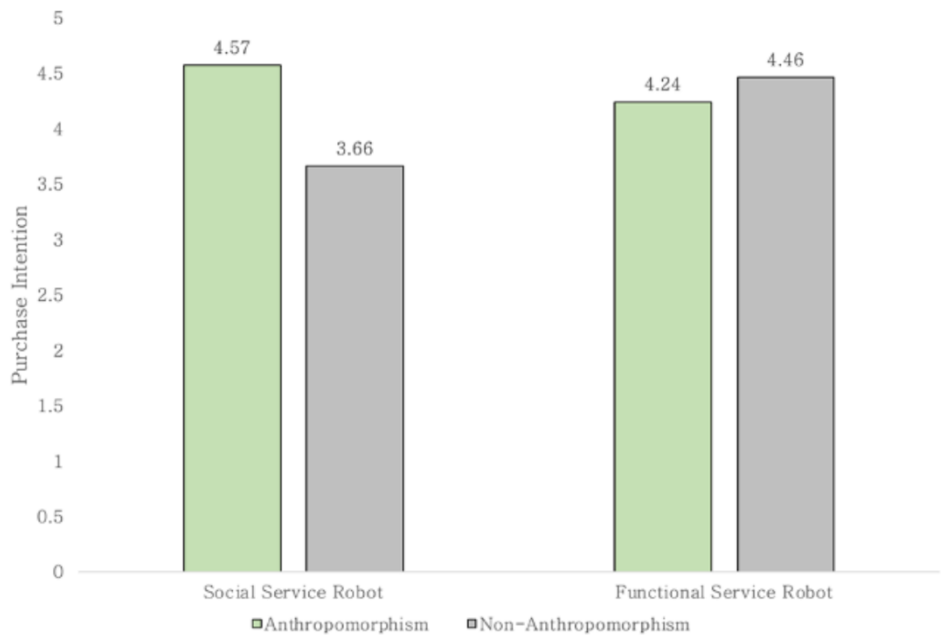


Figure 3

Anthropomorphism and Warmth by Robot Type

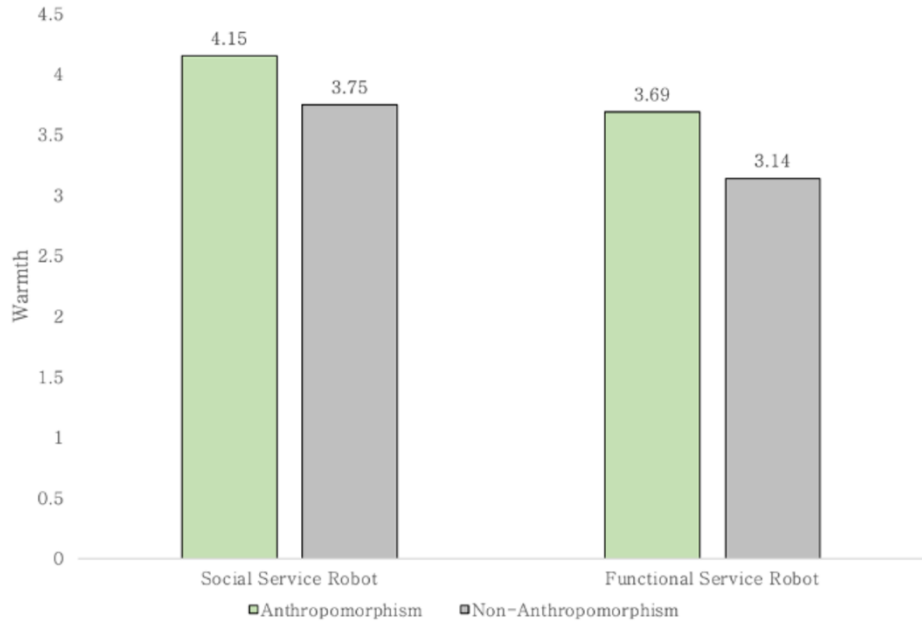
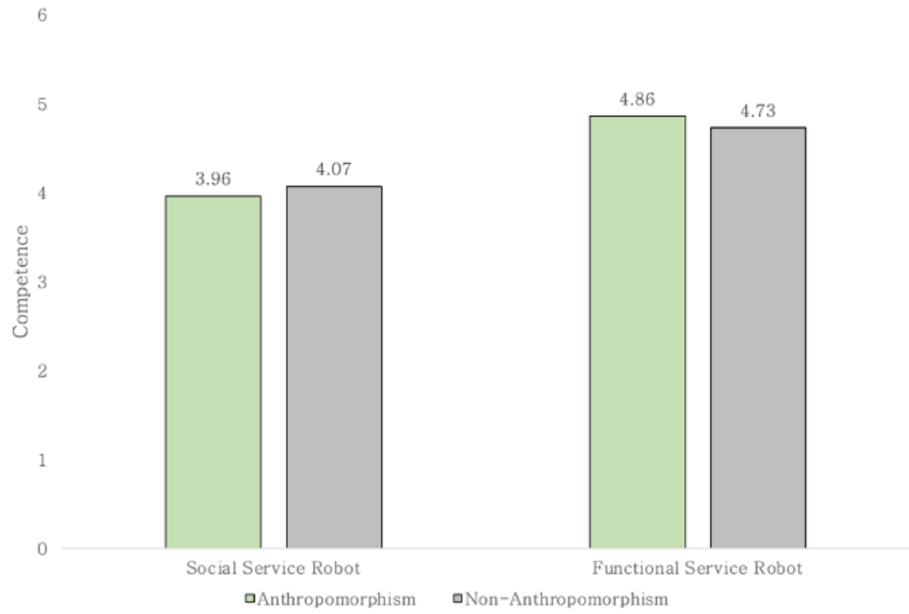


Figure 4

Anthropomorphism and Competence by Robot Type



3.3.4. Effects of Covariates

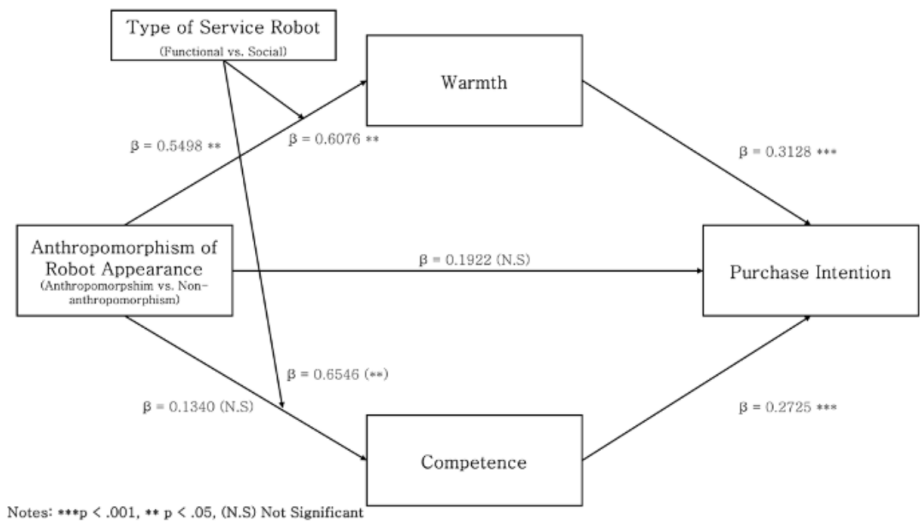
Age (β = 0.0071, p = .068) showed a marginally significant positive effect on warmth, suggesting that older participants may perceive robots as slightly warmer. Loneliness (β = 0.4444, p<.001) had a significant positive effect on warmth, indicating that individuals with higher levels of loneliness rated robots as warmer.

Neither age (β = 0.0001, p = .987) nor loneliness (β = 0.1500, p = .109) significantly influenced competence. This suggests that these covariates do not play a major role in perceptions of robot competence.

Age (β = 0.0117, p = .007) had a significant positive effect on purchase intention, indicating that older participants were more likely to express a willingness to engage with the robot. However, loneliness (β = 0.0897, p = .418) did not significantly predict purchase intention.

Figure 5

Conceptual Model Results



3.4. Discussion

The findings reveal that anthropomorphic design is essential for improving how people view both social and functional robots. The association between robot appearance and purchase intention is mediated by perceived warmth, which is significantly increased by anthropomorphism, even though it does not directly affect purchase intention. Anthropomorphized functional robots received the highest competency ratings, while anthropomorphized social robots were rated as the warmest.

These findings highlight the importance of anthropomorphic design across diverse robot types, demonstrating that including

human-like traits can boost both perceived capabilities and emotional connection. Anthropomorphism improves the desired emotional involvement role of social robots and increases perceptions of competence for functional robots, hence enhancing their practical utility.

This emphasizes the strategic importance of anthropomorphic design in robot development and marketing, demonstrating how human-like characteristics can improve consumer engagement and perceptions regardless of robot type. The findings suggest the introduction of anthropomorphic elements into both social and functional robots, taking into account the particular situations and goals of each kind. Future research could look into how different types and levels of anthropomorphic traits can improve perceptions of competence and warmth in robot applications.

Table 7

Summary of Hypothesis Testing Results

	Hypothesis	**Result**
H1	Robots with an anthropomorphic appearance will lead to higher purchase intentions than non-anthropomorphic robots.	Accepted
H2	The effect of an anthropomorphic appearance on purchase intention will be mediated by warmth.	Accepted
H3	The effect of a non-anthropomorphic appearance on purchase intention will be mediated by competence.	Rejected
H4	The effect of an anthropomorphic appearance on warmth will be stronger for social service robots than for functional service robots.	Accepted
H5	The effect of a non-anthropomorphic appearance on competence will be stronger for functional service robots than social service robots.	Rejected

Chapter 4. General Discussion

4.1. Theoretical Implications

The results of this study provide valuable insights into how anthropomorphism and robot type interact to influence perceptions of competence, warmth, and purchase intention. This research expands our understanding of how robot design—particularly its anthropomorphic traits—can impact user engagement and emotional responses.

The study emphasizes the importance of perceived warmth in the relationship between anthropomorphism and purchase intention, lending theoretical backing to the emotional attraction of anthropomorphic robots. This is consistent with the broader research on human-robot interaction (HRI), in which human-like characteristics are frequently associated with enhanced emotional engagement. The mediation of warmth implies that anthropomorphism's influence on consumer behavior is not limited to functional capabilities but also includes emotional connection. Although anthropomorphism did not significantly mediate competence, it is still an important component in determining purchase intention. This research adds subtlety to previous theories that emphasize the importance of competence in robot design, but it also implies that

how robots are anthropomorphized may not always influence competence perceptions. Future research could look into whether different sorts of anthropomorphic traits (such as voice, demeanor, and appearance) have a distinct effect on competency and how this varies depending on robot function.

The combination of robot appearance and type (social vs. functional) adds to our theoretical knowledge of how robots are assessed based on their intended use. Social robots were regarded to be warmer, whereas functional robots were viewed as more competent. This lends support to the notion that robot design should be tailored to the individual needs and expectations of users, with social robots promoting warmth and practical robots emphasizing competence.

The effect of age and loneliness on perceptions of warmth emphasizes the significance of individual variability in HRI. Loneliness, in particular, significantly increased the feeling of warmth, implying that emotionally isolated people may be more sensitive to robots' human-like features. The minor impact of age on warmth and purchase intention implies that generational differences may influence how older persons interact with robots, which merits additional investigation in future studies.

4.2. Managerial Implications

The findings of this study offer several practical implications for the design, marketing, and deployment of service robots, particularly in aligning robot features with consumer expectations and emotional needs.

Given the importance of anthropomorphism in determining perceived warmth, organizations developing social robots should prioritize human-like qualities that encourage emotional interaction. Robots having anthropomorphic appearances are more likely to elicit warmth, which increases consumer buy intention. This means that robot manufacturers may gain by putting human-like faces, attitudes, and behaviors into social interaction robots, especially in circumstances where emotional connection is important (for example, customer service, healthcare).

The effect of loneliness on feelings of warmth suggests that robots could be designed for emotionally solitary persons, such as the elderly or those in nursing homes. By emphasizing emotional support and companionship, service robots can meet the emotional demands of such customers, increasing their acceptance and utilization. Furthermore, the positive influence of age on purchase intention suggests that older persons may be more willing to interact with robots, allowing marketers to target this population with robots

that give both practical and emotional support.

Companies can modify their marketing tactics to showcase warmth and competence, which are important aspects of consumer engagement with robots. Marketers might highlight the emotional support and companionship provided by social robots, but functional robots should be focused on efficiency, dependability, and work performance. Furthermore, understanding age and loneliness can help to shape tailored advertising and user experience designs that appeal to specific groups based on their emotional and functional needs.

4.3. Limitations and Further Research

A key limitation of this study lies in the design of the manipulation images used to distinguish between anthropomorphic and non-anthropomorphic robots. While the manipulation check confirmed that the robots were perceived as intended, the non-anthropomorphic robots primarily differed in facial expressions. This may not have been sufficient to evoke strong perceptions of competence. Incorporating sharper, angular body features or additional design elements emphasizing functionality could have better communicated the intended characteristics of non-anthropomorphic robots.

Another limitation is that the study focuses on only a few variables—robot appearance, kind, and consumer age—without taking into account other aspects that may influence perceptions and interactions. Nonverbal indicators such as voice, hand gestures, and body language were excluded, despite their potential to dramatically influence consumer engagement with robots. Furthermore, while age was thought to be a moderating factor, other individual variations, such as personality qualities or prior experience with robots, were not investigated, which could have provided further insight into customer behavior.

Future research could build on the findings of this study by looking into other elements that influence consumer perceptions and interactions with robots, particularly those connected to task expectations. One path of investigation is to look into the precise tasks that consumers expect robots to execute in various circumstances. Understanding the types of tasks that consumers connect with different robot types (functional vs. social) may provide a better picture of how robots' perceived utility and purpose influence their acceptability and use. Identifying these preferences may aid in the creation of more personalized robot designs and functionality.

While this study focused on the robot's appearance and type,

future research could look into how nonverbal cues like voice, tone, hand gestures, and body language influence customer impressions of robots. These components of human-robot interaction can have a substantial impact on trust, warmth, and overall user experience. The incorporation of naturalistic behaviors into robots may also influence their acceptability, as customers may react differently to robots that appear more "lifelike" or capable of participating in fluid, human-like interactions. Research into how these elements interact with robot appearance and kind may lead to a better understanding of how consumers interact with robots in a variety of scenarios.

Furthermore, future research could look into how robots are seen in different circumstances, such as public or private spaces. The dynamics of human-robot interaction can vary depending on whether the robot is interacting in a private, home-based or public, commercial environment. In private, robots may be expected to perform more intimate or personal tasks, whereas in public, their role may be confined to utilitarian aid or entertainment. Investigating how consumer perceptions change in these different situations could provide valuable insights for organizations developing robots for diverse environments.

Chapter 5. Conclusion

This study explored how perceptions of warmth, competence, and purchase intention were affected by the type of service robot (social vs. functional) and robot appearance (anthropomorphic vs. non-anthropomorphic). The results show that although anthropomorphism has no direct effect on purchase intention, it significantly increases perceived warmth, which serves as a mediator in the relationship between appearance and purchase intention. The interaction analysis revealed that anthropomorphized functional robots were perceived as the most competent, while anthropomorphized social robots were considered the warmest.

These findings emphasize the importance of tailoring robot design to specific customer needs and settings, meaning that consumer responses may vary depending on the type of robot. Social robots, in particular, have been shown to be more appropriate for consumers seeking emotional connections, whilst functional robots are more suited to people who value practicality and efficiency.

The findings offer practical guidance for robot development and marketing strategies based on warmth and competence that can be successfully applied to both social and functional robots, emphasizing the importance of balancing emotional and functional requirements

for service robots in order to establish a larger market presence. Future research should look into user experiences in greater depth, taking into account things like robot usage duration, cultural context, and other individual psychological factors. Furthermore, studying long-term robot interactions and changes in consumer responses would allow for more targeted development of service robot design and marketing strategies.

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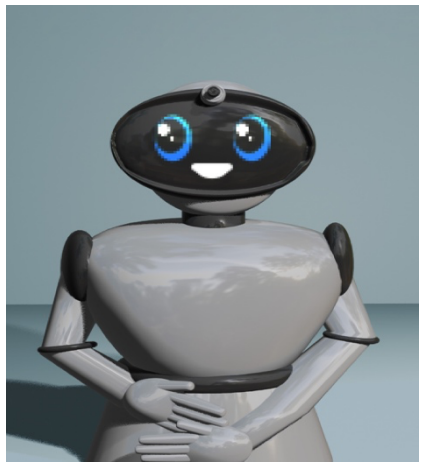
Appendix

Appendix 1: Manipulation of Robots in Studies

Study	Manipulation of Appearance	
	Anthropomorphism	Non-Anthropomorphism
Study 1		

Appendix 2: Scenarios for types of service robot

Anthropomorphism * Social
안녕하세요! 저는 여러분과 따뜻한 교감과 소통을 통해 정서적인 지원을 제공해주는 친구, 하루예요!😊 기분이 울적할 때는 따뜻한 위로의 말을 건네고, 즐거운 이야깃거리로 웃음을 드릴 수 있어요. 여러분의 감정을 알아차리고, 밝은 에너지로 언제나 옆에 있어 드릴게요. 혼자 있는 시간에도 하루와 함께하면 외로움은 잊어버리실 거예요.😊 저는 기쁠 때나 슬플 때나 항상 여러분 곁에 있을 거예요! 새로운 하루를 시작할 때마다, 하루가 든든한 동반자가 되어드릴게요!

Anthropomorphism * Functional
안녕하세요! 저는 여러분의 일상에서 실용적인 도움을 제공해 주는 친구, 하루예요😊 필요하신 물건을 찾아 드리거나, 간단한 작업을 빠르게 해결해 줄 수 있답니다. 가사일이나 정리, 필요한 정보를 찾아주는 일은 물론, 방 불을 꺼드리거나, 장 본 짐을 옮겨 드리고, 요리도 도와드릴 수 있어요. 나가기 전에 까먹은 게 없으신지 확인해 드리고, 차 키도 꼭 챙겨 드릴게요!😊 여러분이 생각하는 것보다 저는 여러분을 위해 할 수 있는 일이 정말 많아요! 하루가 곁에 있으면 하루하루가 더 쉽고 편안해질 거예요!

Non-anthropomorphism * Social
안녕하세요. 이 로봇은 따뜻한 교감과 소통을 통해 정서적인 지원을 제공해주는 친구, 하루예요! 기분이 울적할 때는 따뜻한 위로의 말을 건네고, 즐거운 이야깃거리로 웃음을 드릴 수 있어요. 여러분의 감정을 알아차리고, 밝은 에너지로 언제나 곁에 있어 드릴 수 있어요. 혼자 있는 시간에도 이 로봇과 함께하면 외로움은 잊으실 거예요. 새로운 하루를 시작할 때마다, 이 로봇은 여러분의 든든한 동반자가 되어드려요.

Non-anthropomorphism * Functional
안녕하세요. 이 로봇은 여러분의 일상에서 실용적인 도움을 제공해 주는 로봇, 하루입니다. 필요하신 물건을 찾아 드리거나, 간단한 작업을 빠르게 해결할 수 있습니다. 가사일이나 정리, 필요한 정보를 찾아주는 일은 물론, 방 불을 꺼드리거나, 장 본 짐을 옮겨 드리고, 요리도 도와드릴 수 있습니다. 나가기 전에 까먹은 게 없으신지 확인해 드리고, 차 키도 꼭 챙겨주는 로봇입니다. 여러분이 생각하는 것보다 이 로봇은 여러분을 위해 할 수 있는 일이 정말 많습니다. 이 로봇이 곁에 있으면 하루하루가 더 쉽고 편안해질 거예요.

Appendix 3: Measurement items for all studies

Construct	Measurement Items
Purchase Intention MacKenzie et al. (1986)	해당 로봇을 구매할 의향을 평가해 주세요. (1 = "매우 낮다," to 7 = "매우 높다") 해당 로봇을 구매할 가능성을 평가해 주세요. (1 = "매우 불가능," to 7 = "매우 가능")
Warmth Carpinella et al. (2017)	이 로봇은 행복해 보인다. 이 로봇은 감정이 있다. 이 로봇은 사회적이다. 이 로봇은 유기적이다. 이 로봇은 연민 어리다. 이 로봇은 감정적이다. (1 = "매우 그렇지 않다," to 7 = "매우 그렇다")
Competence Carpinella et al. (2017)	이 로봇은 유능하다. 이 로봇은 반응을 잘한다. 이 로봇은 상호적이다. 이 로봇을 신뢰할 수 있다. 이 로봇은 능숙한 것 같다. 이 로봇은 지식이 많다. (1 = "매우 그렇지 않다," to 7 = "매우 그렇다")
Age	현재 귀하의 만 나이를 적어주세요.
Loneliness Russell et al. (1978)	얼마나 자주 혼자 남겨졌다고 느끼십니까? 얼마나 자주 더 이상 아무하고도 가깝지 않다고 느끼십니까? 얼마나 자주 다른 사람들로부터 고립되어 있다고

	느끼십니까? 얼마나 자주 혼자라고 느끼십니까? 얼마나 자주 당신을 진정으로 아는 사람이 아무도 없다고 느끼십니까? 얼마나 자주 다른 사람들과의 관계가 의미 없다고 느끼십니까? 얼마나 자주 사람들이 당신과 진정으로 함께 있지 않고 그저 주위에 있는 것 이라고 느끼십니까? (0 = “전혀 그렇지 않다,” to 3 = “항상 그렇다”) 얼마나 자주 주변 사람들과 잘 통한다고 느끼십니까? [reverse coded] 얼마나 자주 사람들과 잘 통한다고 느끼십니까? [reverse coded] 얼마나 자주 당신은 주위 사람들과 비슷한 점이 많다고 느끼십니까? [reverse coded] (0 = “항상 그렇다,” to 3 = “전혀 그렇지 않다”)
Anthropomorphism Manipulation Check Han et al. (2023)	위 로봇이 사람의 얼굴과 유사한 정도를 평가해 주세요. (1 = “전혀 그렇지 않다,” to 7 = “매우 그렇다”)
Type of Service Robot Manipulation Grewal et al. (2020)	위 로봇은 기능적인 작업을 수행하는 로봇이다. 위 로봇은 유대감을 형성하는 로봇이다. (1 = “전혀 그렇지 않다,” to 7 = “매우 그렇다”)

국문 초록

본 연구는 로봇의 외형(의인화 vs. 비의인화)과 서비스 로봇의 유형(소셜 로봇 vs. 기능적 로봇)이 따뜻함, 유능함, 구매 의도에 미치는 영향을 조사하였다.

연구 결과, 의인화된 로봇은 구매 의도에 직접적인 영향을 미치지 않지만, 따뜻함에 대한 인식을 유의미하게 향상하며, 이는 외형과 구매 의도 간의 관계를 매개하는 중요한 역할을 하는 것으로 나타났다. 상호작용 분석에서는 의인화된 소셜 로봇이 가장 따뜻하게 인식되는 반면, 의인화된 기능적 로봇은 가장 높은 유능함을 나타내었다.

이러한 결과는 소비자의 특정 요구와 상황에 맞춘 로봇 디자인에서 의인화의 중요성을 보여준다. 소셜 로봇과 기능적 로봇 모두에서 의인화된 디자인이 긍정적인 영향을 미치는 것으로 나타났으며, 이는 로봇의 유형과 관계없이 의인화가 소비자와의 상호작용을 향상시키는 핵심 요소임을 시사한다.

따뜻함과 유능함을 중심으로 한 로봇 개발 및 마케팅 전략이 사회적 및 기능적 로봇 양쪽 모두에서 성공적으로 활용될 수 있는 실질적인 방향성을 제시하며, 서비스 로봇이 더 넓은 시장에서 자리를 잡기 위해 소비자의 감정적 및 기능적 요구를 균형 있게 반영해야 함을 강조한다. 후속 연구에서는 로봇의 사용 기간, 문화적 맥락, 그리고 개인의 다양한 심리적 요인 등을 고려하여 소비자의 경험을 더욱 심층적으로 분석할 필요성이 제기된다. 또한, 로봇의 장기적인 상호작용과 그로 인한 소비자 반응 변화에 관한 연구가 이루어지면, 서비스 로봇의 디자인 및 마케팅 전략을 더욱 구체적으로 발전시킬 수 있을 것이다.

키워드: 의인화,로봇의 유형, 따뜻함, 유능함, 구매 의도

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