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A Perceived Value and Its Influence on Satisfaction and Acceptance in Hotel Robot Services: Unveiling the Role of Trust

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ABSTRACT

This study investigates the impact of the perceived value of hotel robot services on customer satisfaction and acceptance attitudes, focusing on the mediating role of customer satisfaction and the moderating role of trust in robot services. A total of 452 valid responses were analyzed using SPSS 23.0 and AMOS 23.0 for confirmatory factor analysis and structural equation modelling. The results indicate that all dimensions of perceived value significantly positively affect customer satisfaction, with functional value also positively influencing acceptance attitudes. However, creative and entertainment values showed no significant impact on acceptance attitudes. Customer satisfaction mediates the relationship between perceived value and acceptance attitudes, while trust in robot services strengthens customer satisfaction but shows minimal moderating effects between perceived value and acceptance attitudes. These findings suggest that enhancing trust and familiarity with robot services through pre-arrival promotions and safe, human-like service delivery can improve customer acceptance.

Keywords: Robot Service; Perceived Value; Customer Satisfaction; Acceptance Attitudes; Robot Service Trust

INTRODUCTION

Recently, robots have been increasingly used in hotels to enhance work efficiency, driven by the spread of a contactless consumption culture and the adoption of smart customer services. These robots are primarily used to deliver items to guests, often in the lobby. Robots were first used as staff in hotel services at the Henn-na Hotel in Japan in 2015. Before COVID-19, robots were introduced in hotels to improve operational efficiency and provide customers with new experiences; however, the results were less successful than expected (ZDnet Korea, 16 January 2019). However, in the post-COVID-19 era, a shift in customer perceptions of contactless services led to a surge in demand. Consequently, service robots are actively used in various hotels across South Korea, reflecting their increased value in the future of the hospitality industry (Digital Economy, 3 May 2022).

Recently, robots have become increasingly common in roles such as delivering packages in hotels and serving as receptionists in lobbies; this trend is also evident in hospitals, offices, and restaurants. The robot services market is expected to continue to grow. Globally, the number of patents, applications, and registrations related to service robots has increased significantly each year. As of 2021, more than 28,000 service robot patents have been disclosed worldwide. On 4 March 2022, MOTIE (South Korea's Ministry of Trade, Industry, and Energy) announced the 2022 Intelligent Robot Action Plan, committing to investing in and supporting the development of robots across various sectors, including manufacturing and services, while improving regulations to foster a robot-friendly environment. Korea's robotics market is projected to reach KRW 5.5 trillion in 20 years, with an average annual growth rate of 5.4%. The overall market grew by 2.6% in 2020, driven by the rapid expansion of the service robot sector.

The increase in robot services is anticipated to be a pivotal factor in addressing the dearth of human labor in the hospitality industry. Service robots in hotels support fundamental front-desk operations and are increasingly being employed for disinfection and sanitation to ensure guest safety. Moreover, their ability to handle privacy concerns and other guest interactions swiftly enhances their utility and broadens their application spectrum in the hospitality industry. Furthermore, as hotels enable the division of labor between robots and staff, customer interactions are

enhanced and are characterized by increased warmth and efficiency, underlining the necessity for the adoption of robots. Recent shifts towards a contactless culture due to COVID-19 have amplified the demand for smart customer services and unmanned delivery services. Therefore, advanced service robots are being developed to satisfy the increasing consumption levels and needs of hotel customers (Lee et al., 2023). Upon examining the capabilities of robots, it is evident that they employ advanced technologies such as voice or facial recognition by artificial intelligence (AI; Cho, 2018). The introduction of robotic services in the hotel industry has positively impacted customers who receive contactless experiences and services. Particularly, in the era of the Fourth Industrial Revolution, AI technologies are becoming increasingly sophisticated, enhancing their utility as a means for customer communication and interaction. The experience of utilizing robotic services can significantly influence customer satisfaction and future acceptance attitudes based on their perceived service quality. Consequently, hotels must recognize the potential impact of robot services on future competitiveness. The quality of hotel services is a multifaceted concept. This study examines the perceived value of robotic services as a substitute for human staff services. Previous research on contactless services primarily focused on unmanned automation services and quality studies (Kim et al., 2021; Lin & Hsieh, 2011). Furthermore, although the interaction between customers and service robots has been emphasized (Park, 2020), such research has predominantly focused on the technology that provides the service.

The existing body of research on customer satisfaction and acceptance attitudes in the context of contactless services has tended to focus on the technology itself rather than on the evolving interactions between customers and the technology. In light of the rapid advancements in industrial technology, this study aims to measure the extent to which customers trust hotel robotic services as a result of these technological changes. Consequently, this study investigates the interrelationships among the key variables of perceived value, customer satisfaction, and acceptance attitude, as well as the moderating effect of trust in robotic services on these relationships. The objective of this study is to derive strategies that can enhance hotel competitiveness through the implementation of positive robotic service propositions with the intention of influencing customer-centric outcomes.

LITERATURE REVIEW

Hotel Robot Service

Since the 1980s, there have been notable advancements in robotic technology accompanied by a parallel increase in the intelligence of robots. Robots have evolved to learn and recognize emotions, and possess their own reasoning to perceive and provide feedback on their external environments (Liu & Lee, 20219). Service robots operate in either semi-autonomous or fully autonomous modes and are primarily engaged in the service sector of non-industrial production, providing a range of assistance and services to people (Ivanov & Webster, 2019). The influence of service robots on the tourism and hospitality industries can be evaluated from three principal perspectives. First, from an economic standpoint, the integration of AI technology in the context of rising labor costs and the demand for superior service quality enables robots to assume certain operational roles and deliver uniform services through multitasking, thereby reducing the need for human intervention. Such a transformation can result in notable reductions in labor costs, facilitate enhanced customer communication, and provide dependable travel service offerings (Ivanov et al., 2017). In terms of service quality, the provision of self-service through robotic technology represents a novel method for hotels to interact with current and prospective customers. This has a substantial impact on service marketing, increasing service efficiency by avoiding issues related to staff emotions, and accelerating sales of tourism and hotel products (Kuo et al., 2017). Second, regarding the value added by the service, the novelty of robot services can provide an agreeable check-in experience. However, this process may potentially result in a decrease in the perceived value of the service and an unpleasant stay for guests (Kim & Christodoulidou, 2013). Finally, from a social perspective, as robotic technology advances, the prospect of robots replacing human jobs is becoming increasingly plausible (Ivanov et al., 2018). Therefore, it is necessary to further refine the distribution of tasks between the staff and robots to differentiate their respective roles more explicitly. Concurrently, the introduction of robots may give rise to a number of societal issues, including unemployment among certain staff members and concerns regarding customer privacy, which will require attention (Osawa et al., 2017).

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Perceived Value

Perceived value can be defined as a comprehensive belief system that influences an individual's behavior and judgement in specific situations or with regard to particular objects. This ensures that costs incurred by customers align with the benefits they receive. This encompasses several dimensions, including consumer value, service value, customer value, acquisition and exchange value, perceived value, customer perceived value, emotional value, and cognitive value (Jung, 2020; Ryu & Ryu, 2014). Perceived value is important in the field of marketing and is regarded as a pivotal method through which competitive advantage can be gained in the provision of services. Given its subjective nature, perceived value is a multidimensional concept encompassing a range of psychological factors. These include a comparison of the benefits or experiences gained from consumption with the sacrifices made (Blut et al., 2024). Kotler and Levy (1969) defined customer satisfaction as a function of perceived value. A substantial body of research has been conducted to investigate the interrelationships among perceived value, quality, customer satisfaction, and customer behavioral intentions. The findings of numerous studies have indicated that the fulfilment of particular customer values has an impact on purchasing behavior with regard to products and services (Kim et al., 2017; Lee, 2020; Sung, 2020). When examining the components of prior research related to the perceived value of contactless services, several key distinctions are evident. Kwon and Namkung (2022) distinguished between pragmatic and hedonic values associated with social media. They focused on the functional and pleasure-based aspects of social media usage. Similarly, Kim and Yang (2021) examined perceived value as a single factor and investigated the relationship between perceived benefits and perceived sacrifices. The objective of this approach was to gain insight into how the equilibrium between the benefits gained and the sacrifices made influences the overall perceived value. Kim and Park (2020) treated the perceived value of kiosk services as a single factor. The objective of the research was to gain insight into how users perceive the value of automated service systems in facilitating transactions. Gu et al. (2024) investigated the perceived value of chatbot services in relation to their principal functions and attitudes towards acceptance. The perceived value was classified into the following categories: trust, expertise, necessity, distinctiveness, and emotionality. The objective of the study was to examine the mediating effects of these factors on user acceptance.

Mao and Ryu (2023) treated the construct of perceived value as a single factor and tested its relationship with the impact of online shopping mall chatbot services. The focus was on how perceived value influences customer interactions with these automated services. Yung (2023) conducted a study on the perceived quality of dining robots, categorizing it into product quality and system quality to investigate its impact on technology acceptance. In a behavioral study conducted by Lee and Kim (2022), the experiential value of interacting with service robots in a café setting was the focus of analysis. In light of the aforementioned studies and the gaps identified in the research concerning the perceived value of hotel-related robotic services, a plan has been devised to construct perceived value in terms of functional, creative, and recreational values. This structure is employed to investigate the relationship between customer satisfaction and attitudes towards the acceptance of robotic services in hotels. The objective of this approach is to enhance the understanding of the impact of different values ascribed to robotic services on customer perceptions and behaviors in the hospitality sector.

Customer Satisfaction

Customer satisfaction is a critical metric extensively used in the service industry to enhance customer loyalty and promote positive behaviors, serving as a pivotal concept within business frameworks (Riva et al., 2019). This represents a comprehensive evaluation of the perceived disparities between the expected and actual service consumption. Customer satisfaction is achieved when the provision of services meets or surpasses the anticipations of the customer (Shamsudin et al., 2020). Oliver (1997) defined satisfaction as the extent to which the actual perceived level of a service or product meets the user's expectations. Thus satisfaction through the expectancy-discrepancy model as a psychological state that emerges when preconceived expectations of a specific object or service are combined with the actual perceived consumption experience. In examining prior research on customer satisfaction related to robotics and food technology, Ko (2020) studied the convenience of airport robot services and customer satisfaction; Seo (2021) investigated the spread of kiosks and customer satisfaction; Seo and Yoon (2019) explored the perceived service quality of chatbot consultations and customer satisfaction; Jeon and Choi (2021) conducted a study on customer satisfaction among people in their 20s related to kiosks in the restaurant

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industry. In the context of international research, Shead's (2019) study on Japan's robotic hotels revealed that hotel guests felt discomfort when interacting with robots, leading to dissatisfaction with the robotic services. Hong and Slevitch (2018) demonstrated that customer satisfaction with kiosk use in the hotel industry is positively associated with future customer behavioral intentions.

Therefore, there is a notable scarcity of direct research on robotic services in hotels and their impact on customer satisfaction, which highlights the need for further research. This study proposes that customer satisfaction can be considered as an individual's subjective feelings about their expectations from robotic services. It characterizes this satisfaction as an overall positive sentiment towards face-to-face robotic services in an era moving away from human services, suitable for contactless norms today.

Acceptance Attitude

Customers who patronize dining establishments that have introduced new innovative technological services expect a novel experience that shapes their future attitudes towards technology or business (National Restaurant Association, 2022). Customers engage in parts of the service themselves in establishments that have implemented technology-based self-service operations, such as moving food served by robots directly to their tables or ordering food through kiosks without the help of staff members. This allows them to perceive not only functional value, but also a complex blend of behavioral, cognitive, sensory, and relational values (Shin et al., 2020). Such differentiated and memorable service experiences can make customers feel that they are receiving value beyond their expectations, which positively influences their future attitudes towards innovative technologies (Lee, 2012). Customer attitudes towards technological services can be measured using factors such as convenience, controllability, time and cost savings, risk, and self-efficacy. Customers evaluate and utilize technology-based self-services according to the time and effort required, complexity, reliability, accuracy, and enjoyment of the service (Chen et al., 2022). Furthermore, customer attitudes towards technological services can be assessed through expected performance. If customers believe they have achieved better task performance than expected when using robot services, they are likely to form a positive attitude and intend to continue using the service in the future (Park & Lee, 2020). This acceptance attitude towards technological services demonstrates that older individuals, compared to younger generations, have lower levels of technology acceptance and motivation to use technology (Mitzner et al., 2010).

An examination of prior studies on service-related acceptance attitudes reveals that perceptions of technology impact acceptance attitudes (Jeong, 2020), and consumer intentions to use technological services have been evaluated in studies like AI chatbot services and acceptance attitudes (Kim, 2022 b). Acceptance attitudes are defined as the intent to continue usage, which is manifested through actions such as active utilization, reuse, preference, word-of-mouth, and sustained use. Alexandra et al. (2020) found that acceptance attitudes towards robot and chatbot services are associated with perceptions of usefulness, enjoyment, risk, and personal innovativeness.

In light of this research, this study interprets acceptance attitudes as maintaining the intention to continue using robotic services. Furthermore, the perception and reaction towards robotic services, whether positive or negative, can be considered beliefs shaped by perceived values, such as functionality, creativity, and entertainment, which influence satisfaction.

Trust

Xu and Howard (2018) regarded trust as a catalyst that influences interactions between humans and robots. In this study, rather than focusing on the widely utilized concept of trust towards individuals or corporations within the traditional restaurant industry, the emphasis is on trust related to the capabilities of service robots. The literature on trust considers it a belief characterized by certain attributes of the object (Colquitt & Rodell, 2011). In this context, trust is conceptualized as a cognitive belief formed based on interactions and cognitive/emotional elements (Park, 2020). According to Rhim et al. (2023), trust in human-robot interactions differs from trust in human-automation systems. AI robots are designed with a level of autonomy that allows them to adapt to unexpected situations or events that are not explicitly programmed or anticipated during their design process. This differentiates them from automation systems designed to strictly follow preset guidelines, making the role of trust

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in human-robot interactions more complex and difficult to understand (Kim, Lee, & Jung, 2020). Customers' trust level in AI devices plays a crucial role in their evaluations of performance and expected effort (Ghazizadeh et al., 2012). Despite its significance, trust was not initially considered in the original AIDUA framework. However, previous studies (Ghazizadeh et al., 2012; Hengstler et al., 2016) have argued that trust is a critical determinant of performance expectations, especially for emerging technologies that can be considered 'disruptive'. Trust also plays a vital role in mitigating the negative effects of technical errors (Söllner et al., 2016). Therefore, as trust levels increase, the perceived effort required to interact with social robots may decrease, potentially increasing performance expectations (Lee & Song, 2013).

METHODOLOGY

Hypothesis and Research Model

The hypothesis and research model used in this study are presented in Figure 1.

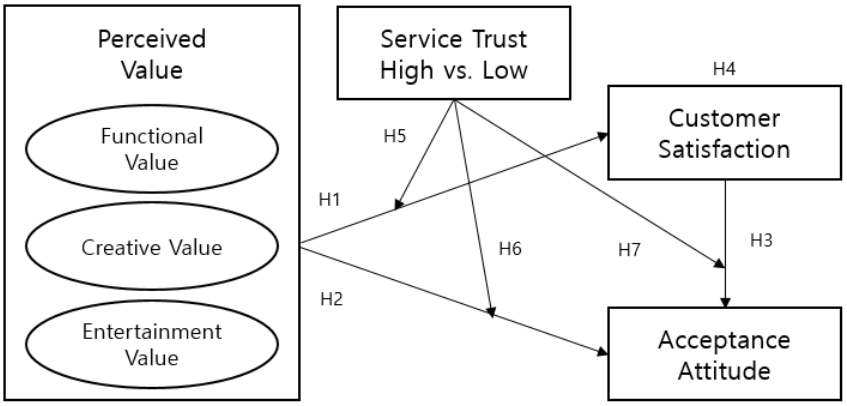

Figure 1. Research Model

The Influence of Perceived Value, Customer Satisfaction, and Acceptance Attitude

Consumers experience various values when interacting with services provided by robots. While these experiences can be positively differentiated from previous ones, they can also elicit negative reactions (Shin et al., 2020). Building on this, a review of the literature on the relationships between perceived value, customer satisfaction, and acceptance attitude reveals that Yung (2023) examined the structural relationship between the perceived quality of service robots in the food industry and technology acceptance and consumer behavioral intentions. Using ChatGPT, Wang (2023) differentiated the perceived value of tourism information into hedonic and utilitarian values and investigated their impact on satisfaction. The findings indicate that all factors of perceived value significantly and positively influence satisfaction, although utilitarian value has a more substantial impact on satisfaction than hedonic value.

In research related to dining out-of-home (O2O) platforms, Kim (2020) found that customer satisfaction increases as the perceived value of the O2O dining platform increases. Similarly, Ryoo et al. (2014) demonstrated that in the context of tourism information, higher perceived value also leads to greater satisfaction with the information provided. Kwon and Namkung (2022) categorized the perceived value of social networking services into utilitarian and hedonic values and verified their impact on satisfaction. As foundational references for hypotheses on customer satisfaction and acceptance attitudes. Kim and Cho (2022) observed that attitudes towards cloud services, as assessed through the technology acceptance model, enhance customer satisfaction, and subsequently increase intentions for continued use. Additionally, Han and Sa (2022) demonstrated that the perceived usefulness and ease of use of smartphones and online tourism platforms increase satisfaction, which positively affects customers' future behavioral intentions. Based on the results of these studies, Hypotheses 1, 2, and 3 have been established as follows:

Hypothesis 1: Perceived value has a significant positive impact on customer satisfaction.

H1.1: Functional value has a significant positive impact on customer satisfaction.

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H1.2: Creative value has a significant positive impact on customer satisfaction.

H1.3: Entertainment value has a significant positive impact on customer satisfaction.

Hypothesis 2: Perceived value has a significant positive impact on acceptance attitudes.

H2.1: Functional value has a significant positive impact on acceptance attitudes.

H2.2: Creative value has a significant positive impact on acceptance attitudes.

H2.3: Entertainment value has a significant positive impact on acceptance attitudes.

Hypothesis 3: Customer satisfaction has a significant positive impact on acceptance attitudes.

The Mediating Effect of Customer Satisfaction

Customer satisfaction, experienced by consumers as a positive emotional evaluation and psychological synthesis reflecting the comprehensive difference between expectations and actual performance of all products and services, influences future behaviors such as word-of-mouth, revisits, continuous use intentions, and acceptance attitudes (Mohsin Butt & Aftab, 2013; Wang et al., 2016). Jeon (2018) and Choi and Lee (2021) suggested that through customer satisfaction, companies can understand the level of fulfilment customers feel towards products and services, the characteristics of the service, and customers' subjective evaluative responses. Moreover, they stated that customer satisfaction is directly linked to corporate performance, as it builds and sustains long-term relationships. Mofokeng (2021) noted that customer-based services in e-commerce affect customer satisfaction and lead to long-term customer trust. Hendar et al. (2021) argued that mobile shopping malls must prioritize customer satisfaction through clear plans and practices in content differentiation, services, and marketing to enhance repurchase intentions.

Kim and Lee (2018) and Homer and Kahle (1988) proposed a hierarchical value-attitude-behavior (VAB) model, suggesting that customer satisfaction driven by perceived value results in positive behavior. Based on these studies, it is posited that customer satisfaction has a mediating effect on consumers' acceptance attitudes, leading to Hypothesis 4:

Hypothesis 4: Customer satisfaction mediates a significant relationship between perceived value and acceptance attitude.

H4.1: Customer satisfaction mediates the significant relationship between functional value and acceptance attitudes.

H4.2: Customer satisfaction mediates the significant relationship between creative value and acceptance attitude.

H4.3: Customer satisfaction mediates the significant relationship between entertainment value and acceptance attitudes.

The Moderating Effect of Trust

Trust can be considered a critical element in transactions as it alleviates the uncertainty and anxiety associated with expectations of understanding promises, honesty, and the absence of deceit towards a particular entity, thereby facilitating engagement in customer relationships and enhancing long-term orientation (Mayer et al., 1995). Additionally, Maeng, Kim, Park, and Hahn (2022) noted that human attitudes towards robots react sensitively based on the robot's behavior types and error recovery methods, thereby enhancing trust.

Lee and Moon (2020) found that trust had a moderating effect on the relationship between customer satisfaction and the intention to continue using the services of Didi Chuxing, a Chinese IT taxi company. Park (2016) and Park et al. (2013) identified trust as a moderating factor in the relationship between mobile payment services, customer satisfaction, and the intention for continued use. Wen and Choi (2022) examined the moderating effect of trust on the relationship between the innovation and presence of the metaverse and the intention for its continued use.

A synthesis of previous research findings indicates that a lack of trust is one of the major obstacles hindering technological advancement, and trust plays a crucial role in reducing transactional uncertainty and fostering

cooperation. Therefore, this study aims to assess the impact of trust as a moderating variable on customer satisfaction and acceptance attitudes within hotel robot services, distinguishing between groups with high and low trust. The following hypotheses are proposed to explore the moderating effect of trust:

Hypothesis 5: Trust has a moderating effect on the significant relationship between perceived value and customer satisfaction.

H5.1: Trust moderates the significant relationship between functional value and customer satisfaction.

H5.2: Trust moderates the significant relationship between creative value and customer satisfaction.

H5.3: Trust moderates the significant relationship between entertainment value and customer satisfaction.

Hypothesis 6: Trust has a moderating effect on the significant relationship between perceived value and acceptance attitudes.

H6.1: Trust moderates the significant relationship between functional value and acceptance attitudes.

H6.2: Trust moderates the significant relationship between creative value and acceptance attitudes.

H6.3: Trust moderates the significant relationship between entertainment value and acceptance attitudes.

Hypothesis 7: Trust has a moderating effect on the significant relationship between customer satisfaction and acceptance attitudes.

Operational Definition of Variables and Survey Structure

Perceived value

In this study, perceived value is defined as the psychological state representing the expected benefits and advantages of functional, creative, and entertainment values experienced while using hotel robot services (Lee & Kim, 2022a; Yook, 2023). The items for perceived value were restructured based on recent research on AI-related robot services (Kwon & Namkung, 2022; Yun & Park, 2022), and categorized into functional, creative, and entertainment values. The questionnaire items were structured as follows: functional value included four items: usability, convenience, efficiency, and safety; creative value included four items: innovation, creativity, trendiness, and proactive attitude; and entertainment value consisted of four items: fun of use, interest, design, and curiosity.

Customer Satisfaction

In this study, customer satisfaction is defined as the degree of fulfilment individuals feel about their expectations of robot services (Oliver, 1997; Shamsudin et al., 2020). The components of customer satisfaction were restructured to align with hotel service robots based on items from Seo (2021), Jeon and Choi (2021), and Shead (2019), and are organized into three items: satisfaction with the service robot, interest, and need fulfilment.

Acceptance Attitude

Acceptance attitude in this study is defined as the customer's intention to continue using the robot service (Alexandra et al., 2020). The items for acceptance attitude were structured as proactive use of hotel robots, reuse, priority selection, and priority use upon revisiting and consisted of four items (Chang et al., 2022).

Trust

In this study, trust is defined as the subjective belief that arises from interactions with hotel robots (Wang et al., 2021; Xu & Howard, 2018). The items for trust included trust in robot services, accurate information provision, and honest treatment, organized into three items (Valentina et al., 2023).

Research Design and Analysis Methods

This study aims to analyze the impact of the perceived value of hotel robot services on customer satisfaction and acceptance attitudes, and to verify the mediating effect of customer satisfaction and the moderating effect of trust.

A survey was conducted among customers using robot services at luxury hotels in Seoul, Busan, and Jeju. Initially, a pre-test was carried out from 1 December to 10 December 2023 targeting customers who had experienced robot

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services in Seoul using 50 online questionnaires (Google Forms) to assess the validity of the questionnaire. Based on the validation results of the pretest, items with low validity and reliability were partially deleted or modified. The main survey was conducted by three researchers visiting regions with numerous luxury hotels (Seoul, Busan, and Jeju) between 1 January and 31 January 2024. A total of 500 questionnaires were distributed and 470 were retrieved (response rate of 94.0%). After excluding 18 insincere or biased responses, 452 responses were included in the final analysis. The survey employed a face-to-face self-administration method, and respondents were thoroughly briefed on the reasons and objectives of the survey to elicit honest responses. The respondents' demographics were measured on a nominal scale, while other variables were measured using a 7-point Likert scale. Data were analyzed using SPSS 23.0. AMOS 23.0 was used for frequency analysis, confirmatory factor analysis, and structural equation modeling.

RESULTS

Characteristics of Data

The demographic characteristics of the participants are presented in Table 1. The gender distribution was predominantly female with 292 respondents (64.6%). A total of 229 (50.7 %) participants were married. The age groups with the highest representation were 40s (27.7%) and 50s (24.6%). A significant proportion of participants, 189 (41.8%), had completed a college degree. Professionals accounted for 111 (24.6 %) respondents. The most represented monthly income bracket was between 4 million and under 5 million won, with 224 respondents (49.6%). The most commonly experienced type of service was guidance services, as noted by 294 respondents (65.0%), and the majority had experienced robot services 3–4 times, accounting for 233 respondents (51.5%).

Table 1. Characteristics of respondents (N=452)

Classification	Contents	Frequency	Percentage (%)	Classification	Contents	Frequency	Percentage (%)
Gender	Male	160	35.4	Martial status	Single	223	49.3
	Female	292	64.6		Married	229	50.7
Age	20s	31	6.9	Education	Under high school	44	9.7
	30s	95	21		High school graduate	92	20.4
	40s	125	27.7		College graduate	189	41.8
	50s	111	24.6		Over graduate	127	28.1
	Over 60s	90	19.9				
Occupation	Student	44	9.7	Monthly average income (million won)	Under 200	11	2.4
	Administrative /Office worker	63	13.9		200 to 300	81	17.9
	Government employee	6	1.3				
	Self-employed	57	12.6		300 to 400	125	27.7
	Housewife	26	5.8		400 to 500	224	49.6
	Sales service worker	34	7.5				
	Technician	29	6.4		500 to 600	7	1.5

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	Professional	111	24.6				
	Other	82	18.1		Over 600	4	0.9
Types of robot service experienced	Check-in/out	29	6.4	Frequency of robot services within 6 months	1–2 times	165	36.5
	Room service	124	27.4		3–4 times	233	51.5
	Information service	294	65		5–6 times	46	10.1
	Other	5	1.1		7 times or more	8	1.8

Confirmatory Factor Analysis

Based on items from previous studies, a confirmatory factor analysis was conducted using AMOS to determine the clear factors for the research concepts and examine the convergent validity for internal consistency. The results of the confirmatory factor analysis for the 22 items are shown in Table 2. The model fit indices were $\chi^2/df = 3.561$ (CMIN/DF = 690.855/194, p = .000), GFI = .880, AGFI = .844, IFI = .899, TLI = .879, RMR = .034, CFI = .899, and RMSEA = .075, indicating that most fit indices did not meet the thresholds, prompting covariance adjustments and a re-analysis. The re-analysis results showed $\chi^2/df = 2.593$ (CMIN/DF = 495.239/191, p = .000), GFI = .913, AGFI = .884, IFI = .938, TLI = .925, RMR = .034, CFI = .938, and RMSEA = .059, with all fit indices except AGFI meeting the criteria, suggesting that the structural model was appropriate for analysis. The standardized factor loadings connecting the measurement items to their respective constructs were all above .6, securing convergent validity with CR significant at the .01 level.

Table 2. Confirmatory Factor Analysis

Factors	Items	Standard factor loading	SE	CR
Functional value	Using the hotel service robot is easy.	0.799		
	Using the hotel service robot is convenient.	0.773	15.63	***
	Using the hotel service robot saves time.	0.682	13.933	***
	Using the hotel service robot is safe.	0.821	14.256	***
Creative value	The hotel service robot is innovative.	0.565		
	The hotel service robot is creative.	0.681	14.104	***
	The hotel service robot is accepted with a proactive attitude.	0.845	11.275	***
	Using the hotel service robot aligns with current trends.	0.728	10.772	***
Entertainment value	Using the hotel service robot is fun.	0.715		
	Using the hotel service robot is interesting.	0.774	14.398	***
	The design of the hotel service robot is impressive.	0.708	13.369	***
	Using the hotel service robot stimulates my curiosity.	0.722	13.59	***
Customer satisfaction	I am generally satisfied with the hotel service robot.	0.699		
	I have a high interest in the hotel service robot.	0.808	14.038	***

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	The hotel service robot has met my service needs.	0.743	13.377	***
Acceptance attitude	I want to use the hotel service robot actively.	0.809		
	I want to use the hotel service robot again.	0.905	20.198	***
	I prefer choosing the hotel service robot over service personnel.	0.719	16.137	***
	I will prioritise using the hotel service robot on my next visit.	0.701	15.638	***
Robot service trust	The hotel service robot treats users honestly.	0.765		
	The hotel service robot provides accurate information.	0.793	15.206	***
	I fully trust the hotel service robot.	0.755	14.706	***
Initial model	Model fit: χ^2/df=3.561(CMIN/DF=690.855/194, p=.000), GFI=.880, AGFI=.844, IFI=.899, TLI=.879, RMR=.034, CFI=.899, RMSEA=.075			
Revised model	Model fit: χ^2/df=2.593(CMIN/DF=495.239/191, p=.000), GFI=.913, AGFI=.884, IFI=.938, TLI=.925, RMR=.034, CFI=.938, RMSEA=.059			

Correlation Analysis and Reliability

The results of the correlation analysis indicated that all constructs demonstrated a significant positive correlation at the significance level ($p < .05$). The construct reliability was above .8, and the average variance extracted (AVE) was above .5, confirming convergent validity. The results of the discriminant validity analysis satisfied the criterion of AVE > (correlation coefficient)², thereby ensuring discriminant validity.

Table 3. Correlation analysis

Factors	Correlation							
	Functional value	Creative value	Entertainment value	Customer satisfaction	Acceptance attitude	Robot service trust	AVE	CCR
Functional value	1	-0.244	-0.36	-0.207	-0.213	-0.159	0.609	0.861
Creative value	0.494	1	-0.283	-0.252	-0.17	-0.289	0.577	0.843
Entertainment value	0.6	0.532	1	-0.25	-0.2	-0.22	0.575	0.844
Customer satisfaction	0.455	0.502	0.5	1	-0.352	-0.339	0.645	0.845
Acceptance attitude	0.462	0.412	0.447	0.593	1	-0.213	0.669	0.889
Robot service trust	0.399	0.538	0.469	0.582	0.461	1	0.676	0.862

*p < .05, **p < .01 ( ): Square of the correlation coefficient

Hypothesis Testing

Hypothesis testing was conducted using a structural equation model, and the overall model fit was initially assessed using the maximum likelihood method. The fit indices were initially low, which led to adjustments in the covariance settings. After modifications, the fit indices were as follows: χ^2/df = 3.350 (CMIN/DF = 465.692/139, p = .000), GFI = .904, AGFI = .868, IFI = .923, TLI = .905, RMR = .034, CFI = .923, RMSEA = .072. When compared with

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general evaluation standards, AGFI was below .9, indicating non-satisfaction, whereas GFI, IFI, TLI, RMR, CFI, and RMSEA levels were satisfactory. Therefore, the overall model fit was adequate, confirming the validity of the model fit.

The results of hypothesis testing showed significant statistical outcomes. For H1, the perceived values of functional (β = .178, CR = 2.642), creative (β = .256, CR = 3.744), and entertainment (β = .257, CR = 3.380) values all significantly influenced customer satisfaction. For H2, functional value (β = .161, CR = 2.542) had a significant effect on acceptance attitudes. However, entertainment value (β = .109, CR = 1.525) and creative value (β = .072, CR = 1.121) did not show significant effects and were therefore rejected. H3 was supported as customer satisfaction (β = .463, CR = 6.572) significantly influenced acceptance attitudes. For H4, the mediating effects of customer satisfaction, analysis through bootstrapping, showed significant mediating effects of functional (CR = .083, p = .010), creative (CR = .119, p = .004), and entertainment values (CR = .119, p = .004), influencing acceptance attitudes via customer satisfaction. H5 and H6 regarding the moderating effects of trust in robot services were tested by dividing the sample into high trust (n = 194) and low trust (n = 258) groups based on the mean trust item value (mean = 5.7677) and analyzing constrained and unconstrained models. The overall moderating effect, assessed through model comparisons, resulted in a significant p = .0011, which suggests rejecting the null hypothesis and adopting the research hypothesis (Song, 2009).

The analysis results of this study revealed the model fit for the unconstrained model with χ^2/df = 2.801 (CMIN/DF = 773.198/276, p = .000), GFI = .849, AGFI = .792, IFI = .880, TLI = .849, RMR = .054, CFI = .878, RMSEA = .063, and for the constrained model χ^2/df = 2.796 (CMIN/DF = 791.349/283, p = .000), GFI = .847, AGFI = .794, IFI = .877, TLI = .850, RMR = .060, CFI = .875, RMSEA = .063. Although the fit indices were somewhat lower than the general evaluation standards, the results indicated that these were sufficient but not necessary conditions. Examining the verification results of the group-specific moderating effects, for the high-trust group (n = 194), there was a moderating effect in the relationship between functional value (β = .274, CR = 2.582), creative value (β = .196, CR = 2.151), entertainment value (β = .226, CR = 2.155), and customer satisfaction. The moderating effect of robot service trust on the relationship between perceived value and acceptance attitude showed no significant effects for functional value (β = .033, CR = .337), creative value (β = -.082, CR = -.940), and entertainment value (β = -.032, CR = -.322). However, a significant moderating effect of robot service trust was confirmed between customer satisfaction (β = .646, CR = 5.751) and acceptance attitude. For the low-trust group (n = 258), moderating effects were observed in the relationships between functional value (β = .204, CR = 2.003), entertainment value (β = .240, CR = 2.521), and customer satisfaction, whereas creative value (β = .119, CR = 1.295) showed no moderating effect. The moderating effect of robot service trust on the relationship between perceived value and acceptance attitude was significant only for functional value (β = .300, CR = 3.255), with no effects for creative value (β = .127, CR = 1.609) and entertainment value (β = .078, CR = .974). Additionally, a significant moderating effect of robot service trust was confirmed between customer satisfaction (β = .310, CR = 3.855) and acceptance attitude.

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Table 4. The results of hypothesis testing

Hypothesis	Path					Standardized Coefficient	CR	p	Results
1	Functional value	→	Customer satisfaction			0.178	2.642	0.008	Accepted
	Creative value	→				0.256	3.744	***	Accepted
	Entertainment value	→				0.257	3.38	***	
2	Functional value	→	Acceptance attitude			0.161	2.542	0.011	Accepted
	Creative value	→				0.072	1.121	0.262	
	Entertainment value	→				0.109	1.525	0.127	
3	Customer satisfaction	→	Acceptance attitude			0.463	6.572	***	Accepted
	Mediating effect (Customer satisfaction)					Standardised coefficient	p		
4	Functional value	→	Customer satisfaction	→	Acceptance attitude	0.083	0.01		Accepted
	Creative value	→		→		0.119	0.004		Accepted
	Entertainment value	→		→		0.119	0.004		Accepted
Before adjustment	Model fit: χ^2/df=4.185(CMIN/DF=594.226/142, p=.000), GFI=.880,								
	AGFI=.839, IFI=.894, TLI=.871, RMR=.036, CFI=.893, RMSEA=.084								
After adjustment	Model fit: χ^2/df=3.350(CMIN/DF=465.692/139, p=.000), GFI=.904,								
	AGFI=.868, IFI=.923, TLI=.905, RMR=.034, CFI=.923, RMSEA=.072								

Moderating effect (Robot service trust)	High(N=194)			Low(N=258)		
	Standardised Coefficient	CR	p	Standardised Coefficient	CR	p

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5	Functional value	→	Customer satisfaction	0.274	2.582	0.01	0.204	2.003	0.045
	Creative value	→		0.196	2.151	0.031	0.119	1.295	0.195
	Entertainment value	→		0.226	2.155	0.031	0.24	2.521	0.012
6	Functional value	→	Acceptance attitude	0.033	0.337	0.736	0.3	3.255	0.001
	Creative value	→		-0.082	-0.94	0.347	0.127	1.609	0.108
	Entertainment value	→		-0.032	-0.322	0.747	0.078	0.974	0.33
7	Customer satisfaction	→	Acceptance attitude	0.646	5.751	***	0.31	3.855	***
Unconstrained model	Model fit: χ^2/df=2.801(CMIN/DF=773.198/276, p=.000), GFI=.849, AGFI=.792, IFI=.880, TLI=.849, RMR=.054, CFI=.878, RMSEA=.063								
Constrained model	Model fir: χ^2/df=2.796(CMIN/DF=791.349/283, p=.000), GFI=.847, AGFI=.794, IFI=.877, TLI=.850, RMR=.060, CFI=.875, RMSEA=.063								
Model comparisons	DF	CNIN	p	NFI	IFI	RFI	TLI		
				Delta-1	Delta-2	rho-1	rho-2		
	7	18.151	0	0.0004	0.0004	0	0		

*p<.05, **p<.01, ***p<.001

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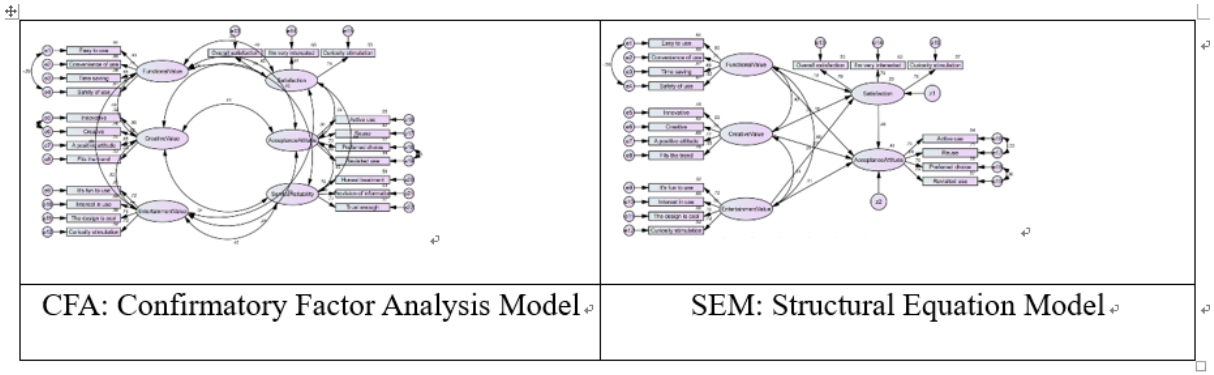

Figure 2. Results of CFA & SEM

CONCLUSION

This study explored the impact of perceived value on customer satisfaction and acceptance attitudes towards hotel robot services. Additionally, it examined the mediating effect of customer satisfaction and the moderating effect of trust in hotel robot services with the goal of providing insights that could enhance hotel competitiveness. Based on data from 452 participants, the sample of customers who had used hotel robot services was used to meet the study's objectives. The perceived value of hotel robot services was divided into functional, creative, and entertainment

values, whereas customer satisfaction, acceptance attitude, and trust were considered as single factors. The findings and implications of this study are as follows:

First, all factors of perceived value in H1 have a significant positive impact on customer satisfaction. This supports the findings of See and Lee (2023) that the perceived quality of service robots in the restaurant industry positively influences consumer behavior and Kim and Namgung (2019) that the perceived value of kiosks positively affects customer behavior. Similar results were observed in the present study. However, Shin et al. (2020) study, which suggested that robot services lead to customer dissatisfaction, was not confirmed. The impact of sub-factors showed that creative and entertainment values have a greater influence on customer satisfaction than functional value, suggesting that it will be necessary to enhance the functional value of robot services in the future. Additionally, the creativity perceived by customers in robots appears to provide enjoyment, novelty, and joy, indicating that developing customized approaches to enhance customer perceptions of robot services could be beneficial. For instance, there is a demand for differentiated capabilities in customizing services based on age and gender.

Second, while the functional value of perceived value in H2 significantly positively influences acceptance attitudes, creative and entertainment values do not have an impact on acceptance attitudes. This partially supports the findings of previous studies (Kim & Namgung, 2019) suggesting acceptance through kiosks and that the technology acceptance model positively affects customer attitudes. While most studies on technology acceptance models, such as kiosks and smartphone applications, show that creative and entertainment values have a positive influence on acceptance attitudes, the current study does not find a significant relationship in the context of hotel robot services. This suggests that hotel robot services are still in the introductory phase when their generalization and normalization are not yet adequate to elicit a positive acceptance attitude among visitors. Based on these results, to enhance long-term usage and the related acceptance attitudes, it is crucial to first eliminate any fear associated with using robots and build an image of robots as convenient and safe. Therefore, to improve customer satisfaction and acceptance attitudes, it is essential to develop robot services that prioritize functional elements, such as convenience, safety, and speed.

Third, H3 showed that customer satisfaction has a significant positive influence on acceptance attitudes. This result supports most previous studies, indicating that to enhance the continued use of hotels, repeat visits, and word-of-mouth intentions, it is essential to achieve customer satisfaction with robot services.

Fourth, H4 found that customer satisfaction mediates the relationship between perceived value and acceptance attitudes in all examined relationships. This supports the findings of previous research by Hwang ng (2021), Yoon and Park (2022), and Homer and Kahle (1988), which align with the VAB model. Satisfying customer expectations

for robot services is critical for facilitating continued usage, which is expected to enhance hotels' competitiveness by securing long-term customer loyalty.

Fifth, the moderating effects of trust in H5, H6, and H7 are as follows: In the high-trust group, all factors of perceived value significantly positively influenced customer satisfaction, and there was no moderating effect of trust between the perceived value and acceptance attitudes. However, the moderating effect of trust on customer satisfaction and acceptance attitudes was strong. Conversely, in the low-trust group, trust moderated the relationship between functional and entertainment values of perceived value and customer satisfaction. Additionally, a moderating effect of trust was observed in the relationship between functional value and acceptance attitudes. This finding suggests that trust significantly strengthens customer acceptance attitudes.

The results regarding the moderating effects of trust support the findings of Kim (2022b) and Seo and Lee (2021), who indicated that when customers are willing to accept robot services, they are more likely to trust them. Trust reduces perceived risks associated with robots and enhances customer satisfaction. Additionally, the results align with those of Tussyadiah and Park (2018), who found that if robot innovation technology can meet customers' expectations in terms of capabilities, attitudes, and behaviors, it can significantly enhance customer satisfaction and acceptance attitudes. Therefore, trust in robots, when linked to high levels of service performance, increases both customer satisfaction and acceptance attitudes.

The results confirm that higher trust in robot services correlates strongly with increased customer satisfaction. To enhance trust in robot services, it is essential to provide services that are as comfortable, stable, and safe as those provided by human staff, thus boosting trust in robots. Given that there was almost no moderating effect of trust between the perceived value and acceptance attitudes across groups, it suggests that the generalization of robot services may be insufficient. Therefore, it is prudent to develop strategies for engaging with customers prior to their visits through applications and social media promotions of robot services. This can facilitate interaction and foster a more familiar and accessible use of robotic services for customers.

Despite the varied results and implications of this study, there are directions for future research. First, the study is based on customers of luxury hotels in Korea, which may limit the generalizability of the results to general business hotels nationwide. Moreover, considering that the introduction of robots in the hospitality industry is still in its growth phase, it is essential to compare these findings in the more mature and advanced stages of robot integration. Finally, while diverse verification results have been presented using trust as a moderating variable, there is a need to construct more specific questions about trust in robot services to provide a broader range of verification results concerning customer behavior. These steps will enhance the depth and applicability of future research on robotics within the hospitality industry.

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