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Anthropomorphism and social presence in Human–Virtual service assistant interactions: The role of dialog length and attitudes

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ABSTRACT

In this study, we delve into the perceived quality of recommendations provided by AI-based virtual service assistants (VSAs). Specifically, the role of the social presence of VSAs in influencing recommendation perceptions is investigated. We also explore how the social presence of a VSA is formed and how perceived anthropomorphism plays a vital role in shaping social presence and eventually instilling trust in VSAs among consumers. These relationships are examined in the context of online government services. The results indicate that consumer interaction with VSAs - manifesting via perceived anthropomorphism, social presence, dialog length, and attitudes - improves recommendation quality perceptions, which further instills trust in VSA-based recommendations. Perceived anthropomorphism was found to strongly influence the formation of social presence, whereas trust and recommendation quality - the outcomes of social presence - were found to be partially conditional on the dialog length and the degree of positive attitudes toward VSAs. The findings additionally suggest that a VSA can be considered a social actor that possesses the capability to bring a “human touch” to online services, therefore improving the overall online service experience.

1. Introduction

The current business environment increasingly offers services and applications powered by general artificial intelligence (AI), which enables automated and highly personalized customer experiences (Wedel & Kannan, 2016). Among these interfaces are conversational agents and chatbots known as virtual service assistants (VSAs), which offer a cost-effective substitute for human-centered communication that has traditionally been undertaken by human personnel. In addition to providing functional help, VSAs serve as social companions by adding social presence to online services. The formerly human-driven social interaction between service providers and customers is now mediated by VSAs, which are becoming the dominant interfaces for customer-company interaction (Araujo, 2018).

The use of VSAs in both business organizations' services, as well as public services, is forecasted to increase, as firms and government organizations are expected to invest heavily in cognitive and AI systems. According to Peart (2020) and International Data Corporation (IDC report, 2020), conversational AI and deep learning applications are experiencing particularly strong momentum with an annual global

market growth rate of 40% (Peart, 2020). The conversational AI global market is expected to grow from USD 4.8 billion in 2020 to USD 13.9 billion by 2025 (Markets and Markets, 2020). VSAs are expected to capture the largest market share, as they have numerous use areas, such as tracking customer behavior, providing customer support, and personalizing customer interactions. The rapid growth in VSAs is further enhanced by the positive experiences of organizations that use them, which have benefited from reductions in calls, chats, and email requests, increased customer satisfaction, and significant cost savings (Information Age, 2019; Peart, 2020).

The present study understands VSAs as sociotechnical systems that are part of a wider socio-technical assemblage (Kitchin, 2017) embedded in various organizational structures (Orlikowski, 2009). They offer a higher degree of autonomy in providing recommendations to human decision-makers (Araujo et al., 2020) compared to sociotechnical systems with human advisors. In the latter, the human actor brings “belongings,” such as needs, values, expectations, attitudes, and goals, to a recommendation encounter in addition to affecting the creation of the message, its perception, and the reaction to it (Ruben & Gigliotti, 2016). These belongings are critical and influence the framing of the

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message (Goffman, 1974), which helps to define the situational social reality, set expectations for ongoing communication, and bring human actors' attitudes and goals to the situation. In socio-technical situations involving AI-based VSAs, such as the public online services that are the focus of the present study, VSAs arguably promote enhanced interactivity through social presence, stronger control over information, and higher consumer personalization, greater access, and convenience for their consumers.

According to the computers as social actors (CASA) theory, such VSAs could be perceived as social actors that can assume an active role in a communication system. They are a means of replacing a human actor in interactions, imitating human communication, and expressing features that suggest a human likeness (i.e., perceived anthropomorphism) by, for example, signaling an identity, engaging in small talk, providing responses that meet users' input and expectations, and conveying empathy (Adam et al., 2020). Additionally, research suggests that people prefer recommendations from AI-based systems over those from humans (Logg et al., 2019) and that, in terms of fairness, usefulness, and risks, decisions made by AIs are often evaluated as superior to decisions made by humans (Araujo et al., 2020).

The present study understands the consumer-VSA interaction occurring in a government's online service as a communication system in which the VSA is a social actor. The need for the present is highlighted for example by Naneva et al. (2020) and Rapp et al. (2021), stating that there is a lack of evidence regarding communication with VSAs in real-life interaction. Therefore, the primary goal of this paper is to explore the role of social presence, its formation, and its effects on interaction outcomes in VSA-consumer interaction in the context of online services. Specifically, we aim to investigate the connection between the perceived anthropomorphism in VSAs (i.e., the imitation of human likeness) and social presence in an existing, real-life service setting. Araujo et al. (2020) have noted a difference in how individuals think of (automated) decisions that they encounter in real life versus in a simulated or imagined situation. Therefore, in the current study, we focus on a real-life AI-based recommendation system setting in the context of a government's online service.

Studies on VSA-human interaction have suggested that social presence positively affects the outcomes of the interaction between VSAs and humans in a service environment (Etemad-Sajadi, 2016). Previous scholarship on such outcomes have highlighted factors including satisfaction with the service encounter (Verhagen et al., 2014), trust in the service provider (Hess et al., 2009), communication, recommendation quality, and improved customer motivation and engagement (Baylor, 2011). In the present study, we focus on the influence of social presence on consumers' perceived quality of recommendations offered by a VSA as well as the degree to which such social presence instills trust among consumers.

Overall, the study contributes to the literature on computers as social actors – assuming that the human-computer relationship is fundamentally social (Nass & Steuer, 1993) – by empirically testing the influence of perceived anthropomorphism on social presence with VSAs. Furthermore, it enriches the literature on social presence by providing empirical evidence from a real service interaction and insight into how perceived anthropomorphism drives social presence (Edwards et al., 2019; Etemad-Sajadi, 2016; Lee et al., 2006). Finally, it adds to the present knowledge of outcomes of social presence in the context of online services (Araujo, 2018; Liebrecht et al., 2020; Lu et al., 2016; Pitardi & Marriott, 2021) by testing the impact of attitudes (Hassanein et al., 2009; Naneva et al., 2020) and communication style (Adam et al., 2020; Feine et al., 2019; Hill et al., 2015; Ruben & Gigliotti, 2016) on interaction outcomes.

2. Theory

2.1. Computers as social actors (CASA)

The present study is built upon the notion that individuals interact with computers (and other media) in the same way as with real people. Thus, users unconsciously apply the same social rules used in human-to-human interaction and view the computer as a peer in social interaction (Nass et al., 1996; Reeves & Nass, 1996). This assumption is based on the media equation theory (Reeves & Nass, 1996), which states that interactions with media are equivalent to real-life interactions with other people. Accordingly, to obey the same social rules that govern interaction with real people, an individual must first understand the computer or media to be a social actor that is worthy of social responses (Nass & Moon, 2000). The CASA paradigm was eventually expanded to include versatile media as social actors, including robots (Edwards et al., 2016; Goble & Edwards, 2018) and bots (Araujo, 2018; Ciechanowski et al., 2019). Previous studies have found that social presence had an important role in human-robot (Lee et al., 2006) and human-VSA interaction (Ciechanowski et al., 2019). Researchers have also suggested that anthropomorphic features of VSAs, such as human-like language or a human name, increase the perception of the agent as human-like (Araujo, 2018), though it remains unclear how those anthropomorphic, human-like features interplay with perceived social presence.

2.2. The virtual service assistant as a social actor

A VSA is an AI-based online program that operates autonomously but acts for users. It is proactive and can interpret, learn, and argue during interactions. It can also pursue precise and changing goals according to changes in the environment (Mimoun & Poncin, 2015; Paraschiv, 2002, p. 102). Examples of intelligent applications include digital assistants (e.g., Apple's Siri, Google Assistant, Google Duplex, Amazon's Alexa, and Microsoft's Cortana) as well as automated cars, refrigerators, and technology that provide functional help and social elements in online and offline services. These intelligent applications have been described in numerous terms, such as conversational agents (CA), chatbots, virtual assistants, and digital assistants (see, e.g., Feine et al., 2019). All these terms refer to diverse types of digital assistants that give people help and advice (Mimoun & Poncin, 2015) and may possess the capacity to interpret, learn, and argue during interactions (Paraschiv, 2002). Furthermore, AI-based conversational applications can be understood as social applications. For example, Edwards et al. (2016) have suggested that a bot may be considered a social bot if it is a substitute for a human partner in communication and imitates human-to-human communication. In line with Väänänen, Hiltunen, Varsaluoma, and Pietilä (2019, November), the present study conceives of a VSA as "a software that discusses with the user via written text or speech about a topic," such as an information search or request or instructions. VSAs function in connection with online services or mobile applications (e.g., bank services, government services, or online stores).

The development of VSAs is leading them to become an integral part of the decision-making process of consumers, who may outsource their buying decisions to VSAs (Klaus & Zaichkowsky, 2021). Because VSAs can imitate human interaction, their attributes are believed to strongly affect interaction outcomes. For example, McLean et al. (2021) have posited that VSAs are becoming an important source of brand-related information and part of the brand engagement process, as VSA attributes (e.g., social presence, perceived intelligence, and social attraction) were found to influence consumer brand engagement. Previous evidence also reveals that the ability to interact with VSAs may increase a consumer's perceived service quality, satisfaction, trust, and purchase intentions (Etemad-Sajadi & Ghachem, 2015; Holzwarth et al., 2006). However, there is limited empirical evidence from customer-VSA interactions to conclude how VSA attributes affect interaction outcomes.

2.3. Social presence and recommendation quality

Online services are characterized by limited human contact, which reduces the perceived personalness of service and leads to greater social distance, thus making it more difficult for service providers to establish trusting relationships with customers (Pavlou et al., 2007). By using VSAs, which are viewed as social actors (Nass & Moon, 2000; Oh et al., 2018), companies seek to improve the overall service experience by enhancing customers' perceptions of being in contact with another (Lu et al., 2016). This "sense of being with another" reflects the concept of social presence (Biocca & Harms, 2002), in which the "other" may be a human or an AI-powered system (Edwards et al., 2016). A communication system such as a VSA aims to create a sense of social presence by providing social cues in, for example, human-like attributes (Kim et al., 2020) and communication styles (Liebrecht et al., 2020). Strong social presence has been considered a positive affect leading to positive social outcomes (Oh et al., 2018) as well as greater persuasion and attraction (Fogg & Tseng, 1999), higher communication quality (Hassanein & Head, 2007; Liebrecht et al., 2020), improved overall satisfaction (Abeele et al., 2016), and trust (Cyr et al., 2007). However, previous findings have indicated that social interaction may be undesirable in certain situations, and Oh et al. (2018) have noted that greater social presence does not always produce positive outcomes. These insights imply that the effects of social presence are likely to differ significantly between communicational contexts. Nevertheless, evidence of such situational differences is scarce.

2.4. Perceived anthropomorphism

In the literature on machine-human interaction, perceived anthropomorphism is understood as the attribution of human-like features, motivations, intentions, emotions, and behaviors to non-human agents (Epley et al., 2007; Fan et al., 2016). Non-human agents that possess such qualities are perceived as anthropomorphic or human-like. In addition, the CASA paradigm (Reeves & Nass, 1996) proposes that social influences in human-machine interaction are similar to those in human-human interaction (Kim et al., 2007), therefore, voice and communication style also influence the perception of anthropomorphism.

Furthermore, VSAs perceived as anthropomorphic can be viewed as social influencers (Baylor, 2009), which can affect and change the beliefs, attitudes, and behaviors of others (Bagozzi, Fornell, & Larcker, 1981). Existing evidence indicates that the most effective influencers display features resembling those of the audience or that the audience aspires to possess (Baylor, 2011). The previous evidence supports this by showing that perceived anthropomorphism affects social presence, purchase intentions (Han, 2021), and overall interaction effectiveness (see Hess et al., 2009; Qiu & Benbasat, 2009). Thus, the first hypothesis states as follows:

H1. Perceived anthropomorphism of a VSA positively affects social presence.

2.5. Recommendation quality

In online services where VSAs act as recommendation agents, recommendation quality is the measure of the consumer-VSA interaction outcome. Following the CASA paradigm (Reeves & Nass, 1996), when a VSA has human-like characteristics, consumers tend to perceive it as a real person. Accordingly, they apply the same interaction patterns and expect a similar interaction style as in an interaction with a real human. The findings of, for example, Liebrecht et al. (2021) indicate that interaction with VSAs is more closely aligned with consumers' expectations and involves a more familiar interaction style will result in higher perceived interaction quality.

Araujo (2018) has studied social presence created in social

interaction and found a positive relationship between the degree of social presence and interaction outcomes. In their research, interaction with a human-like VSA led to more positive outcomes compared to interaction with a machine-like VSA, and social presence mediated the interaction-outcome effect. Go and Sundar (2019) have similarly suggested an overall positive relationship between social presence and consumers' perceptions.

In the present study, we focus specifically on the context of VSA-consumer interaction in an online service environment where the effect of social presence on recommendation quality has not been empirically verified. We consider recommendation quality to be constructed by perceived usefulness and personalization of the recommendation (cf. Abeele et al., 2016) and positively affected by social presence. Thus, we propose the following hypothesis:

H2. Social presence will positively affect the perceived quality of the recommendation provided by the VSA.

2.6. Trust in the VSA

Trust is an important component of successful online service experience, satisfaction, and loyalty (Ball et al., 2004) and is embedded in all social relationships, including both human-human and human-machine. Trust represents a person's assessment of the other party's trustworthiness based on the evidence available under the circumstances (Lewis & Weigert, 1985). According to social response theory, social presence plays a key role in human-machine interaction that positively affects the formation of trust (Lu et al., 2016), attitudes (Hassanein & Head, 2007), and online behavior (Chung et al., 2015). Pitardi and Marriotti (2021) have reported that a human-like conversation with a VSA can promote the formation of social presence, which is foundational to attitudes and the development of trust. Thus, we expect that a high perceived social presence during an interaction with a VSA will lead to greater trust in the VSA than in the case of a low perceived social presence.

Previous research in the online context has illustrated that information quality and website design affects the formation of trust in online services (Hsu & Tsou, 2011). Trust in a VSA derives from the expectation that the VSA has specific knowledge and no egoistic motives and adheres to generally accepted principles, such as honesty and honoring promises. Therefore, trust depends on the individual's knowledge and perceptions of the VSA's competence and honesty in dealing with the assigned task (Wang et al., 2016) and is inspired by competence, benevolence, and integrity (McKnight et al., 2002). On this basis, a VSA's ability to provide accurate and useful information is expected to be positively associated with trust in the VSA and the service provider (Nilashi et al., 2016). High-quality recommendations are those considered useful, good, accurate, or personalized to one's needs (Wilson, 1983). A consumer-VSA interaction that drives social presence is also predicted to result in improved service quality by enabling more personalized and accurate recommendations, which further cultivates trust in the VSA and intention to follow the recommendations. Therefore, recommendation quality is believed to mediate the relationship between social presence and trust (Lee & Shin, 2014; Mimoun & Poncin, 2015). Given this, we propose the following hypotheses:

H3. Perceived recommendation quality will positively affect trust in the VSA as a social recommendation agent.

H4. Social presence will positively affect trust in the VSA, with perceived recommendation quality mediating the relationship.

2.7. Attitudes toward VSAs

Attitudes are defined as predispositions to respond either positively or negatively to an object and are found to be antecedents of behavioral intentions (Ajzen & Fishbein, 2000). Social response theory dictates that social presence is positively associated with attitudes (Hassanein &

Head, 2007) leading to actual behavior (Chung et al., 2015). However, the relationship may vary between different contexts of communication, due to differences between media types in the capability of being able to provide perceptions of anthropomorphism to the audience (Lu et al., 2016; McLean et al., 2020).

In a recent study, Pitardi and Marriott (2021) examined the effect of social presence and the role of attitudes in the context of voice assistants. They found no direct effect of social presence on attitudes but detected a significant positive effect of attitudes on behavioral intentions. In addition, McLean et al. (2020) have identified a significant positive relationship between social presence and attitudes toward a website in the live chat context. The findings of a cross-cultural study by Hassanein et al. (2009) have also provided indications of a significant association of social presence with attitudes in a website service context. Recently, a systematic literature review by Naneva et al. (2020) has reported that people's affective attitudes and cognitive attitudes toward social robots (i.e. social entities capable of interacting socially with the user) are slightly positive. Interestingly, the review found that attitudes in situations of direct face-to-face contact with a social robot were more positive than in situations of indirect contact. In addition, Hong et al. (2022) also demonstrated that a positive general attitude of individuals toward machines led to a more positive evaluation of their performance. This positive effect is expected to hold in the case of VSAs, such that a positive predisposition toward VSAs will strengthen the effect of social presence on perceived recommendation quality and trust, while a negative predisposition will weaken it. Thus, the following hypotheses are set:

H5a. Attitude toward a VSA will moderate the relationship between social presence and recommendation quality, such that a positive or negative attitude will weaken or strengthen the effect, respectively.

H5b. Attitude toward a VSA will moderate the relationship between social presence and trust, such that a positive or negative attitude will weaken or strengthen the effect, respectively.

2.8. Dialog length

According to the CASA paradigm (Nass et al., 1996), users ascribe personalities to computers. In this process, the strength of the language, the interaction order, and the expressed confidence level are central elements. Because the customer-VSA interaction takes place through a real-time dialog, VSAs use verbal cues when interacting with users (Araujo, 2018; Feine et al., 2019). A recent study on VSA interaction has identified the type of dialog as a decisive factor for user compliance with the VSA's recommendations. In particular, perceived anthropomorphism formed in a verbal interaction increased users' willingness to rely on the VSA's recommendations (Adam et al., 2020). Thus, the mode of dialog can have a significant role in constructing social interactions with VSAs. In exploring users' verbal behavior, Hill et al. (2015) have found that users communicated with VSAs for longer durations and with less rich vocabulary and more profanity compared to in human-to-human interactions. Additionally, an extensive literature review of VSAs by Feine et al. (2019) has concluded that the use of social cues can help to imitate human-to-human interaction. Therefore, social cues can shape perceptions of the authenticity of service agents and inform users' evaluations of the quality of the communication (Wuenderlich & Paluch, 2017).

The acceptance of social cues depends on the chosen communication style and verbal techniques and includes the use of empty phrases, colloquial language, emotions, attentiveness, and personalization, which all characterize a persuasive communication style (Feine et al., 2019). In this way, the dialog design influences the agreement of users with the VSA's requests (Adam et al., 2020). However, the dialog design also depends on the context, which determines the type of dialog that is appropriate and expected. When entering an interaction, an individual invests their communicational belongings (e.g., needs; Ruben & Gigliotti, 2016), which implies that the expected outcomes of the

interaction and the chosen communication style are important. As stated, the actual communication styles of VSAs – including their dialog style – should align with users' expectations (Go & Sundar, 2019).

Kim et al. (2021) in their study on human perceptions of AI use have noted that interpersonal behaviors and their communicative exchange can be considered task-orientated or relationship-orientated, and the goals of these situations vary (Forsyth, 2010, pp. 118–122). A task orientation aims to accomplish a certain performance, whereas a relationship orientation focuses on maintaining a relationship. The orientation of communication has effects on all aspects of communication (Kim et al., 2021), including dialog style. In the context of the present study, which concerns a public online service, the goal of the communicative exchange with the VSA was presumably task-orientated, as the users were seeking a solution to their taxation-related problems. Thus, the simple goal of the interaction was to obtain a sufficient amount of accurate and up-to-date information in an appropriate format on taxation. The style was a task-oriented dialog.

Users have different expectations of the performance and dialog style of VSAs depending on whether they are identified as humans or VSAs (Go & Sundar, 2019). Users value a high-interactivity VSA dialog style, which adds anthropomorphism, more than a low-interactivity style. A high-interactivity dialog is continuous and responsive to the participant's messages, mainly by acknowledging the participant's responses to previous questions but also by conveying an awareness of the participant's previous responses. This style supports cohesion and continuity of the conversation (Go & Sundar, 2019) and affects the length of each response as well as the dialog length as a whole. Thus, we expect that the length of the dialog with the VSA will be significantly associated with the outcome effectiveness of social presence, and we posit the final hypotheses:

H6a. Dialog length will moderate the relationship between social presence and recommendation quality, such that a long or short response will strengthen or weaken the effect, respectively.

H6b. Dialog length will moderate the relationship between social presence and recommendation trust, such that a long or short response will strengthen or weaken the effect, respectively.

In the present study, we constructed and tested a conceptual model (Fig. 1) that expects perceived anthropomorphism to affect social presence during a social interaction where a VSA provides information and help to a consumer. A higher degree of perceived anthropomorphism is predicted to improve social presence during the interaction, which would, in turn, lead to increased recommendation quality, trust in the VSA, and perceived interaction success. Dialog length and attitudes toward VSAs are expected to play conditional roles in the present study by impacting the outcomes of social presence.

3. Methodology

3.1. Participants and design

The present study followed a between-subjects experimental design with 623 useable responses. Two experimental conditions (dialog length: short, long) was created on an online government taxation service where an AI-based VSA provided help to citizens. The VSA operated on the service's website throughout the experiment period, and the VSA's conversations were modified for the two experimental conditions. In addition, the 10 most common conversation themes (based on the data history) were identified and included in the experiment (e.g., "a tax ID card for benefits," "when do I get the tax decision," "where do I find my tax decision," and "a tax card for children"). The selected conversation trees were modified to resample either a short or long dialog (see Appendix 1). The long dialog condition featured significantly longer and more thorough responses than the short dialog condition. In the long dialog style, answers included links to access further information on the issue, and the user had to proceed through several steps to find the

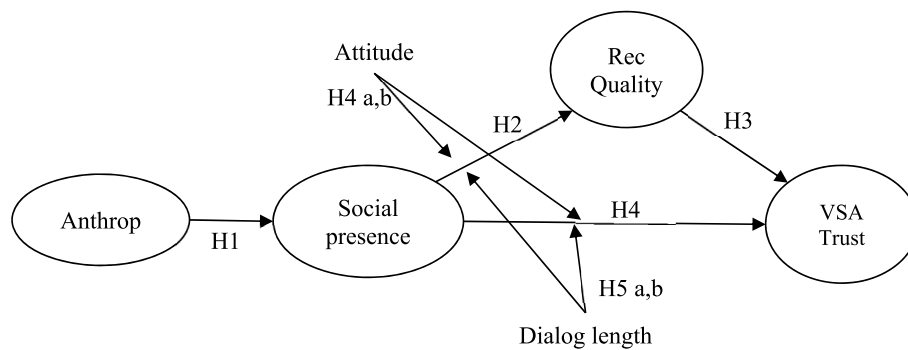


Fig. 1. Conceptual model.

answer to their original question. Since users encountered more information in the long dialog version, they had to expend more effort than in the short version. We did not modify responses in terms of colloquial language, emotions, attentiveness, or personalization.

The experiment lasted for approximately 16 weeks. The short dialog condition was presented in the first half of the experiment period, and the long dialog condition was presented for the remaining weeks. In addition to setting experimental conditions for dialog length, three other experimental conditions were set to manipulate the perceived anthropomorphism of the avatar. The visual appearance of the VSA was modified during the study period by changing the visualization between a human avatar, a robot avatar, and no avatar (see Appendix 2). A three-item scale of anthropomorphism by Eyszel et al. (2011) was applied as a manipulation check variable, but no significant difference was detected in the mean values of anthropomorphism between the three experimental conditions ($F = 0.83$, sig. > 0.05). Therefore, the effect of perceived anthropomorphism on social presence was not experimentally validated.

3.2. Data Collection and analysis

The respondents were clients of the online taxation service who voluntarily engaged in conversations with the VSA for assistance with taxation- or service-related problem. The VSA window was located in the lower-right corner of the webpage. At the end of the conversation, the respondents were asked to participate in the survey by clicking a link that introduced the survey with a privacy notice, information about the study, and a chance to participate in a grocery gift drawing. After accepting the privacy notice, the respondents were directed to the survey items.

The respondents were reasonably representative of the average customers of the taxation service. The respondents were 42 years of age ($SD = 12.4$) on average. In terms of gender, 61.5% were female, 30.7% were male, and 7.9% gave no response. On average, the respondents were very familiar with VSAs in general, as 63% had used them several times. However, 68% indicated that they had no previous experience with this particular VSA. The problems that prompted the respondents to seek advice from the VSA were, on average, simple, with a mean value of 2.89 ($SD = 1.66$; 1 = very easy, 7 = very complicated). Respondents also reported very high interaction success with the VSA, with a mean value of 6.88 ($SD = 3.06$; 0 = weak success, 10 = excellent success).

To test the conceptual model and proposed hypotheses, we adopted structural equation modeling with the maximum likelihood estimation method using SPSS AMOS 26 software. In addition, the bootstrapping method was employed to test mediation and interaction effects with the Andrew Hayes PROCESS macro in SPSS Hayes, 2012).

3.3. Independent variables

Perceived anthropomorphism was measured with a four-item scale

(warm, friendly, trusting, agreeable) adapted from Eyszel et al.'s (2011) original 10-item scale. These four items were selected after being assessed as the most suitable for measuring the perceived anthropomorphism of the VSA studied in the present service context. Chu and Kamal's (2008) five-item scale was used for measuring attitudes toward the VSA. The dialog length was manipulated between two experimental conditions: a short dialog condition and a long dialog condition (see Appendix 1).

3.4. Dependent variables

Verhagen et al.'s (2014) five-item scale was used to measure social presence. Tam and Ho (2006) suggested scales for measuring the personalization of recommendations (five items) and the usefulness of recommendations (three items) were adapted to measure perceived recommendation quality. Trust in the VSA as a recommendation agent was measured as a three-dimensional construct comprised of competence (five items), benevolence (three items), and integrity (three items), as adapted from Wang et al. (2016). All of the scales used a seven-point Likert scale.

3.5. Ethical considerations

Throughout the research process, we followed the code of ethics for researchers of the local university. The approval of the local ethical committee was not required, as the research consisted of participants over the age of 18, did not intervene in the physical integrity of the research participants, and did not expose participants to exceptionally strong stimuli or involve a risk of causing mental or physical harm. All subjects were aware of the purpose of the research, the research ethics, and the privacy and confidentiality considerations and gave informed consent following the Declaration of Helsinki.

4. Results

A confirmatory factor analysis (CFA) with SPSS AMOS was conducted to test the validity and unidimensionality of the measurement scales. The CFA results with factor loadings are presented in Table 1. The variables loaded well to their assigned factors with loading values between 0.73 and 0.98 and composite reliabilities higher than 0.8 showing good internal reliability (Bagozzi & Yi, 2012). The variables were also found to converge on their assigned factor constructs, as the average variance extracted (AVE) values ranged from 0.65 to 0.82, which exceeded the cut-off value of 0.5 (see Table 2). Because the square root of the AVEs exceeded the between-factor correlations in each construct, the factor constructs were assessed as demonstrating adequate discriminant validity (Ping, 2004). A robustness test was also performed to confirm the insignificant effect of modifying the avatar's visual appearance on the scales in the model. The mean values of the scales between the three conditions were tested for differences with analysis of

Table 1
Confirmatory factor analysis.

Measures and Items	Loadings
RecTrust	
This VSA is like a real expert	0.827
understands my needs and preferences concerning the problem question.	0.865
has good knowledge about taxation issues.	0.852
puts my interest first.	0.867
keeps my interests in its mind.	0.885
wants to understand my needs and preferences.	0.878
provides unbiased product recommendations.	0.68
is honest.	0.677
I consider this VSA to have integrity.	0.702
SocPre	
I felt a sense of human contact with the VSA.	0.831
I felt a sense of personalness with the VSA.	0.786
I felt a sense of human sensitivity with the VSA.	0.921
Anth	
This VSA was agreeable.	0.922
Warm	0.756
Trusting	0.808
Sociable	0.767
Friendly	0.847
Att	
I feel <i>favorable - unfavorable</i> toward chatbots in general.	0.812
good – bad ...	0.913
wise – foolish ...	0.799
beneficial – harmful ...	0.87
positive – negative ...	0.876
RecQual	
The VSA's advice matched my needs.	0.961
I felt that the VSA's advice was personalized to me.	0.753
Asking advice from the VSA enabled me to accomplish my task quickly.	0.942
I found the VSA's advice useful.	0.956
DialogLength (manipulated) – short – long length	n.a.

Note: RecTrust = trust in recommendation; SocPre = social presence; Anth = perceived anthropomorphism; Att = attitude toward chatbots; RecQual = recommendation quality.

variance (ANOVA). No significant difference in the mean values of social presence, recommendation quality, trust, and attitude was detected. Therefore, we can exclude the potential of a significant biasing effect of the avatar's visual modifications on the analysis results.

4.1. Test of the structural model

Next, a structural model was constructed and tested. The results of the model and hypothesis tests are presented in Table 3. The model fit indices suggested a good model fit (Schermelleh-Engel et al., 2003). The chi-square value divided by the degrees of freedom was slightly elevated but still below 5 (PCMIN/DF 4.82), which is considered the cut-off value. In addition, other model fit indices were also examined, which exceeded the cut-off value of 0.9 (IFI = 0.952, TLI = 0.94, RFI = 0.926, CFI = 0.951), and the root-mean-square error of approximation remained below 0.08 (RMSEA = 0.072). Therefore, the model was assessed as showing a good model fit. The estimated model accounted for 73% of the variance in recommendation trust, 54% of the variance in social presence, and 4% of the variance in perceived recommendation

Table 2
Discriminant validity, means, and SDs, square root of AVEs (on diagonal).

	Mean (SD)	CR	AVE	RecTrust	SocPre	Anth	Att	RecQual	DialogLength
RecTrust	4.25 (1.58)	0.949	0.823	0.907					
SocPre	3.55 (1.70)	0.884	0.719	0.140	0.848				
Anth	4.08 (1.59)	0.912	0.676	0.392	0.654	0.822			
Att	4.78 (1.37)	0.931	0.731	-0.075	0.424	0.242	0.855		
RecQual	3.84 (2.02)	0.944	0.653	0.258	0.792	0.764	0.346	0.808	
DialogLength	n.s.	n.a.	n.a.	0.074	0.042	0.030	0.066	-0.006	n.a.

Note: Rec_trust = trust in recommendation; SocPre = social presence; Anth = perceived anthropomorphism; Att = attitude toward chatbots; RecQual = recommendation quality.

quality. The direct effects representing H1–H4 shown in Table 3 were all significant; thus, the hypotheses were supported. The results reflect that social presence positively affected the perceived quality ($\beta = 0.21, p < 0.001$) and trust ($\beta = 0.83, p < 0.001$) in the VSA's recommendations. In addition, social presence was strongly driven by the perceived anthropomorphism of the VSA ($\beta = 0.74, p < 0.001$).

4.2. Mediation and moderation tests

The mediation and moderation effects were tested by running Andrew Hayes's PROCESS macro in SPSS. The standardized factor scores were imputed based on the constructed measurement model in AMOS and used to test moderation and mediation effects with the PROCESS macro (Model 8). The PROCESS macro was employed because it is more suitable than AMOS software for interaction effect analysis in particular. The results are summarized in Table 4. The indirect effect of SocPre→RecQual→RecTrust was found to be significant, although the effect size was low ($\beta = 0.018, \text{low CI} = 0.002, \text{high CI} = 0.025$). Thus, H4 was supported, which suggests that perceived recommendation quality mediated the relationship between social presence and recommendation trust.

Next, an interaction effect analysis was applied to detect the hypothesized moderation effect of the respondents' attitudes toward VSAs

Table 3
Results of testing the conceptual model.

Structural model	β	CR	sig.	R ²	Hypothesis
Anth → SocPre	0.736	18.09	<0.001	0.54	H1: supported
SocPre → RecQual	0.208	4.60	<0.001	0.04	H2: supported
SocPre → RecTrust	0.831	19.24	<0.001	0.73	H4: supported
RecQual → RecTrust	0.091	3.28	<0.01		H3: supported
Model fit: PCMIN/DF 4.20, RFI .923, IFI .950, TLI .940, CFI .950, RMSEA .072					

Note: Rec_trust = trust in recommendation; SocPre = social presence; Anth = perceived anthropomorphism; Att = attitude toward chatbots; RecQual = recommendation quality.

Table 4
Results of mediation and interaction effect analyses.

Mediation	β	Lower/Higher CI	Sig.	Hypothesis
SocPre→RecQual→RecTrust	0.018	0.007/0.037	0.006	H4: supported
Interaction effect				
SocPre × Bot Att → RecQual	0.112	2.32	0.021	H5a: supported
SocPre × Bot Att → RecTrust	0.039	2.28	0.023	H5b: supported
SocPre × DialogLength → RecQual	-0.014	-0.01	>0.05	H6a: not supported
SocPre × DialogLength → RecTrust	0.086	1.98	0.049	H6b: supported

Note: RecTrust = trust in recommendation; SocPre = social presence; Anth = perceived anthropomorphism; Att = attitude toward chatbots; RecQual = recommendation quality.

on the effects of social presence. The results indicate that attitude had a significant positive moderating effect on the SocPre–RecQual ($\beta = 0.11, p < 0.05$) and SocPre–RecTrust ($\beta = 0.04, p < 0.05$) relationships. Thus, a positive attitude strengthened the positive effect of social presence on perceived recommendation quality and recommendation trust. This result supports H5_a and H5_b. Finally, the moderating effect of dialog length (manipulated - short/long dialog length) was tested. The results reflect that dialog style significantly strengthened the SocPre–RecTrust relationship ($\beta = 0.09, p < 0.05$) but had no such moderating effect on the SocPre–RecQual relationship. Therefore, dialog length fostered a direct positive effect of social presence on recommendation trust. This result supports H6_b, but not H6_a.

The interaction effects were further explored with slope analysis, as shown in Fig. 2. The results of the slope analyses evidence that respondents who had a positive previous attitude toward VSAs and perceived low social presence during the study perceived a more negative recommendation quality than those with a negative previous attitude toward VSAs. This result may suggest differences in expectations of the VSA. Furthermore, improvement in social presence had a significantly stronger positive effect on perceived recommendation quality among respondents who had a positive previous attitude than among those with a negative previous attitude. A similar moderating effect of dialog length on the relationship between social presence and recommendation trust was also detected. Improvement in social presence had a stronger positive effect on perceived recommendation trust when the VSA provided long responses than when it provided short responses.

5. Discussion and conclusions

5.1. Discussion and theoretical contributions

The present study is one of the first field studies to investigate the interaction of consumers with a VSA and their perceptions of its recommendations in an existing, real-life service setting. Our particular interest was in the influence of perceived anthropomorphism, social presence, attitudes, and dialog length on the effectiveness of recommendations. The VSA was understood as a social actor, and the human-VSA interaction was viewed as a communication system (Ruben & Gigliotti, 2016) in which social presence plays a central role (Etemad-Sajadi, 2016). In human-VSA social interaction, an individual’s belongings (e.g., attitude toward the VSA) and the VSA’s communication style are expected to be important factors for interaction outcomes (cf. Adam et al., 2020; Feine et al., 2019). The conceptual model was constructed and tested with a field experiment among a sample of consumers using a VSA in online government service. Each respondent engaged in a conversation with the VSA to obtain help and information.

The results extend the existing knowledge of the role of social presence in human-machine interactions (Araujo, 2018; Ciechanowski et al., 2019; Edwards et al., 2016) and demonstrate how attitudes (Naneva

et al., 2020) and dialog style through its length (Adam et al., 2020; Feine et al., 2019) affect interaction outcomes in the context of online services. The novel perspective that the interactional situation with the VSA should be considered a communicational situation with certain expected goals enabled us to also look beyond the actual interaction. The results support the proposed model, wherein social presence acts as the focal driver of human-VSA interaction outcomes, as it accounted well for perceived recommendation quality and trust in the VSA. The results also confirm that social presence in human-machine interactions and with the VSA can positively affect not only individuals’ engagement but also interaction outcomes reported by, for example, Abeeel et al. (2016), Baylor (2011), and Liebrecht et al. (2020). Consumers were willing to share more information, which allowed for the provision of more personalized and useful information and, in turn, produced positive outcomes, such as higher trust in the VSA.

The findings contribute to research streams on the social presence (Chung et al., 2015; Hassanein & Head, 2007) and attitudes in consumer behavior (Hong et al., 2022). Our objective was to examine the formation of social presence and test how previous attitudes toward VSAs might affect the outcomes of consumer-VSA interaction in the human-machine interaction context. The results add to the debate on the relationship and outcomes of social presence and attitudes in the consumer-VSA interaction context (Hassanein et al., 2009; McLean et al., 2020; Pitardi & Marriott, 2021). An interesting finding was that underlying attitudes toward VSAs proved to be important in determining the impact of social presence on the interaction outcomes of recommendation quality and recommendation trust. A positive attitude led to stronger effects of social presence on recommendation quality and VSA trust. Therefore, although more positive prior attitudes led to more negative outcomes in low social presence situations, the improvement in perceived social presence resulted in stronger positive outcome effects than in negative prior attitude situations. Accordingly, outcomes of consumer-VSA interaction should be viewed in a wider context than the actual communicational encounter. In this regard, it is worth considering how different societal positions may affect AI- and VSA-generated interaction prior to the actual interactional situation. For instance, Araujo et al. (2020) have found that higher educational background was a predictor of a more positive attitude.

The third main finding relates to the role of dialog and its length, which was expected to impact the outcomes of social presence and was operationalized in the research context as the length of the VSA’s response. We showed that a more thorough and longer dialog strengthened the positive outcomes of social presence for consumers’ trust in the VSA recommendations. This result may indicate that thorough responses, even when strictly informational and task-orientated, can be considered a distinguishable feature of social interaction, as a relationship requires time to emerge, and they, therefore, strengthen the effect of social presence on the formation of trust in the VSA. Consequently, with the present study, we contribute to the research on text-

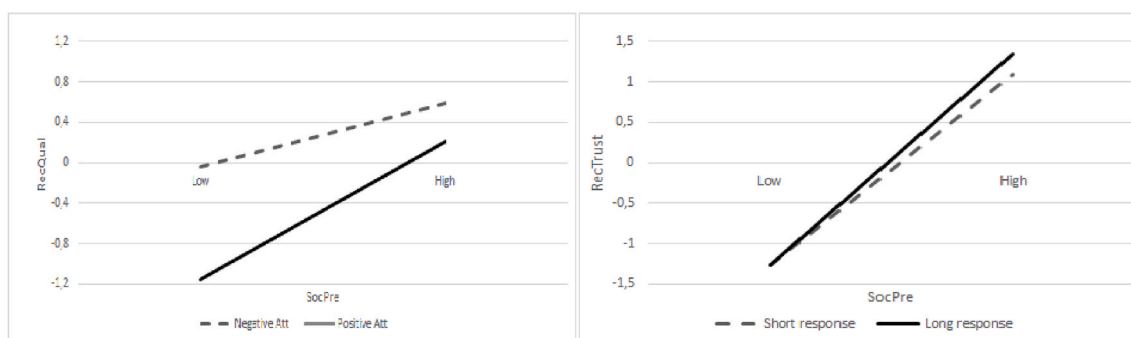


Fig. 2. Slope analysis: Interaction effects of SocPre × Att on ReqQual and SocPre × Dialog Length on RecTrust. Note: Low = -1 SD from mean; High = +1 SD from mean.

based VSAs. As [Rapp et al. \(2021\)](#) have noted, there is a lack of research on the particular design features of text-based VSAs and how they affect anthropomorphic, human-like interaction.

Although the main focus of this study was not to identify human-like features, the operationalization of social presence as the sense of “being with another” ([Biocca & Harms, 2002](#); [Edwards et al., 2016](#)) filled this evident research gap. We found that social presence may be sensed in service encounters that do not particularly emphasize the VSA’s human likeness through design features; instead, the long dialog, which was designed to be formulaic, official, and strictly task-oriented, increased the sense of social presence. This result suggests that official service environments may benefit from increasing social presence but increasing social presence does not always entail imitating informal, human-like interaction at least through dialog. Social presence, as the sense of being with another, increases trust both in the VSA and in the recommendations it offered. But this “other” may well be an AI-powered partner. This aligns well with the CASA paradigm, users interacting with bots as like with humans. However, our research finding relates to evidence on algorithmic appreciation ([Araujo et al., 2020](#); [Logg et al., 2019](#)) that, in many situations, individuals prefer recommendations from AI or VSAs over human recommendations. Interestingly, the previous research on social bots ([Lucas et al., 2014](#); [Skjuve et al., 2021](#)) has also revealed that individuals are more willing to self-disclose (one predictor for successful interaction), with a bot than with a human partner.

The present findings imply that social presence in human-machine interaction increases the effectiveness of the human-VSA interaction. However, individuals may prefer that the VSA, as an interaction partner, uses language and a dialog that seem appropriate for a machine - if the situation is framed as AI-powered. This insight further highlights how essential it is for users to be aware of who or what they are communicating with ([Go & Sundar, 2019](#)) and that the design of the interactional features is aligned with it. These further point out the need to carefully consider the expected goals for interacting with VSA and the use of AI-powered systems, whether they are used for functional and task-orientated purposes or social and relationship-orientated purposes ([Kim et al., 2021](#)).

As suggested, the actual identity of a conversation partner, whether it is a human or VSA, does not necessarily play a significant role ([Ho et al., 2018](#)). The main concern should be laid on communication to confirm it is consistent and in line with the goals of the interactional situation. As [Hong et al. \(2022\)](#) found out in their research on the creative use of AI in the music scene, users are not necessarily interested in whether they are encountering machines or not. What matters is the performance and the quality of these encounters. In their study, it was the quality of the AI-generated music, not the fact that it was AI-generated. As they pointed out, future studies should explicitly indicate that there is no relationship between the features that an AI agent has and its performance. From our study, we can state that the features of AI certainly play a significant role in how the performance is perceived, but these features are not necessarily ones that are mimicking human-likeness.

5.2. Managerial implications

The managerial implications of this study are twofold. First, given that VSA technologies are becoming the primary interface between customers and service providers, VSAs could be seen as social actors that can effectively deliver information, help, and recommendations in online services. The effectiveness of a VSA depends on its characteristics and if they provide customers with a feeling of “being with another” (i. e., social presence). Evoking this feeling can enhance interaction outcomes, such as recommendation quality and trust in the VSA. Second, features of human actors, such as previous attitudes toward VSAs, have significant influences and further define how social presence affects interaction outcomes. We found that the sense of “being with another”

improved perceived recommendation quality and trust among individuals who had a positive attitude toward VSAs. This finding implies that efforts to improve interaction outcomes in real service settings should target individuals with a negative attitude, as encouraging a positive change in attitude can effectively improve human-VSA interaction outcomes.

This study has demonstrated that framing the human-VSA interaction in the service context as a communication situation supports a focus on the actual interaction and aspects that increase social presence in that situation. Moreover, it guides attention to attitudes and the mechanisms that lead the human partner to expect positive outcomes and lean toward social presence (“being with another”) in or through VSA-generated communication. Such insight further reflects how VSAs, as examples of AI-generated automatization, are part of the wider socio-technical environment. Achieving expected interaction outcomes then concerns not only VSA design but also the expectations that individual sets for the VSA as a partner before the interaction.

This study is one of the first empirical studies of human-VSA communication in a real service setting. The findings indicate that individuals can benefit from VSA-generated services. However, it is important to understand that individuals’ attitudes vary between service contexts. Service providers should also carefully consider who benefits the most from VSA-generated communication.

5.3. Limitations and suggestions for future research

The present study involved limitations that illuminate avenues for future research. The first limitation relates to the research design, which centered on a particular VSA operating on one government taxation service website. This context may possess unique characteristics that lessen the applicability of the research findings to other service contexts, and the findings may be too specific to the service category and VSA characteristics. The study also concerned only service and selected customer problem cases related to taxation issues. As user groups and their usage motives differ across services, future studies should test the constructed model in other service contexts and with VSAs that have different characteristics.

In addition, the relationship between perceived anthropomorphism and social presence was not experimentally validated in this study. The manipulation of perceived anthropomorphism by modifying the avatar’s visual appearance was not successful – possibly because the avatar was small, and the size could not be modified due to the field experiment condition. The image manipulation could have been especially hindered using mobile devices among participants. Furthermore, the manipulated image of the avatar was displayed only on the welcoming window when the discussion was opened and not during the conversation. The unsuccessful manipulation might alternatively indicate that the avatar’s appearance was less important in the present study context, which signals research opportunities to further investigate VSA characteristics that have a more significant effect on the VSA’s anthropomorphism.

Another limitation is that we focused on only one possible outcome variable of social presence. Other important marketing performance indicators, such as following recommendations, satisfaction, and brand attitude, may be of great interest to research and practice. Finally, since consumers’ attitudes toward VSAs were not manipulated experimentally, the moderating effect is only correlation-based. Future studies should experimentally test the role of attitudes in the constructed VSA effectiveness model. In this context, it would be interesting to examine how attitudes toward VSAs form and influence human-VSA interaction outcomes.

6. Conclusions

The present study has aimed to generate novel empirical knowledge of human-machine interaction with VSAs. We framed VSAs as social actors participating in a communication system in the context of real-life

online services. The research investigated how perceived anthropomorphism affected the sense of social presence and how social presence subsequently shaped perceived recommendation quality and trust in the VSA communication. We also explored how individuals' attitudes prior to the communication situation and the dialog length during the situation affected the interaction outcomes.

The results of this field experiment study contribute to the existing literature on computers as social actors, human-machine interaction, and social presence by illustrating how a sense of social presence led to higher perceived recommendation quality and trust in the VSA. Perceived anthropomorphism was found to strongly influence the formation of social presence, and the outcomes of social presence proved to be partially conditional on the dialog length and the degree of positive attitudes toward VSAs. The findings further indicate that consumers' perceptions of anthropomorphism and social presence were moderate, and AI-based VSAs as social actors possess the capability to bring a "human touch" to online services, therefore improving the overall online service experience.

The study suggests that more effort should be devoted to creating a

sense of social presence in human-VSA interactional situations. A sense of social presence can increase the likelihood of achieving desirable interaction outcomes. Notably, the effect of recommendation quality increasing trust in the VSA implies that it is crucial to contextually define the appropriate style of recommendation, particularly for putting the recommendation into practice. In line with the CASA paradigm, the results evidence that a positive attitude of an individual toward the interaction partner in a human-machine encounter is decisive for the interaction outcomes. Lastly, the finding that a lengthy, official dialog strengthened the positive outcomes of social presence for trust in the VSA reflects that the appropriate dialog of a VSA is not necessarily one that mimics informal, human-like dialog.

Credit author statement

Conceptualization, J.M., K.T.-L., D.M.; Data Collection, J.M., K.T.-L.; Analysis, J.M.; Writing, review and editing, J.M., K.T.-L., D.M.; Funding, Foundation for Economic Education, grant ID 180236; All authors have read and agreed to the published version of the manuscript.

APPENDIXES

Appendix 1

Example of the stimulus for manipulating the dialog length.

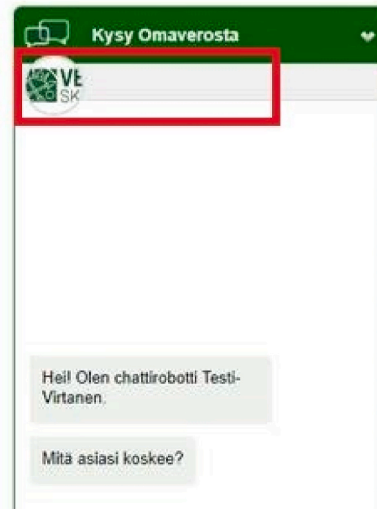
Short dialog

Topic: "Tax ID card for the benefit"
Response:
 You will need a tax card for your benefit income. If you do not have a tax card, the payer of the benefit makes a formal withholding tax.
 Order a tax card from OmaVero. You will receive a tax card when you report the amount of the benefit in the Other Income section under Benefits.
 What do you think of the answer? Press the button below to answer the survey.
 Answer the survey and take part in the lottery

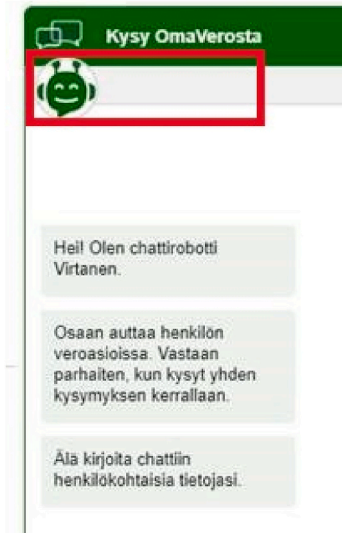
Long dialog
Question: "Tax card for the benefit"
Response:
 You can order a tax card for benefit income from OmaVero.
 If you do not have a tax card, the payer of the benefit makes a formal withholding tax. When you order a tax card, the tax rate may be lower or higher than the formula percentage.
 On the My Tax home page, find the Actions section and select Tax Cards and Withholding Tax. Click Order to order a new tax card.
 → Next
 Please review your income information and make the necessary changes. You do not have to change your payroll information if you do not want a new tax card for payroll.
 You will receive a tax card for the benefit when you report the amount of the benefit in the Other Income section under the Benefits section.
 What do you think of the answer? Press the button below to answer the survey.
 Answer the survey and take part in the lottery
 → Read more
 → Answer the survey and take part in the lottery

Appendix 2. Example of the stimulus for manipulating perceived anthropomorphism

Low perceived anthropomorphism (no avatar).



Moderate perceived anthropomorphism (robot avatar).



High perceived anthropomorphism (graphical human face with name avatar).



Appendix 3

Validation of the insignificant effect of the avatar’s visual modification on the model constructs

		N	Mean	SD	F	Sig.
Trust	No avatar	196	4.20	1.56	.246	.782
	Robot	152	4.22	1.64		
	Graphical human face	275	4.30	1.56		
	Total	623	4.25	1.58		
Social presence	No avatar	196	3.50	1.66	.028	.973
	Robot	152	3.46	1.69		
	Graphical human face	275	3.49	1.69		
	Total	623	3.48	1.68		
Attitude	No avatar	196	3.13	1.29	.047	.954
	Robot	152	3.11	1.40		
	Graphical human face	275	3.15	1.28		
	Total	623	3.13	1.31		
Recommendation quality	No avatar	196	3.85	1.98	.681	.507
	Robot	152	3.68	2.07		
	Graphical human face	275	3.92	2.02		
	Total	623	3.84	2.02		

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