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The Effect of Customer Value on User Satisfaction With Dialogue Characteristics of Apple's Intelligent Agent Siri

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ABSTRACT

Intelligent agent products with dialogue characteristics are rapidly becoming common household and personal gadgets. The purpose of this study was to investigate the effect of dialogue characteristics on user satisfaction with intelligent agent products. The authors predicted that factors leading to this effect would differ from products without such interactive features. To date, dialogue characteristics have primarily been studied in robots with human-like gestures and appearance, but few studies have addressed dialogue characteristics in intelligent agent products designed for home or mobile usage. To address this gap, the authors conducted surveys about Apple Siri, a representative commercial intelligent agent. The results indicate that dialogue support had the most positive impact on user satisfaction, followed by playfulness and social presence. These findings suggest new directions in intelligent agent research and design that could increase user satisfaction.

KEYWORDS

Anthropomorphism, Customer Value Theory, Dialog Support, Intelligent Agent, Playfulness, Siri, Social presence, User satisfaction

INTRODUCTION

Agents are systems that automatically process a given task with decision making, learning, and autonomy (Jennings & Wooldridge, 1995; Kiesler, Powers, Fussell, & Torrey, 2008; Maes, 1994). In today's market for household and personal gadgets, intelligent agents with interfaces that permit user interaction are rapidly being commercialized. When using an interactive interface, consumers can imagine the personality of the agent or be emotionally affected through simulated conversation (Nass & Moon, 2000). Therefore, user experiences with an interactive, intelligent agent are likely to differ from user experiences with more traditional electronic devices.

Intelligent agents with dialogue characteristics feature an interactive user interface (UI) that permits naturalistic communication, allowing users to feel as if they were conversing with a real person. These dialogue characteristics are anthropomorphic. Anthropomorphism is the tendency to regard nonhuman agents as human beings and to attribute actual or imagined actions to objects (Epley, Waytz, & Cacioppo, 2007).

Previous studies on anthropomorphism have focused on visual characteristics such as the shape and gestures of a robot (Bartneck, Bleeker, Bun, Fens, & Riet, 2010; Darling, 2017; Epley et al., 2007; Eyssel & Ruiter, 2012; Kiesler et al., 2008; Salem, Eyssel, Rohlfing, Kopp, & Joublin, 2013; Tondu, 2012; Vallverdu, Nishida, Yoshisama, Moran, & Lazare, 2018; Waytz & Cacioppo, 2010).

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However, few studies have explored dialogue characteristics, the personifying feature of various intelligent agents currently being commercialized more rapidly than robots.

The aim of the current study was to investigate the effect of dialogue characteristics on user experiences with intelligent agents. Previous studies have addressed topics related to the technology of intelligent agents (Emary & Hassanien, 2011; Honarvar, 2013; Roger, King, Russ, Lambert, & Reese, 2001; Singh & Dave, 2013). However, the results of these studies did not address the relationship between user satisfaction and intelligent agent product design. Therefore, we proposed a solution to improve user satisfaction by investigating user experiences with intelligent agents. Our study also expands research on anthropomorphism; in the case of intelligent agents, the anthropomorphic element of intelligent agents is dialogue (i.e., audible), whereas the anthropomorphic elements of robots typically include appearance and gesture (i.e., visible). Finally, the current study suggests new directions for intelligent agent product design in order to improve user experiences with dialogue characteristics.

Using customer value theory as a framework, we explored user experiences with intelligent agents characterized not by human-like, physical characteristics (e.g., robots) but by human-like, conversational characteristics (e.g., voice-interactive smartphones). We categorized dialogue characteristics into three dimensions of value: dialogue support (functional value), playfulness (emotional value), and social presence (social value). These characteristics were the independent variables of the study. To collect data, we conducted surveys with people who used Siri, the intelligent agent on mobile devices designed and marketed by Apple.

THEORETICAL BACKGROUND

Intelligent Agents and Anthropomorphism

An intelligent agent is a system designed to accomplish tasks autonomously in a complicated and variable environment. An intelligent agent has (a) the autonomy to perform based on its own judgment and without direct instruction by another system, (b) the ability to cooperate through interaction with a person or another agent, (c) the responsiveness to perform appropriate work after detecting changes in the environment or the user, and (d) the initiative to resolve problems proactively (Jennings & Wooldridge, 1995; Maes, 1994). A more recent feature of intelligent agents is a UI that permits naturalistic, conversational interaction (e.g., Cortana on Windows 10, Siri on iPhone, and Echo on Amazon).

Enhancing a non-human object with an interactive UI is a form of anthropomorphism, which is the attribution of human characteristics to a product or system to make it feel more like a person (Aggarwal & McGrill, 2007). Human beings are more likely to accept products with anthropomorphic qualities, to understand product features that resemble human behavior or appearance, and to feel psychologically motivated to interact with intelligent devices in lieu of other people (Aggarwal & McGrill, 2007; Epley et al., 2007; Guthrie, 1993; Waytz, Heafner, & Epley, 2014).

Methods of anthropomorphism include two types: external and internal. External anthropomorphism is giving human-like form to an object, and internal anthropomorphism is to giving human-like emotion and behavior to an object. Research has also addressed how systems can interact with people through conversation, a form of social anthropomorphism (Brave, Nass & Hutchinson, 2005). Through an interactive UI, a user can imagine the personality of a system and, in turn, be affected emotionally.

Among previous studies on anthropomorphism, Kiesler et al. (2008) examined the influence of anthropomorphic robot features on social presence and interactivity. Another study found that users responded emotionally to interaction with a robot that was similar in appearance to a human being and perceived the robot to be more useful (Epley et al., 2007).

Previous studies on anthropomorphism have primarily focused on the physical characteristics of robots (e.g., appearance), but few studies have addressed the dialogue characteristics of intelligent agents. The purpose of this study was to examine user experiences with intelligent agents that do not physically resemble human beings but have features that mimic human social interaction. The current study extends previous studies by investigating user satisfaction with the dialogue characteristics of intelligent agents.

Customer Value Theory

Customer value theory explains how customer value plays a crucial role in consumer purchase behavior in a variety of situations (Kim, Gupta, & Koh, 2011; Mitsura, 2000). Customer value is defined in a marketplace environment, and organizations that operate economically in that marketplace can gain a competitive advantage by understanding the value that customers expect from a product or service (Anderson & Narus, 1998). A market environment consists of consumers from diverse cultures, income levels, preferences, expectations, beliefs, and values (Mitsura, 2000). Diversity within a market results from the diversity of values held by its consumers. Therefore, business strategies should be based on a thorough understanding those values (Bloch, Senior, & Almquist, 2016).

Sweeney and Soutar (2001) classified consumer purchasing value into three types: functional, emotional, and social. Functional value derives from the perceived usefulness of a product or service. Emotional value is the extent to which a product or service invokes a specific emotion or appeals to a customer. Social value measures how successfully a product or service enhances the social well-being of the consumer (Sweeney & Soutar, 2001). In the current study, dialogue support corresponded to the functional value of the intelligent agent, playfulness to the emotional value, and social presence to the social value.

Customer value theory has been used as a framework in many marketing studies. Sweeney and Soutar (2001) classified customer purchase value into functional, emotional, and social values. Various user experience studies (Hassenzahl & Tractinsky, 2006; Law, Roto, Hassenzahl, Vermeeren, & Kort, 2009; Vermeeren et al., 2010) have also examined functional and emotional satisfaction with products or services. However, few studies have applied customer purchase value to user experience. In the current study, we used customer value theory to investigate user experiences with a relatively new type of digital device (i.e., intelligent agent) for several reasons. First, the services provided by intelligent agents have functional, emotional, and social value. Second, "value" is an important factor in user satisfaction with a new product or service (e.g., intelligent agents). Finally, the perceived value of new, relatively unfamiliar products predicts user satisfaction and future purchase behavior.

Research Model and Hypotheses

Dialogue support refers to how an agent helps a user perform tasks through human-like conversation (Fogg & Nass, 1997). The functional value of an interactive agent (e.g., Siri) depends on how accurately that agent performs the spoken commands of the user. By providing useful and meaningful information to a user, the agent reduces the effort needed to find that information. Lehto, Oinas-Kukkonen, Pätiälä, and Saarelma (2012) found that support for dialogue in healthcare agents affected user confidence and purchase intention. Dialogue support can improve user self-efficacy, reduce cognitive load and confusion caused by system use, and increase positive effect (Derrick, Jenkins, & Nunamaker, 2011; Nadkarni & Gupta, 2007; Webster & Ahuia, 2006). Therefore, we proposed the following hypothesis:

H1: Dialogue support will have a positive impact on user satisfaction with the intelligent agent.

Zolkepli and Kamarulzaman (2015) defined playfulness as the extent to which users believe that using a technology brings them pleasure. Playfulness is an important factor in Human Computer Interaction (HCI) research because in areas such as multimedia, graphics, and animation, the technology itself can be pleasurable (Serenko & Turel, 2007). Various HCI studies have explored interaction design and enjoyment (Hackbarth, Grover, & Yi, 2003). Mathwick, Malhotra, and Rigdon (2001) found that playfulness induced intrinsic pleasure by allowing users to escape from their routine lives while interacting with a particular technology. Moon and Kim (2001) reported that playfulness resulted from user curiosity about interacting with an online service. Users can feel playfulness when jokes or witticisms are uttered by intelligent agents. Related to satisfaction and positive emotion, this playfulness increases the emotional value of agents (Webster & Martocchio, 1992). Perceived playfulness strengthens behavioral intention and favorably impacts perceived usefulness, attitude, and intention to use (Liu & Arnet, 2000; Mimoun & Poncin, 2015). In light of these findings, we proposed the following hypothesis:

H2: Playfulness will have a positive impact on user satisfaction with the intelligent agent.

According to Lee (2004), a virtual object can have three types of presence: physical, self, and social. Physical presence means that the virtual object feels real, and self presence means that a hypothetically composed self is experienced as a real self. Social presence refers to how a user experiences a virtual artifact as a social reality, either sensibly or non-sensibly. Social presence occurs when technology users are unable to distinguish between real social actors and artifacts that mimic social actors. For example, when a user responds to an avatar or agent as if it were a real human, the user experiences a strong sense of presence (Biocca, 1997). Among these three types of presence, social presence is most relevant in human-agent interaction (Duffy, 2003). Social presence is especially important for robots and software agents. When people successfully interact with a social robot, they react to it as if it were a human being. Turel, Serenko, and Bontis (2010) found that the social relationship between digital artifacts and users had a positive impact on perceived value. Therefore, we proposed the following hypothesis:

H3: Social presence will have a positive impact on user satisfaction with the intelligent agent.

Haslam (2006) divided humanness into two concepts: Uniquely Human (UH) and Human Nature (HN). UH refers to the unique characteristics of human beings that distinguish them from animals, and HN consists of basic characteristics that define what being human feels like. Removing an HN attribute can make a human feel like a machine (Haslam, 2006; Haslam & Loughnan, 2014); accordingly, HN attributes provide a strong measure of artificial intelligence. Previous studies have found that perceived intelligence and perceived emotional support were higher when a smart home system expressed warmth and emotion (Rozzell et al., 2014; Seo, 2016). In this context, we predicted that perceived value of the intelligent agent and user satisfaction would depend on the warmth and emotion perceived in the simulated voice. To test how the degree of humanness impacted user satisfaction, we proposed the following hypotheses:

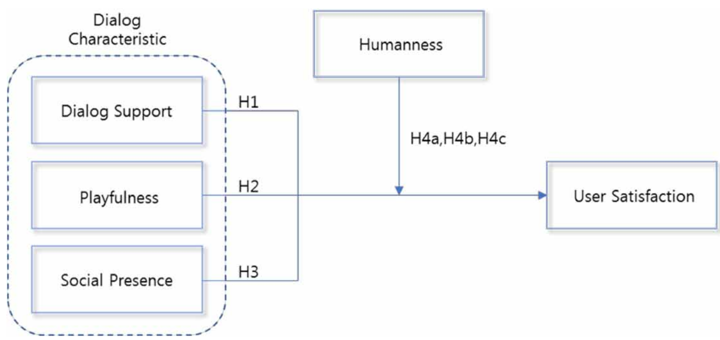
H4a: The impact of dialogue support on user satisfaction will vary with degree of humanness.
H4b: The impact of playfulness on user satisfaction will vary with degree of humanness.
H4c: The impact of social presence user satisfaction will vary with degree of humanness.

The purpose of this study was to investigate how dialogue support, playfulness, and social presence of an intelligent agent impacted user satisfaction at different levels of perceived humanness. Based on the hypotheses, we developed the following research model (see Figure 1).

Methodology

We used survey data to verify the proposed research model. Measurement items were modified or added to the study based on previous studies (see Table 1).

Figure 1. Research model



We measured each variable across several items to increase reliability. We presented a scenario on the survey site to help respondents understand the survey items and to help us clearly investigate the user experience.

We conducted focus group interviews on the questionnaire items before conducting the surveys. Four students with a master's degree or higher were interviewed to verify face validity and sort the items. After the measurement items were ready, we conducted a pilot test with 30 people. After reexamining the questionnaire, we conducted the survey for four days (August 15–18, 2017). We

Table 1. Measurement items

Variable	Content	Reference
Dialogue Support	• I can get what I need through dialogue with the agent. • The agent makes it easy to find the information I want to get. • Talking with the agent is efficient in finding information. • I can get the proper feedback I want to know through dialogue with the agent. • The agent provides information that is relevant to me. • The agent plays an important role in helping me with information.	Lehto et al., 2012; Mimoun & Poncin, 2015
Playfulness	• Talking with the agent is fun. • The agent feels friendly and is in good mood. • Interacting with the agent can lead to imagination. • Dialogue with the agent gives me pleasure.	Mimoun & Poncin, 2015; Etemad-Sajadi, 2016
Social Presence	• The agent felt like a person. • I felt like the agent had emotions. • I felt the agent had warmth like a human. • When I talked to the agent, I seemed to speak to a real person. • I sometimes feel like the agent has real feelings. • I sometimes feel like the agent is looking at me.	Heerink, Krose, Evers, & Wielinga, 2010; Shin & Choo, 2011
User Satisfaction	• I am satisfied with the functionality provided by the agent. • I am happy because of the services the agent provides. • It is better for the agent to find information than to find information in the old way.	Mimoun & Poncin, 2015
Humanness	• Fake / real • Mechanical / human • Unconscious / conscious • Artificial / living • Unnatural / Natural	Bartneck, Kulić, Croft, & Zoghbi, 2009

distributed the questionnaire through Facebook and KakaoTalk (No. 1 SNS in Korea). A message about winning a coffee coupon through a lottery provided additional incentive to respond to the survey.

A total of 240 participants responded to the web questionnaire; 13 questionnaires were excluded for faulty processing or insincere responses. Because the dependent variable was user satisfaction, respondents who had actually used Siri were selected for the final sample ($N = 162$). The number of male and female respondents was nearly equal, but the percentage of respondents in their 20s and 30s was high. In terms of education, 56.8% were university students, 33.4% had graduated from college (including vocational colleges), and 9.9% had at least a Master's degree (see Table 2).

DATA ANALYSIS AND RESULTS

Analysis and Results

Factor analysis using SPSS 21.0 verified the conceptual validity of the items used in this study. Principal Component Analysis (PCA) using the Varimax Rotation method confirmed five factors with eigenvalues greater than 1.0 (see Appendix A).

The total variance explained for all variables was 67.7%, and three items (SUP4, SUP5, and SUP6) were distributed across two factors (multi-loading factor). The fourth item of social presence (SPR4) showed factor loadings of less than 0.6. The factor loadings of all other items were greater than 0.6. We used Cronbach's alpha coefficients to examine the reliability of the items loaded on each factor and to investigate the internal consistency of the questionnaire items. The multi-item scale was internally consistent because the reliability of the variables was 0.7 or more. Confirmatory factor analysis (CFA) showed reliability and intrinsic validity because the mean variance extraction (AVE) and the conceptual reliability (CR) exceeded acceptable levels (0.5 and 0.7, respectively). CFA also indicated discriminant validity because the AVE of each concept was larger than ø2 (see Table 3). As a result, we proceeded to test the hypotheses.

Table 2. Respondent characteristics

Item		Frequency	Composition Ratio (%)
Sex	Male	75	46.3
	Female	87	53.7
Age	Teens	2	1.2
	20s	120	74.1
	30s	30	18.5
	40s	7	4.3
	50s or higher	3	1.9
Education Level	Currently in college	92	56.8
	Graduated from college	54	33.4
	At least a Master's degree	16	9.9
Frequency of Agent Usage	Fewer than twice in 2 months	63	38.9
	2–6 times in two months	75	46.3
	6–10 times in two months	9	5.6
	More than 10 times in 2 months	15	9.3
	Total	162	100.0

Table 3. Confirmatory validity verification

Conceptual correlation	AVE	CR	Conceptual correlation coefficient (ø)	ø2
SPR PLF	0.83 0.74	0.96 0.93	0.52	0.27
SPR SUP	0.83 0.74	0.96 0.89	0.13	0.02
SPR SAT	0.83 0.73	0.96 0.89	0.33	0.11
SPR HMN	0.83 0.77	0.96 0.94	0.40	0.16
PLF SUP	0.74 0.74	0.93 0.89	0.23	0.05
PLF SAT	0.74 0.73	0.93 0.89	0.38	0.14
PLF HMN	0.74 0.77	0.93 0.94	0.43	0.18
SUP SAT	0.74 0.73	0.89 0.89	0.54	0.29
SUP HMN	0.74 0.77	0.89 0.94	0.26	0.07
SAT HMN	0.73 0.77	0.89 0.94	0.45	0.20

Note. PLF: playfulness, SPR: social presence, SUP: dialogue support, SAT: satisfaction, HMN: humanness.

Hypothesis Test Results

Using 162 samples, we conducted multiple regression analysis with dialogue support, playfulness, and social presence as independent variables (see Table 4). Because we entered the moderating variables as products of the independent variables, we performed correlation analysis to confirm that multi-collinearity would not be a problem. Regression analysis using moderating variables can lead to multi-collinearity because of complete or strong correlation between the independent variables. When the Pearson correlation coefficient is 0.6 or higher, multi-collinearity between two variables can occur. Results of the analysis indicated no risk of multi-collinearity.

The results shown in Model 1 of Table 4 indicate that the effects of dialogue support, playfulness, and social presence on satisfaction were significant, supporting H1, H2, and H3. The explanatory power of the model was 38%, and dialogue support had the strongest impact on user satisfaction when the voice of the intelligent agent had warmth and emotion. The results of the moderating effect of humanness on the relationship between each independent variables (i.e., dialogue support, playfulness, and social presence) and user satisfaction are shown in Model 3 of Table 4.

Although the moderating variables increased the explanatory power of the model ($p < .05$; $R^2 =$ 0.43–0.44), no effect on dialogue support, playfulness, or social presence emerged. Therefore, H4a, H4b and H4c were rejected.

CONCLUSION

Discussion and Research Implications

The results of the multiple regression analysis indicate that dialogue characteristics (i.e., dialogue support, playfulness, and social presence) of the intelligence agent increased user satisfaction. Dialogue support had the greatest effect. Defined as helping the user through a human-like conversation (Fogg & Nass, 1997), dialogue support is measured by how precisely the agent can perform user commands during interaction. In the current study, dialogue support had the strongest effect because users experience the greatest utility through interaction with the intelligent agent.

At the same time, playfulness had a positive impact on user satisfaction. This result is consistent with previous findings that playfulness strengthened perceived usefulness and intention to use (Liu & Arnet, 2000; Mimoun & Poncin, 2015). It is also consistent with findings that playfulness increased the emotional value of intelligent agents (Webster & Martoochio, 1992).

Social presence positively affected user satisfaction with intelligent agents as well. We found that experiencing the social presence of the intelligent agent during conversation resulted in social value, increasing user satisfaction. Although humanness did not appear to be a moderating variable, it appeared to affect user satisfaction. The human characteristics of the voice of the intelligent agent increased user satisfaction. This result suggests that dialogue support and humanness are characteristics that users can clearly recognize. In the same context, because playfulness and social presence were perceived subjectively by the user, they had less influence on user satisfaction than dialogue support and humanness.

The current study has both theoretical and practical implications. First, previous studies have discussed the technical aspects of intelligent agents featured in the mobile cloud computing market (Emary & Hassanien, 2011; Honarvar, 2013; Roger, King, Russ, Lambert, & Reese, 2001; Singh & Dave, 2013). However, the current study focused on user experiences with a particular intelligent agent, diversifying intelligent agent research. Second, the findings of this study suggest that the principles of robot-based anthropomorphism can be applied to intelligent agents with non-physical anthropomorphic features. Third, we showed that customer value theory, which has primarily been used in marketing research, is relevant to user experiences with novel products (e.g., intelligent agents). These theoretical implications are valuable for three reasons. First, the current study creates momentum for intelligent agent study from the user experience perspective. Second, it suggests how

Table 4. Multiple regression results

	Model 1	Model 2	Model 3
SUP	0.48***	0.44***	0.42***
PLF	0.18*	0.11	0.13
SPR	0.17*	0.12	0.10
HMN		0.25***	0.25***
HMN X SUP			-0.05
HMN X PLF			0.06
HMN X SPR			-0.10
R2	0.38	0.43	0.44
ΔR2			0.01
F			2.62*

Note. PLF: playfulness, SPR: social presence, SUP: dialogue support, SAT: satisfaction, HMN: humanness.

investigation of dialogue characteristics might enhance research on user experience with various types of products and services that feature intelligent agent systems. Third, by using customer value theory as a framework, it broadens the scope of user experience research for future studies.

Our findings also suggest practical directions for future intelligent agent design. Dialogue characteristic can positively impact user experience, and the application of interactive UI features (e.g., dialogue support and humanness) that are clearly recognizable by users should increase satisfaction. Intelligent agent designers can improve user satisfaction by focusing on the conversational style of intelligent agents. In particular, voice designers should create more natural, warm, and emotional tones to improve user experience. On the other hand, designers could create optional interactive profiles that heighten playfulness and social presence, for these characteristics might not satisfy all users.

Limitations and Future Research

One limitation of the current study is that the survey focused on only one intelligent agent: Apple's Siri. Future studies should consider various types of intelligent agents to enhance the validity of the findings. Humanness was used as a moderating variable, but because humanness itself is a rich concept in the study of intelligent agents, future studies should set humanness as an independent variable. Most of the respondents in this study were between 20 and 30 years old, so the findings might not be generalizable to other age groups. In addition, one reason the results might not have been robust is that that respondents did not all frequently use intelligent agents. Future studies should use sampling methods that filter participants by their usage habits.

COMPETING INTERESTS

There are no all financial and non-financial competing interests.

AUTHORS' CONTRIBUTIONS

Under the guidance of academic advisers, both authors contributed equally to this study. Study design and manuscript preparation were done by Hye Rin. Surveys, programming, and data collection and analysis were done by Byoung Gwan.

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APPENDIX A. PRINCIPAL COMPONENT ANALYSIS

Table 5. Principal component analysis

Item	1	2	3	4	5	Coefficient
PLF1	0.82	0.00	0.14	-0.06	0.13	0.87
PLF2	0.74	0.34	0.17	0.07	0.13	
PLF3	0.85	0.19	0.15	0.00	0.15	
PLF4	0.66	0.21	0.12	0.33	-0.04	
PLF5	0.76	0.27	0.17	0.10	0.11	
SPR1	0.27	0.70	0.24	0.15	0.08	0.81
SPR2	0.18	0.80	0.04	-0.10	0.20	
SPR3	0.31	0.61	0.26	-0.21	0.24	
SPR5	0.23	0.74	0.22	-0.09	0.02	
SPR6	0.02	0.68	0.00	0.31	-0.05	
HMN1	0.26	0.14	0.69	0.22	0.11	0.78
HMN2	0.16	0.19	0.74	0.03	0.20	
HMN3	0.07	0.03	0.65	0.10	0.00	
HMN4	0.03	0.25	0.71	-0.05	0.14	
HMN5	0.20	0.01	0.71	0.05	0.20	
SUP1	0.07	-0.03	-0.04	0.72	0.27	0.81
SUP2	0.05	0.04	0.14	0.85	0.31	
SUP3	0.09	0.03	0.19	0.82	0.14	
SAT1	0.18	0.01	0.24	0.29	0.72	0.80
SAT2	0.05	0.12	0.17	0.27	0.77	
SAT3	0.21	0.21	0.19	0.25	0.74	
Eigenvalue	3.44	2.95	2.91	2.50	2.13	
Dispersion ratio	16.36	14.05	13.88	11.91	10.15	
Accumulation	16.36	30.41	44.28	56.19	66.34	

Note. PLF: playfulness, SPR: social presence, SUP: dialogue support, SAT: satisfaction, HMN: humanness.