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The Split Persona Effect in Healthcare:

Focusing on the Different Roles of Agent*

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As the adoption of digital technologies accelerates, conversational agents are increasingly employed in healthcare. The personas of these agents play an important role in user interaction. This study explores the design and implementation of conversational agents in healthcare, specifically aiming to examine the effects of split persona where agents are distinguished by their roles. An experiment (N = 84 participants) was conducted using a 2 (nurse agent: absence vs. presence) × 2 (doctor agent: absence vs. presence) between-subjects design. They interacted with assigned agents regarding health-related surveys and recommendations. The results showed that interactions with the nurse agent led to more positive effects on perceived usefulness, attitude, and satisfaction compared to doctor agent. Additionally, the condition with split persona did not show significant effects compared to the single agent condition. These findings have important implications for healthcare conversational agent design, highlighting careful persona consideration to enhance user experience.

Key words : digital healthcare, conversational agent, persona, split persona

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1. Introduction

The World Health Organization (WHO) refers to the term ‘digital healthcare’ as a digital transformation in healthcare and defines it as ‘the transfer of medical resources and healthcare through electronic means’ (Sharma & Kshetri, 2020). Digital healthcare compensates for the lack of traditional healthcare and provides various advantages through its digital nature.

Indeed, the adoption of digital technologies is accelerating at an unprecedented rate, and these technologies are becoming more common in healthcare. Many countries and organizations are focusing on digital healthcare, and the number of digital healthcare policies and reports has increased dramatically (Hunady et al., 2022; World Health Organization, 2022). Zion Market Research (2019) estimates that the mobile healthcare application market will exceed over 110 billion by 2025, and in 2019, a total of 44,384 iOS healthcare applications were released on the Apple Store and 41,377 on the Google Play Store (Statista, 2019). These statistics underscore the importance and potential of digital healthcare services.

In recent years, advances in technologies such as natural language processing (NLP), speech recognition, and artificial intelligence (AI) have significantly increased the availability and use of conversational agents in digital healthcare. A conversational agent is a computer system that communicates with a user through text and voice interfaces (Kim & Song, 2024). Conversational agents have demonstrated numerous benefits, particularly in healthcare. They are used to provide scalable and affordable healthcare support solutions that can help at any time through smartphone apps or websites (Pereira & Díaz, 2019). Conversational agents can assist patients in improving consultations, support behavior change and play a useful role in healthcare (Tokunaga et al., 2016). They can also assist in specific tasks, such as self-monitoring and self-management, which are important in chronic disease management. For example, diabetics need to regularly monitor their blood glucose levels and adjust their diet or medication plan accordingly. An interactive agent can automatically collect and analyze this data and provide real-time feedback to the patient.

Despite these advancements, the design and implementation of conversational agents in

healthcare remain a critical area of research. One important aspect of conversational agent design is the agent's persona. Users are influenced by the appearance (Robertson et al., 2015; van Wissen et al., 2016), speech style (Rhee & Choi, 2020), and voice tone (Qiu & Benbasat, 2005) of the conversational agent. The specific persona of a conversational agent can impact the success of forming a positive relationship between humans and agents. Applying a persona to the agent can help establish a positive relationship between the agent and the user, thereby improving the user's health management behaviors. A study investigating differences in persona of virtual agents found that people responded differently and had different experiences based on the agent's persona and characteristics (Wang et al., 2015). This effect becomes more complex when considering split persona, where different roles are assigned to separate agents rather than integrating them into a single agent. The concept of split persona has been explored primarily in educational settings, where agents divided by role have shown promising results in improving user experience and learning outcomes. However, this concept has been widely applied in education but not in healthcare. This study aims to address this research gap by applying the concept to healthcare. This study was conducted to evaluate the importance and influence of conversational agents in the field of digital healthcare. Advances in digital technology have the potential to improve the accessibility and efficiency of healthcare services, and conversational agents are central to this transformation. Against this background, this study has two main objectives. First, our primary goal in this research was to evaluate the impact of persona designs, specifically focusing on the use of conversational agents that are embodied within digital healthcare services. Despite the documented benefits of these agents, comparative studies distinguishing between embodied and non-embodied agents are still limited. Second, we delved into the effects of split personas, assessing how role-specific differentiation in agent personas influences healthcare outcomes. Through these investigations, our aim is to identify optimal strategies for integrating conversational agents in healthcare settings, which could improve the effectiveness of these agents and enhance the overall user experience.

2. Literature Review

1) Conversational Agent in Healthcare

An agent can be defined as a physical or virtual entity that can act and communicate with people, is autonomous, and has skills (Ferber & Weiss, 1999). Agents can exist in many forms (Franklin & Greeser, 1996), some of which are visually observable, while others interact using only voice or text. Among these, conversational agent is a software-based system that communicate with humans using text or spoken language. Conversational agent is an overarching term for software that interacts with users through written or spoken natural language and includes systems such as virtual assistants based on voice interaction and chatbots based on textual communication (Diederich et al., 2022).

The use of conversational agents in healthcare has become more advanced in recent years, with various studies showing promising results. For instance, Bickmore et al. (2010) demonstrated that virtual health counselors could significantly improve medication adherence among patients. Similarly, Laranjo et al. (2018) highlighted that conversational agents could effectively support chronic disease management by providing personalized feedback and health education. Furthermore, a study on asthma self-management among adolescents found that the use of conversational agents increased awareness of asthma symptoms and triggers, leading to a greater sense of control (Rhee et al., 2014).

Conversational agent, in addition to their current functions, can take on embodied forms and can be classified into embodied conversational agent and non-embodied conversational agent. Both types are software-based systems that communicate with users (Feine et al., 2019), but embodied conversational agent can be enhanced using human-like character embodiments (Schouten et al., 2022). These embodiments can be expressed in various ways. They can communicate through virtual humans, robots, text, voice, gestures, and facial expressions (Provoost et al., 2017), and can be represented in different forms such as gender, age, race, 2D and 3D displays, and levels of realism (Schouten et al., 2022; Straßmann & Krämer, 2017). These embodiments can address and compensate for the negative outcomes of

inadequate interactions with conversational agents (Go & Sundar, 2019). In the healthcare field, positive outcomes have been reported from interacting with embodied agents. Embodied agent, through human-like interactions, have been shown to increase user trust (Cowell & Stanney, 2005), encourage more frequent participation in health management (Bickmore et al., 2005), and help users understand complex health information more easily (Hudlicka, 2003).

However, the use of embodied agents does not consistently lead to positive outcomes. Some studies have reported beneficial effects, such as increased motivation and self-efficacy (Rosenberg-Kima et al., 2008), improved problem-solving performance (Atkinson, 2002), and enhanced physical activity adherence in healthcare (Bickmore et al., 2013; Watson et al., 2012). In contrast, other studies found no significant effect on goal adherence (Blanson Henkemans et al., 2009) or learning outcomes (Moundridou & Vivou, 2002), suggesting that embodiment alone may not guarantee effectiveness. Although research has demonstrated the positive impact of embodied conversational agents in healthcare, the results have been mixed. There has been a paucity of comparative studies that examine the effects of embodied conversational agents versus non-embodied conversational agents. Therefore, this study aims to investigate whether the use of embodiment in conversational agents has a positive impact in healthcare.

In this study, the embodied conversational agent was implemented as a 2D virtual character with a human-like visual appearance. The agent appeared on the screen as a static image and delivered messages in a consistent manner. While the agent did not include dynamic non-verbal behaviors such as gestures or facial expressions, it maintained a stable visual presence throughout the task.

RQ1. How does the no-agent condition differ from conditions that had an embodied agent?

2) Split Persona Effect

The importance of applying persona in the use of conversational agents in the healthcare

field has been emphasized in many studies. A persona represents the virtual personality or character of an agent, serving as a strong identity signal that can elicit social responses and interactions from people (Nass & Moon, 2000; Reeves & Nass, 1996). The application of persona, which have proven their effectiveness primarily in education, enhances interaction with learners and contributes to their engagement and satisfaction. For instance, Lester et al. (1997) discovered the persona effect, where the presence of realistic characters in a learning environment positively influenced students' perceptions of their learning experience. Similarly, Baylor and Ryu (2003) found that incorporating persona into educational software agents significantly improved learners' participation and satisfaction levels.

In the healthcare field, the importance of persona is also gaining increasing attention, with various studies exploring their application. Particularly, nurse or doctor personas are frequently employed to support real-world users. The nurse persona was mainly used in a caring role rather than making expert decisions, such as providing information to users or monitoring health conditions. For example, nurse agents have been used as assistants to promote physical activity, with increased average number of daily steps (Bickmore et al., 2013). In addition, Mccue et al. (2015) showed that participants who interacted with the nurse agent were more likely to comply with suggestions for stress reduction and healthy eating habits. In a study of the nurse agent performing discharge tasks such as reviewing care plans and medications, it was also reported that the participants showed a high level of satisfaction and a preference for the nurse agent over professional medical staff (Zhou et al., 2014). However, the nurse agent is considered only as a support and care role and has limitations in making professional judgements (Abbott et al., 2016). In another study, it was shown that the doctor agent is an important factor in the acceptance of healthcare services. When the doctor agent was present, participants said that the information provided by the agent was more scientific and reliable, which also affected attitudes toward the service (Hwang et al., 2021).

In addition to the impact of individual persona, research has also examined the benefits of distributing roles across more than one agent persona (Baylor & Ebbers, 2003; Baylor & Kim, 2005). The split persona effect states that it is preferable to split the roles of an agent into two separate agent persona rather than to integrate these roles into a single agent

persona (Baylor & Ebbers 2003). In the context of education, three agents were designed to represent the different roles of motivator, expert, and mentor (Baylor & Kim, 2005). This suggests that students may learn more when working with motivator and expert agents than when working with a single mentor agent. The better performance of those in the two-agent condition may be due to the increased collaborative interactivity, which required the learner to exercise greater agency (Bandura, 2000) in choosing which agent would be more useful. Overall, using a separate visually present agent, even if it is not a human-like avatar, rather than adding to the existing agent functionality, has a positive impact on the learning experience (Roselyn Lee et al., 2007). Similarly, Baylor (2002) conducted the effect of pedagogical agents representing different perspectives on learning and motivation. As a result, there was an effect of two agents in increasing metacognitive awareness.

Based on promising results from education, it is crucial to examine the split persona effect in healthcare. Specifically, healthcare interactions often require both emotional support and expert medical advice. By splitting these roles into two distinct agents, patients may benefit from more specialized and clear interactions. This division emphasizes the strengths of each role, enhancing the overall user experience by providing both empathy and expertise (Hudlicka, 2013). Furthermore, studies indicate that patients' trust and compliance improve when healthcare advice is given by a specialized agent (Bickmore & Picard, 2005). Splitting roles between agents can help reduce users' cognitive load by distributing tasks and clarify communicative intent, which may lead to better comprehension and engagement (Baylor & Kim, 2005; Sweller, 1988). In this study, the split persona condition was implemented by presenting two agents: a nurse agent who delivered an introductory message, followed by a doctor agent who provided the health recommendation. This design reflects real-world healthcare settings by separating the emotional (nurse) and informational (doctor) roles. Therefore, splitting between nurse and doctor personas can lead to more effective health interventions by leveraging their specific attributes and expertise. This study aims to determine if using two separate agents (one with a nurse persona and one with a doctor persona) has more positive effects than using a single agent that combines both roles.

H1. Participants in the split persona condition (nurse + doctor) will report higher levels of (a) agent-related perceptions (i.e., cognitive trust, affective trust, social presence, and perceived message strength) and (b) overall evaluations of the service (i.e., perceived usefulness, attitude toward the service, satisfaction, and intention for continued use), compared to those in the nurse-only (single agent) condition.

H2. Participants in the split persona condition (nurse + doctor) will report higher levels of (a) agent-related perceptions (i.e., cognitive trust, affective trust, social presence, and perceived message strength) and (b) overall evaluations of the service (i.e., perceived usefulness, attitude toward the service, satisfaction, and intention for continued use), compared to those in the doctor-only (single agent) condition.

RQ2. What is the main effect of showing the nurse and doctor agent?

3. Method

1) Overview

The experiment used a 2 (Nurse agent: absence vs. presence) X 2 (Doctor agent: absence vs. presence) between-subjects design. Participants were randomly assigned to one of the following conditions: (a) condition without an agent (n = 22, 26.2%), (b) single agent condition with nurse persona providing both guidance and recommendation (n = 20, 23.8%), (c) single agent condition with a doctor persona providing both guidance and recommendation (n = 21, 25.0%), and (d) split agent condition, in which a nurse persona provided guidance and a doctor persona provided the recommendation (n = 21, 25.0%).

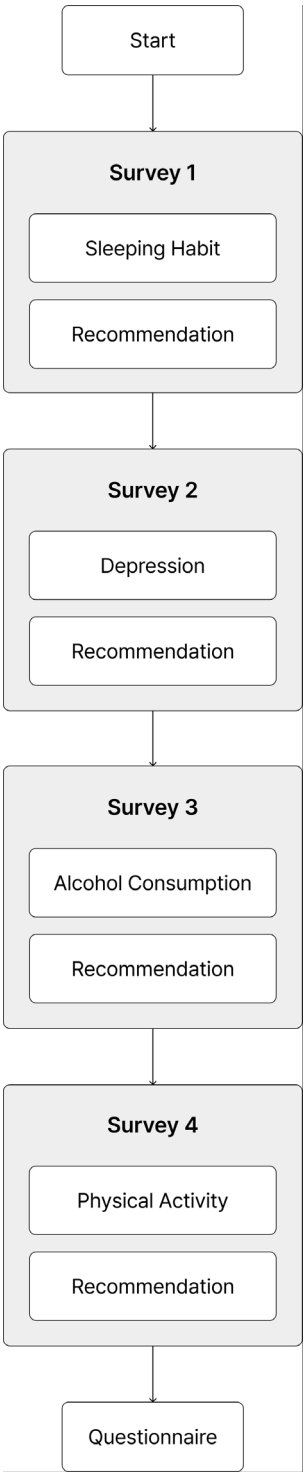
2) Participants

This study involved a total of 84 undergraduate and graduate students from a university located in Seoul, South Korea. We advertised for participants through postings on the university website bulletin boards. The study was conducted from November 15 to 22, 2024. Participants were required to have no prior experience with health surveys and recommendations related to healthcare services. The age of participants ranged from 21 to 35 years, with a mean age of 25.58 years (SD = 2.39). Slightly more females (n = 47, 56.0%) participated in the study compared to males (n = 37, 44.0%).

3) Apparatus

For this experiment, a webpage was developed, which was available on PC using the JavaScript language. The webpage consisted of two main parts: a health-related survey and recommendations. The health-related survey consists of four parts (Sleep, Depression, Alcohol consumption, Physical activity) about the participant's habits. The surveys used in the experiment were based on the health records of the Health Promotion Center of Seoul National University Hospital. Each survey consisted of 4-5 questions and participants had to choose one of four answers. For example, the question 'How many hours of sleep did you get per night in the past week?' has four possible answers (e.g., less than 1 hour, 1-3 hours, 3-5 hours, more than 5 hours). The recommendations were general and non-personalized, such as information on the disadvantages of sleep deprivation and ways to address it and were designed to function as health-related suggestions following the participant's survey responses. When recommendations were provided, text also appeared with the agent to make it feel like the user was receiving health-related information. The virtual agents which were developed using Adobe Firefly, each tailored to specific experimental conditions and divided according to their roles (see <Figure 1>).

<Figure 1> Screenshots of Four Conditions:
(a) No Agent, (b) Nurse Agent, (c) Doctor Agent, (d) Nurse+Doctor Agent



<Figure 2> Flowchart for Experimental Procedure

4) Procedure

The experiment proceeded as shown in Figure 2 and described as follows. Recruited participants received the direct link to experiment and were randomly assigned to one of four conditions. Once participants have read the overview of the tasks, participants will enter name, gender, birth and four health surveys. After completing each survey, the agent corresponding to the condition provided recommendations. For example, in the nurse agent condition, a nurse appeared and offered recommendations after each health-related question. In the doctor agent condition, both the health-related questions and the recommendations were presented by a doctor. In the split agent condition (nurse + doctor), a nurse appeared at the beginning of the survey and informed participants that a doctor would provide the recommendations. Once the participant completed the survey, the doctor appeared and offered the recommendations. After completing all surveys and receiving the corresponding recommendations—which took approximately 15–20 minutes—participants filled out a final questionnaire. Upon completion of the study, participants received 5,000 KRW as compensation. This study was approved by the University's Institutional Review Board (IRB).

5) Measures

The survey utilized a 7-point Likert scale for all measurements. The questionnaire consisted of two parts. The first part of the questionnaire asked participants about their thoughts about the agents. Trust in the agent was assessed in two main elements: cognitive trust (Johnson & Grayson, 2005) (α = 0.79) and affective trust (McAllister, 1995) (α = 0.89). In addition, other constructs measures included social presence (Heerink et al., 2008) (α = 0.94) and perceived message strength (Zhao et al., 2011) (α = 0.87). The second part of the questionnaire asked participants about their overall evaluation of the service. Perceived usefulness (Venkatesh et al., 2003) (α = 0.93), attitude (Wixom & Todd, 2005) (α = 0.82), satisfaction (Murti et al., 2013) (α = 0.89) and continuous usage intention (Jang et al., 2016) (α = 0.95). All measurement items were derived from previous literature and modified

to fit the healthcare context (see <Table 1>).

<Table 1> Measurement Scales used in the Questionnaire

Measures	Scale items	Sources
Cognitive Trust	Given my financial adviser's track record, I have no reservations about acting on his or her advice. Given my financial adviser's track record, I have good reason to doubt his or her competence. (-) I have to be cautious about acting on the advice of my financial adviser because his or her opinions are questionable. (-) I cannot confidently depend on my financial adviser since he/she may complicate my affairs by careless work. (-)	Johnson & Grayson (2005)
Affective Trust	We have a sharing relationship. We can both freely share our ideas, feelings, and hopes. I can talk freely to this individual about difficulties I am having at work and know that (s)he will want to listen. We would both feel a sense of loss if one of us was transferred and we could no longer work together. If I shared my problems with this person, I know (s)he would respond constructively and caringly. I would have to say that we have both made considerable emotional investments in our working relationship.	McAllister (1995)
Social Presence	When working with the agent, I felt like working with e real person. I occasionally felt like the agent was actually looking at me. I can imagine the agent as a living creature. I often realized the agent is not a real person. Sometimes it seemed as if the agent had real feelings.	Heerink et al. (2008)
Perceived Message Strength	The statement is a reason for ___ that is believable. The statement is a reason for ___ that is convincing. The statement gives a reason for ___ that is important to me. The statement helped me feel confident about how best to ___. The statement would help my friends ___.	Zhao et al. (2011)

<Table 1> Measurement Scales used in the Questionnaire (continued)

Measures	Scale items	Sources
Perceived Usefulness	Using smart healthcare services improves my health management performance. Using smart healthcare services increases my productivity for my health management. Using smart healthcare services enhances my effectiveness in my health management. Using smart healthcare services is useful in my health management.	Venkatesh et al. (2003)
Attitude	Using is very enjoyable. Overall, using is a pleasant experience. My attitude toward using is very favorable.	Wixom & Todd (2005)
Satisfaction	I am satisfied with the health care service. My decision to visit this hospital has been a wise one. I did the right thing when I decided to avail this hospitals service. The overall feelings about the service of care in this hospital are better than what I expected.	Murti et al. (2013)
Continuous Usage Intention	I intend to use u-healthcare. I intend to perform health management using u-healthcare. I intend to use u-healthcare frequently.	Jang et al. (2016)

4. Results

To test RQ1, ANOVA with a planned contrast test was conducted. No-agent condition was compared to all other conditions. Showing the image of the agent did not show significant effects across all dependent variables: cognitive trust [$t(80) = 1.09$, $p = .28$], affective trust [$t(80) = -.55$, $p = .59$], social presence [$t(80) = .24$, $p = .81$], perceived message strength [$t(80) = .68$, p = .50], perceived usefulness [$t(80) = -.72$, $p = .47$], attitude [$t(80) = -.52$, $p = .60$], satisfaction [$t(80) = -.52$, $p = .60$] and continuous usage

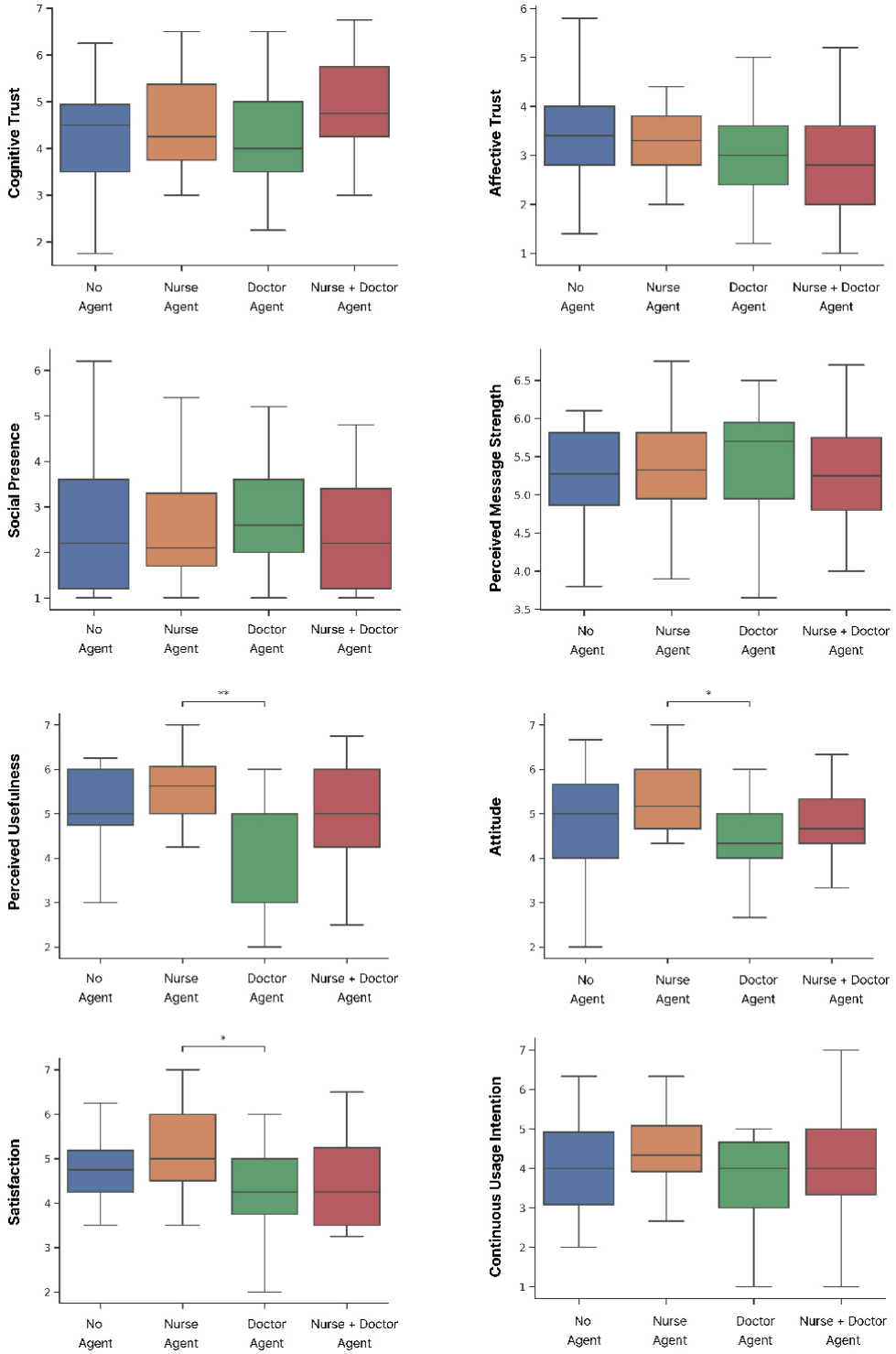
intention [$t(80) = -.59$, $p = .56$]. Thus, using an embodied agent did not have a more positive effect on user experience compared to not embodied one.

Before testing the hypotheses, a series of one-way ANOVA analysis was performed. First of all, the conditions were significantly different on perceived usefulness [$F(3, 80) = 5.76$, $p = .00$, $\eta^2 = .18$], attitude [$F(3, 80) = 3.60$, $p = .02$, $\eta^2 = .12$] and satisfaction [$F(3, 80) = 3.78$, $p = .01$, $\eta^2 = .12$]. However, no significant difference was observed for affective trust [$F(3, 80) = .52$, $p = .67$, $\eta^2 = .02$], social presence [$F(3, 80) = .17$, $p = .92$, $\eta^2 = .01$], perceived message strength [$F(3, 80) = .35$, $p = .79$, $\eta^2 = .01$] and continuous usage intention [$F(3, 80) = .98$, $p = .41$, $\eta^2 = .04$] (see <Table 2>).

<Table 2> Comparison between Conditions

Variable	No Agent ($n = 22$)		Nurse Agent ($n = 20$)		Doctor Agent ($n = 21$)		Nurse+Doctor Agent ($n = 21$)			
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*
Cognitive Trust	4.20	1.27	4.58	1.11	4.24	1.02	4.85	1.08	1.54	.21
Affective Trust	3.44	1.21	3.54	1.28	3.27	1.34	3.06	1.50	.52	.67
Social Presence	2.57	1.52	2.69	1.69	2.83	1.02	2.54	1.51	.17	.92
Perceived Message Strength	5.26	.60	5.42	.70	5.42	.76	5.26	.72	.35	.79
Perceived Usefulness	5.07	.98	5.61	.75	4.26	1.17	4.92	1.23	5.76**	.00
Attitude	4.80	1.18	5.35	.78	4.35	1.02	4.79	.86	3.60*	.02
Satisfaction	4.75	.97	5.26	1.04	4.20	1.12	4.52	1.02	3.78*	.01
Continuous Usage Intention	4.08	1.20	4.32	1.54	3.65	1.16	3.78	1.53	.98	.41

To test hypotheses related to the split persona effects on overall evaluation of the service, Scheffe's post hoc pairwise comparison test was conducted (see <Figure 3>). When the split agent condition was compared with the nurse agent condition, no significant mean differences were found in overall evaluation of the service, including perceived usefulness ($p = .22$),



<Figure 3> Bar Plot for Each Condition

attitude (p = .35) and satisfaction (p = .17). Thus, H1a and H1b was not supported. Similarly, the comparison between the doctor agent condition and the split agent condition (nurse+doctor) showed no significant mean differences in overall evaluation of the service, as reflected in perceived usefulness (p = .26), attitude (p = .54) and satisfaction (p = .80). Thus, H2a and H2b was not supported.

RQ2 further investigated the role-specific impact of agents. A series of two-way ANOVA was conducted to examine the main and interaction effects of agent roles. First, the main effects of the doctor agent were significant on perceived usefulness [F(1, 80)= 10.73, p = .00, η^2 = .12], attitude [F(1, 80) = 5.62, p = .02, η^2 = .07] and satisfaction [F(1, 80) = 8.07, p = .01, η^2 = .09] (see <Table 3>). Specifically, participants in the absence of doctor agent (M = 5.33, SD = .91) reported higher levels of perceived usefulness than those in the presence of doctor agent (M = 4.59, SD = 1.23). Similarly, the absence of doctor agent (M = 5.06, SD = 1.03) showed higher levels of attitude compared to the presence of doctor agent (M = 4.57, SD = .96). Satisfaction was also higher in the absence condition (M = 4.99, SD = 1.02) than in the presence condition (M = 4.36, SD = 1.07). No significant differences were observed for cognitive trust (p = .54), affective trust (p = .27), social presence (p = .87), perceived message strength (p = .99) and continuous usage intention (p = .11).

<Table 3> Main Effects of the Doctor Agent on Dependent Variables

Variable	Presence		Absence				
	M	*SD*	*M*	*SD*	*F*	η^2	*p*
Cognitive Trust	4.54	1.08	4.38	1.20	.38	.01	.54
Affective Trust	3.16	1.14	3.49	1.23	1.25	.02	.27
Social Presence	2.69	1.28	2.63	1.59	.03	.00	.86
Perceived Message Strength	5.34	.73	5.34	.64	.00	.00	.99
Perceived Usefulness	4.59	1.23	5.33	.91	10.73**	.12	.00
Attitude	4.57	.96	5.06	1.03	5.62*	.07	.02
Satisfaction	4.36	1.07	4.99	1.02	8.07*	.09	.01
Continuous Usage Intention	3.71	1.35	4.19	1.36	2.59	.03	.11

On the other hand, the main effects of the nurse agent were significant on perceived usefulness [$F(1, 80) = 6.84$, $p = .01$, $\eta^2 = .08$] and attitude [$F(1, 80) = 5.41$, $p = .02$, $\eta^2 = .06$] (see <Table 4>). The presence of nurse agent ($M = 5.26$, $SD = 1.07$) showed higher levels of perceived usefulness than the absence of nurse agent ($M = 4.67$, $SD = 1.14$). Likewise, attitude was higher in the presence of nurse agent ($M = 4.88$, $SD = 1.08$) than the absence of nurse agent ($M = 4.48$, $SD = 1.07$).

<Table 4> Main Effects of the Nurse Agent on Dependent Variables

Variable	Presence		Absence				
	M	*SD*	*M*	*SD*	*F*	η^2	*p*
Cognitive Trust	4.71	1.09	4.22	1.14	3.95	.05	.05
Affective Trust	3.29	1.40	3.35	1.27	.03	.00	.86
Social Presence	2.62	1.58	2.70	1.30	.07	.00	.79
Perceived Message Strength	5.34	.70	5.34	.68	.00	.00	.99
Perceived Usefulness	5.26	1.07	4.67	1.14	6.84*	.08	.01
Attitude	5.07	.86	4.58	1.12	5.41*	.06	.02
Satisfaction	4.88	1.08	4.48	1.07	3.39	.04	.07
Continuous Usage Intention	4.04	1.54	3.87	1.20	.38	.01	.54

No significant interaction effects were found across all dependent variables: cognitive trust [$F(3, 80) = .23$, $p = .63$], affective trust [$F(3, 80) = .29$, $p = .59$], social presence [$F(3, 80) = .40$, $p = .53$], perceived message strength [$F(3, 80) = 1.03$, $p = .31$], perceived usefulness [$F(3, 80) = .06$, $p = .81$], attitude [$F(3, 80) = .06$, $p = .81$], satisfaction [$F(3, 80) = .18$, $p = .67$] and continuous usage intention [$F(3, 80) = .04$, $p = .85$] (see <Table 5>).

<Table 5> Interaction Effects on Dependent Variables

Variable	F	η^2	p
Cognitive Trust	.23	.00	.63
Affective Trust	.29	.00	.59
Social Presence	.40	.01	.53
Perceived Message Strength	1.03	.01	.31
Perceived Usefulness	.06	.00	.81
Attitude	.06	.00	.81
Satisfaction	.18	.00	.67
Continuous Usage Intention	.04	.00	.85

5. Discussion

1) Overall Discussion

This study examined the effects of agent personas—specifically nurse and doctor roles—in a healthcare context, as well as the effects of dividing responsibilities between these roles. Contrary to expectations, showing the agent's appearance did not significantly improve responses compared to the no-agent condition. This may be attributed to the absence of non-verbal behaviors including movement or facial expressions in the experimental setup, which have been identified in prior research as critical factors for fostering user engagement and emotional connection (Bickmore & Picard, 2005; Cowell & Stanney, 2005).

Interestingly, the study found that the nurse persona was more effective in enhancing user experience compared to the doctor persona. Participants who interacted with the nurse agent, compared to no nurse agent, perceived the service as useful and showed a positive attitude toward it. On the contrary, participants who interacted with the doctor agent, compared to no doctor agent, perceived the service as less useful and showed a negative attitude toward it

with lower satisfaction. It is also worth noting that not all outcome variables showed significant effects. While satisfaction and perceived usefulness differed depending on the persona, other variables such as trust did not show meaningful differences. This may be because trust is less responsive to short-term interactions and requires more time to be meaningfully affected.

There are several potential explanations for the stronger reception of the nurse agent. First, the nurse agent was presented as a young female, while the doctor agent was an older male. Prior research suggests that users generally prefer younger, female agents—especially in caregiving contexts—because of peer preference and gendered associations (Forlizzi et al., 2007; ter Stal et al., 2020). This implies that the stronger preference for the nurse agent may not have been due to her occupational role, but rather influenced more significantly by demographic attributes such as being a young female. As a health companion/assistant agent, users may prefer a young female agent, rather than an old male agent. Second, participants may not have perceived the doctor agent as more expert or competent. In prior studies, older agents were often rated as less trustworthy or professional than younger ones (Andreoletti et al., 2015; Cuddy et al., 2008). Furthermore, because the system provided general rather than personalized feedback, participants might have felt a gap between the expected expertise of the doctor and the actual experience (Komatsu et al., 2012). More importantly, participants responded more positively to the nurse agent regardless of whether roles were split or combined. This suggests that agent effectiveness may depend less on role division and more on which persona is presented. In particular, the presence of a nurse persona alone may be more impactful than attempts to divide roles functionally.

This study explored the impact of splitting the agent by role and found that combining roles into a single agent was more effective than splitting them. One possible explanation is that healthcare interactions often benefit from emotional continuity. A split persona may have disrupted this continuity, potentially diminishing users' sense of trust and engagement (Bickmore et al., 2010). Therefore, rather than focusing solely on functional role division, it may be more effective to design a single agent whose persona evokes empathy, relatability, and competence—qualities aligned with users' emotional expectations in healthcare contexts.

In conclusion, this study demonstrates that the embodiment of an agent is not sufficient to enhance user experience. Instead, agent characteristics such as persona type, clarity of role, and demographic cues like age and gender—play a significant role in shaping user perception and satisfaction. Notably, the study highlights the importance of designing personas that align well with users' expectations and preferences, indicating that a well-crafted persona can positively impact both user experience and satisfaction. These insights provide valuable guidance for optimizing agent design in healthcare settings.

2) Contributions and Implications

This research provides valuable insights into the design of healthcare agents and a deeper understanding of their application and effectiveness. It presents empirical evidence that the use of embodied conversational agent in healthcare does not consistently yield positive outcomes. Additionally, this study contributes to the literature by comparing scenarios with and without embodied conversational agent. This comparative approach offers a more comprehensive assessment of the real-world benefits and limitations of using these agents in healthcare.

One significant contribution of this research is the provision of practical guidelines for the application of agents in real-world healthcare settings. These guidelines can help in designing more effective and user-friendly agents. For example, the study examined the impact of role-based agent segmentation. Although we did not observe a significant effect from segmenting agents by role, it should not be understood that split agent is not effective in healthcare context. The focus of this study was primarily on providing health-related information, which may not have aligned with users' expectations of physicians. For example, it is not clear if role segmentation would also not be effective for diagnostic and treatment services requiring expertise. Therefore, this exploration lays the groundwork for future research to delve deeper into role-based segmentation and its potential benefits.

Additionally, this study found that using nurse persona has positive impact on user experience. This result aligns with existing literature that favors young female agents and underscores the importance of considering agent characteristics such as age and gender in the

design phase of healthcare services. By incorporating such agents early on, healthcare providers can potentially attract and engage more users. Furthermore, this insight encourages further exploration into other professional persona that might be beneficial in various healthcare contexts, thereby broadening the scope of effective agent design strategies. By understanding and leveraging the characteristics that make certain persona effective, healthcare services can be designed to better meet user needs and expectations, ultimately contributing to enhanced user satisfaction and improved health outcomes.

These findings take on added relevance in light of recent developments in digital healthcare in South Korea. As of 2025, the country has been expanding its digital health infrastructure, including mobile health platforms, AI-powered consultation services, and government-led telemedicine pilots (Kim et al., 2025; Shinn et al., 2025). In this context, understanding how users perceive and interact with healthcare agents can inform the development of more acceptable and effective digital services. Building on these contextual implications, this study further examined how specific persona characteristics may influence user experience in healthcare services.

In conclusion, this research highlights the importance of healthcare agent design and the segmentation of agents according to their roles, providing strategic directions for enhancing user experience and improving the efficiency of healthcare services. This will ultimately contribute to the advancement of digital healthcare, enabling more users to access effective healthcare services. The practical guidelines and strategic insights provided by this study can be a valuable resource for healthcare providers, designers, and researchers working to develop more effective healthcare solutions.

3) Limitations

There are several limitations in the current study that should be addressed in future research to enhance the validity and reliability of the findings. First, we observed low response scores for certain survey items, which may indicate that participants had difficulty understanding the questions. This may have resulted in a floor effect, potentially skewing the

data and making it difficult to draw accurate conclusions about the effectiveness of the embodied conversational agent. Future studies should consider restructuring or simplifying the survey to ensure clearer understanding and more diverse responses.

Second, we followed role and gender stereotypes by setting the nurse as a young female and the doctor as an older male. Previous research (Fiske et al., 2018) indicates that societal preferences for young female agents might have influenced the positive reception of the nurse persona. By conforming to these stereotypes, the study may have unintentionally biased the results, as participants might respond more positively to an agent that fits their stereotypical expectations. In addition, since agent roles and visual attributes (e.g., age, gender) were manipulated simultaneously, it becomes difficult to isolate the effect of each factor. This may have contributed to the lack of clear effects in the split persona condition. Future research should vary age and gender independently and examine how user-agent similarity (e.g., gender, age) affects user responses.

Third, the lack of a distinction between the roles of the nurse and the doctor may represent a limitation in the manipulation of experimental stimuli. As illustrated in Figure 1, the appearances of the doctor and nurse were designed to reflect highly stereotypical depictions: the doctor was portrayed as an older male wearing a white gown and a stethoscope, while the nurse was depicted in a nurse uniform holding a medical chart. When both the nurse and the doctor appeared together, the distinction between their roles was relatively clear, allowing participants to differentiate the two more easily. However, in the single agent conditions—where either a nurse or a doctor alone performed both roles—participants may have experienced ambiguity regarding the professional identity of the agent. In particular, since the doctor agent in this study did not provide diagnoses or treatment for serious conditions but merely delivered the results of basic health screenings, the role may have been perceived as overlapping with that of a nurse or a medical technician, thereby contributing to potential confusion. Given these limitations, future studies employing the split agent design should explore contexts beyond the nurse-doctor paradigm to examine its applicability and generalizability further.

Fourth, some of the lower evaluations of the doctor agent may have resulted from a

mismatch between participants' expectations and the content delivered. Participants may have anticipated personalized or expert-level recommendations after completing the questionnaire, especially given that the doctor was presented as an older male agent. However, the system only provided general feedback, which may have been perceived as too generic or lacking credibility. Furthermore, we did not assess prior expectations toward the different personas, which may have influenced how the agent's recommendation was perceived. Future research should consider including both expectation measures and personalized agent responses to enhance perceived credibility and effectiveness.

Lastly, the study sample consisted primarily of healthy undergraduate and graduate students. As a result, the generalizability of the findings to other age groups or individuals with different health conditions may be limited. Future research should include more diverse samples to evaluate the broader applicability and effectiveness of agent-based healthcare systems across varied populations. By refining the design and methodology, future studies can build on these findings to develop more effective and widely applicable healthcare agents.

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헬스케어에서의 분할 페르소나 효과:
에이전트의 역할을 중심으로*

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디지털 기술의 채택이 가속화됨에 따라, 대화형 에이전트는 의료 분야에서 점점 더 많이 사용되고 있다. 이러한 에이전트의 페르소나는 사용자 상호작용에서 중요한 역할을 한다. 본 연구는 역할에 따라 구분된 페르소나를 사용하는 효과를 조사하여 의료 분야에서 대화형 에이전트의 설계 및 구현을 탐구하고자 한다. 본 연구는 84명의 참가자를 대상으로 2 (간호사 에이전트: 부재 vs. 존재) × 2 (의사 에이전트: 부재 vs. 존재) 간의 실험 설계를 사용하여 진행되었다. 참가자들은 건강 관련 설문조사 및 권고를 받으며 지정된 에이전트와 상호작용하였다. 결과적으로, 간호사 에이전트와 상호작용한 경우 의사 에이전트보다 인식된 유용성, 태도 및 만족도에 더 긍정적인 영향을 미쳤다. 또한, 분할 페르소나 조건은 단일 에이전트 조건과 비교했을 때 유의미한 차이를 보이지 않았다. 이러한 결과는 대화형 에이전트 설계에 중요한 시사점을 제공하며, 에이전트 페르소나를 신중하게 고려하여 사용자 경험을 효과적으로 향상시킬 필요성을 강조한다.

주제어 : 디지털 헬스케어, 대화형 에이전트, 페르소나, 분할 페르소나

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