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Abstract

Virtual representatives are increasingly used in recommender systems to guide users and add conversational aspects. However, the impacts of virtual representatives on users' evaluations of the recommender system have not been investigated. This study specifically examined the influence of virtual representatives' anthropomorphism cues on system users' perceptions of system credibility and liking. The results revealed that system users' perceptions of the virtual representative's credibility have a significant influence on users' perceived credibility and liking of the system. Also, the human-like appearance of a virtual representative significantly influences users' perceived attractiveness of the virtual representative, while voice outputs from the representative were found to have a significant influence on users' liking of the recommender system.

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The Influence of Virtual Representatives on Recommender System Evaluation

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ABSTRACT

Virtual representatives are increasingly used in recommender systems to guide users and add conversational aspects. However, the impacts of virtual representatives on users' evaluations of the recommender system have not been investigated. This study specifically examined the influence of virtual representatives' anthropomorphism cues on system users' perceptions of system credibility and liking. The results revealed that system users' perceptions of the virtual representative's credibility have a significant influence on users' perceived credibility and liking of the system. Also, the human-like appearance of a virtual representative significantly influences users' perceived attractiveness of the virtual representative, while voice outputs from the representative were found to have a significant influence on users' liking of the recommender system.

Keywords

Recommender systems, Source credibility, Liking, Virtual representative, Anthropomorphism, Voice

INTRODUCTION

Recommender systems (RS) are increasingly taking on important roles in online consumers' information search and decision making. However, these systems are usually not efficiently used by decision makers because of a lack of confidence in the recommendations they provide (Moulin et al., 2002). It is important for RS research and design to examine factors that can influence the likelihood of recommendations to be accepted and integrated into decision-making processes. The persuasion literature suggests that people more likely accept recommendations from credible and likable sources (O'Keefe, 2002). Fogg (2003) found that source credibility also matters when computers take on advisory roles. Similarly, Komiak and Benbasat (2008) state that user compliance with advice given by a RS is dependent on trust in the system. This implies that the perceived credibility and perceived liking of the RS would be important factors that influence a user's likelihood to accept recommendations.

Recent studies have proposed that computer-based help systems can be more persuasive when they give a variety of social cues that elicit social responses from their human users (Nass & Moon, 2000; Fogg, 2003; Fogg et al., 2002). One approach to increasing the social aspects of RS is to use a virtual representative (VR) to guide users through elicitation processes. Several RSs have been implemented with interfaces that feature VRs. However, it is still not clear how the VRs are perceived by RS users and influence users' interactions with these systems. Further, it has not been investigated whether the VRs presented as part of the system interface would influence users' evaluations of the RS as a whole, not just of the VR itself. In other words, the question is whether RS users distinguish the VRs from the system or if they personify it and evaluate the system based on the representative.

Previous research supports that the characteristics of the spokesperson in advertisements influence consumers' perceptions of the advertisement (Goldsmith et al., 2000; Lafferty and Goldsmith, 1999). Since VRs in RSs take on a similar role, this implies that there are likely impacts of representatives on system evaluation. Also, a recent study conducted by Qiu and Benbasat (2005) provides some evidence of the impacts of interface representatives on system-user interactions. It is thus believed to be important to investigate how the design and use of VRs in RSs influences users' perceptions.

To address the above issues this study investigated the impacts of VRs presented in RSs on system users' perceptions. In particular, the influence of the VRs' anthropomorphism cues on system users' perceptions of system credibility and liking were examined.

LITERATURE REVIEW

Recommender Systems as Social Actors

Existing studies have viewed RSs as information search tools and have largely neglected their social roles in the interaction with users. The social aspects of technologies have only been recently emphasized (Reeves & Nass, 1996; Nass & Moon, 2000; Fogg, 2003). Nass and Moon (2000) noted that the computer's social role is encouraged when the computer fills roles traditionally filled by humans and also provides words for output and interactivity. Indeed, Wang and Benbasat (2005) found that users perceive RSs as having human characteristics and treat systems as social actors. The findings by Aksoy et al. (2006) suggest that the similarity rule is also applied when humans interact with RSs. The study found that a user is more likely to use a recommender agent when it generates recommendations in a way similar to the user's decision-making process. Morkes, Kernal, and Nass (1999) demonstrated that computer agents that use humor are rated as more likable, competent, and cooperative. In addition, trust in RSs was found to be important in supporting system users' decision making (Bauernfeind & Zins, 2006) as well as intentions to adopt a RS (Wang & Benbasat, 2005; 2008).

Recommender system evaluation

RS evaluation approaches are typically based on user satisfaction and technology acceptance (Wixom & Todd, 2005). Many studies also evaluated RSs in terms of system accuracy (Herlocker et al., 2004). With the growing interest in the social aspects of systems, more recent studies evaluated systems in terms of helpfulness (Iba, 2007) and user trust (Wang & Benbasat, 2005; Xiao & Benbasat, 2007).

In the persuasion literature, perceived credibility and liking are identified as important criteria when people evaluate the source of advice (O'Keefe, 2002). Flanagin & Metzger (2008) noted that impacts of source credibility apply to the context of online environments. Fogg (2003) also found that source credibility matters when humans interact with computers. They stressed that credibility is especially important when computers instruct or advise users. Since the role of RSs involves giving advice in online environments, traditional studies of source factors could provide an important framework to examine the interaction between users and systems as well as users' evaluations of systems. Taking the most researched source factors into account, the current study examined the perceived credibility and liking of a RS.

Virtual representatives

One way of increasing the social aspects of technologies is to use VRs (Rosenberg-Kima, Baylor, Plant & Doerr, 2008). In the RS context, VRs take on the role of increasing users' interpersonal communication experiences and, thus, emphasize the social role of the system as the advice giver.

Virtual representatives in human-computer interaction

Many communication technologies use VRs to facilitate interactions with users. Existing studies have found that adding VRs in interfaces facilitates human and computer interactions. Van Mulken et al. (1998) demonstrated that system users more likely engage with a system and perceive the system as more useful when a VR is presented. Similarly, Moundridou & Virvou (2002) found that adding a VR increases engagingness and perceived credibility of the system. VRs were also found to augment social interactions (Qiu, 2006) and to induce trust (Wang & Emurian, 2005). In addition, VRs present in online shopping decision aid systems enhance online shopping experiences (Holzwarth et al., 2006).

Although VRs were found to enhance user-computer interaction, it is still not clear what types of VRs are most preferred and beneficial. Importantly, it has been argued that different types of VRs have different effects on personal perception (Nowak, 2004; Nowak & Biocca, 2003; Taylor, 2002; Qiu, 2006). Thus, it is necessary to identify important characteristics of VRs and their impacts on users' perceptions in a RS context.

Anthropomorphism

Anthropomorphism is defined as the extent to which a character has the appearance or behavioral attributes of a human being (Koda, 1996; Nowak, 2004; Nowak & Biocca, 2003; Nowak & Rauh, 2005). According to social cognitive theory, one of the basic functions of social cognition is to categorize the environment based on an entity's level of anthropomorphism in order to differentiate among inanimate objects, animals, and humans that could pose a threat or an opportunity for cooperation (Kunda, 1999). The rule of homophily, i.e. the tendency to associate with similar others (e.g. McCroskey, Richmond, & Daly, 1975; McPherson, Smith-Lovin & Cook, 2001), also supports the possible influence of anthropomorphism cues on trust building. In human-computer interaction research, anthropomorphism of VRs has been identified as an important factor that influences people's interactions with computers (e.g. Koda, 1996; Nowak & Biocca, 2003; Nowak, 2004). Static VRs and

animated VRs were compared by Baylor and Ryu (2003) and the influence of different levels of anthropomorphism on social presence, telepresence and co-presence was examined by Nowak and Biocca (2003). Yet, the benefits and costs of anthropomorphic VRs are debatable. For example, more anthropomorphic VRs are rated as more credible, engaging, attractive and likeable than less anthropomorphic images in some studies (Koda, 1996; Nowak & Rauh, 2005) while other studies found contrasting results (Nowak, 2004; Nowak & Biocca, 2003; Murano, 2003). Also, the voice output of VR was found to be helpful to induce social and affective responses from users in some studies (Qiu, 2006; Moreno et al, 2001) but other studies found that sociability is higher when VRs only communicated with text (Sproull et al., 1996). The likely explanation for these contradictory findings is that responses to VRs could be different depending on the context of interaction (Nowak & Rauh, 2005). Thus, it is necessary to examine the influence of VR anthropomorphism in the specific RS context. In this study, the VR's human-like appearance and voice feedback were tested to examine the influence of anthropomorphism in the specific context of travel RSs.

Many scholars have argued that users' social responses appear to be stronger with more human-looking images (Turkel, 1995; Koda, 1996; Nass et al., 1998). Nowak and Rauh (2005) found that more human-like VRs were perceived to be more attractive and credible, and people were more likely to choose to be represented by them in computer-mediated communication. Similarly, more anthropomorphic VRs were rated as more credible, engaging and likeable than less anthropomorphic images (Koda, 1996). Also, human-like VRs are preferred when people seek information from computers (Berry et al., 2005). Therefore, the following hypotheses are posited based on previous findings.

H1a: A human-like appearance of the VR increases perceived VR credibility.

H1b: A human-like appearance of the VR increases perceived RS credibility.

H2a: A human-like appearance of the VR increases perceived attractiveness of the VR.

H2b: A human-like appearance of the VR increases perceived liking of the RS. .

It is found that computer users behave socially to speech interfaces and use the same rules and heuristics they would normally apply to other humans (Reeves & Nass, 1996; Nass & Brave, 2005). Nass and Brave (2005) noted that voice interfaces increase users' liking, trust and efficiency. In the RS context, voice output by the VR was found to be helpful in inducing social and affective responses from users and to increase perceived enjoyment (Qiu, 2006). Moreno et al. (2001) also found that voice agents increase the interests in tutoring systems. Therefore, the following hypotheses are proposed.

H3a: Voice feedback increases perceived VR credibility.

H3b: Voice feedback increases perceived RS credibility.

H4a: Voice feedback increases perceived attractiveness of the VR.

H4b: Voice feedback increases perceived liking of the RS.

Taking into account likely transfer effects from the virtual "spokesperson" to the overall system (Goldsmith et al., 2000; Lafferty and Goldsmith, 1999), it is assumed that the evaluation of the VR impacts the evaluation of the overall system. Consequently, the following hypotheses are proposed.

H5: Perceived VR credibility positively influences perceived RS credibility and liking.

H6: Perceived VR attractiveness positively influences perceived RS credibility and liking.

METHODOLOGY

A 2x2 full-factorial between-subjects experiment was designed, with the first factor being human-like appearance and the second factor voice output. Human-like appearance was manipulated by including a photographic image of a human (high human-like appearance) versus a photographic image of an object (suitcase; low human-like appearance) (See Figure 1). Voice output was manipulated by including voice feedback versus not including voice feedback. In the voice feedback condition, the VR provided verbal encouragements to subjects when they moved from one page to another.

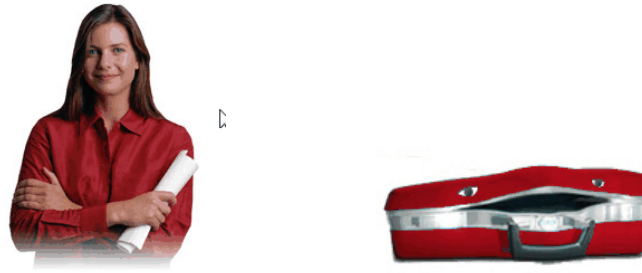


Figure 1. Human Vs. Non-Human Appearance Conditions

Data collection

Data was collected from November 14 to December 5, 2008. A total of 137 college students in a University in the United States participated in the experiment. Course extra-credits were used as an incentive.

Procedure

Participants were greeted, seated in front of a computer, and informed that a travel agency was interested in embedding a newly developed RS on its website and would like to evaluate the system. Then, a hypothetical situation which asked them to search for a destination for a spring break vacation was explained to them. Participants were randomly assigned to one of the experimental conditions, showing the homepage of a travel RS. Participants in all conditions were asked to answer the same 10 questions aimed at capturing their vacation preferences. These questions were adapted and modified from Gretzel (2004) and the vacation personality quiz developed by the United States Tour Operators Association (USTOA). After answering all the questions, participants were presented with the name, picture and description of a spring break vacation destination. The destination was chosen based on the findings of a pilot study that aimed to identify an appropriate destination. Every participant received the same recommendation so that the variations in the evaluation of the RS would depend on the experimental conditions, not the specific characteristics of recommended destination. Study participants were then asked to evaluate the system and the VR in terms of credibility and liking/attractiveness.

Measures

To measure users' perceived credibility and liking of travel RSs, measurement scales were developed based on previous studies regarding source credibility and liking (Ohanian, 1990; Newell & Goldsmith, 2001; O'Keefe, 2002; McCroskey et al., 1973; McCroskey & Young, 1981). A total of 10 credibility and 5 liking measurement items were developed. All items were measured on a 7-point semantic differential scale (e.g. Untrustworthy-Trustworthy; Dislikable-Likable). Factor analyses were conducted to evaluate the uni-dimensionality of the scales while the internal consistency of the scales was measured using Cronbach's coefficient alpha. The results of the analyses confirm the uni-dimensionality of the scales as only one factor for each scale emerged and explains more than half of the variance (72% in the case of credibility and 68% for liking). The alpha values are above the recommended level of 0.8 (credibility=.96 and liking=.86).

Subjects were asked the exact same credibility measures when they had to evaluate the VR. However, rather than asking them about the overall liking of the representative, the questionnaire asked respondents to specifically assess the attractiveness of the representative along 6 items (e.g. Unattractive-Attractive; Ugly-Beautiful), as this was the measure typically used for individual sources (Ohanian, 1990; Newell & Goldsmith, 2001; O'Keefe, 2002; McCroskey et al., 1973; McCroskey & Young, 1981). For both measures, factor analyses confirmed uni-dimensionality, with the individual factors explaining 77% and 58% of the variance, respectively. The alpha values are at or above the recommended level of 0.8 (credibility=.97 and attractiveness=.80).

Analysis

Descriptive analyses were conducted to describe the participants as well as the overall evaluations of VRs and RSs. Multiple regression analyses were then used to assess the influence of the perceptions of VR on RS evaluations. To further investigate the effects of specific characteristics of the VR, a series of one-way between-groups analysis of variance (ANOVA) were used.

RESULTS

Sample profile

More females (68.6%) than males participated in the experiment. Since the sample consisted of college students, the participants were mostly between 21 and 23 years old. The majority was Caucasian (80.3%) and had never used a travel RS before (95.6%). In terms of their travel experience, 78.8 percent reported extensive travel experience within the United States while about 40 percent had extensive international travel experience. Almost all the respondents (94.2%) indicated that they had good Internet knowledge and skills.

Descriptive results

The presented VRs were perceived as reasonably credible ($M = 5.22$, $SD = 1.13$) and attractive ($M = 4.26$, $SD = 1.03$). Also the RS was evaluated as reasonably credible ($M = 5.21$, $SD = 1.07$) and liking ratings were quite high ($M = 5.67$, $SD = 0.91$). This suggests that the experimental manipulations looked realistic and professional and were not discredited by the subjects.

The relationships between virtual representative evaluations and recommender system evaluations

To investigate the relationships between interface VR evaluations and RS evaluations, multiple regression analyses were conducted. The regression models (Table 1 and Table 2) were statistically significant and explained 65 percent and 47 percent of the variance of the users' perceptions of RSs respectively. The results revealed that system users' perceptions of VR credibility have significant influences on user's perceived credibility ($\beta = .808$) and liking ($\beta = .692$) of the RS. However, no significant relationships were found between the perceived attractiveness of the VR and the perceived credibility and liking of the system. Thus, these findings only partially confirm the hypothesized transfer effects.

Independent Variables	Beta	P
Perceived credibility of VR	.808	.000
Perceived attractiveness of VR	-.011	.850

R Square = 0.645; Adjusted R Square = 0.640; $F(2, 134) = 121.72$ ($p < 0.000$)

Table 1. Influences of Perceptions of VR on Perceived Credibility of the RS

Independent Variables	Beta	P
Perceived credibility of VR	.692	.000
Perceived attractiveness of VR	-.014	.845

R Square = 0.471; Adjusted R Square = 0.463; $F(2, 134) = 59.67$ ($p < 0.000$)

Table 2. Influences of Perceptions of VR on Perceived Liking of the RS

Influences of Anthropomorphism Cues

A series of ANOVAs were conducted to explore the impacts of specific characteristics of the VR. The results (Table 3) indicate that there is a significant influence of human-like appearance of the VR on users' perceptions of VR attractiveness ($F(1, 135) = 4.01$, $P = .048$). The perceived attractiveness of the VR is higher when it is a human ($M = 4.45$, $SD = .82$) than a suitcase ($M = 4.09$, $SD = 1.19$). However, there is no significant influence of human-like appearance on the evaluation of VR credibility. Also, no significant main effects of voice feedback and no significant interaction effects were found.

	df	F	P
Appearance of VR => Perceived credibility of VR	1, 135	0.513	.475
Appearance of VR => Perceived attractiveness of VR	1, 135	4.006	.048*
Voice of VR => Perceived credibility of VR	1, 135	0.238	.626
Voice of VR => Perceived attractiveness of VR	1, 135	0.240	.625
Appearance*Voice => Perceived credibility of VR	1, 135	0.189	.664
Appearance*Voice => Perceived attractiveness of VR	1, 135	0.024	.877

Table 3. Effects of Anthropomorphism Cues on VR Evaluations

Although only human appearance significantly influenced VR evaluations, the mean value plots show some interesting trends (see Figure 2). The suitcase condition achieved higher credibility ratings, while the human condition achieved higher attractiveness ratings. This suggests that credibility and attractiveness do not necessarily go hand in hand. Indeed, the overall correlation between the two evaluations is only .426 ($p=.000$) and it is even smaller for the human condition (.271; $p=.024$). Also, it shows that there is not even a uniform trend for voice visible in that it has a negative effect, no effect or a positive effect depending on the human appearance condition and the evaluation question asked.

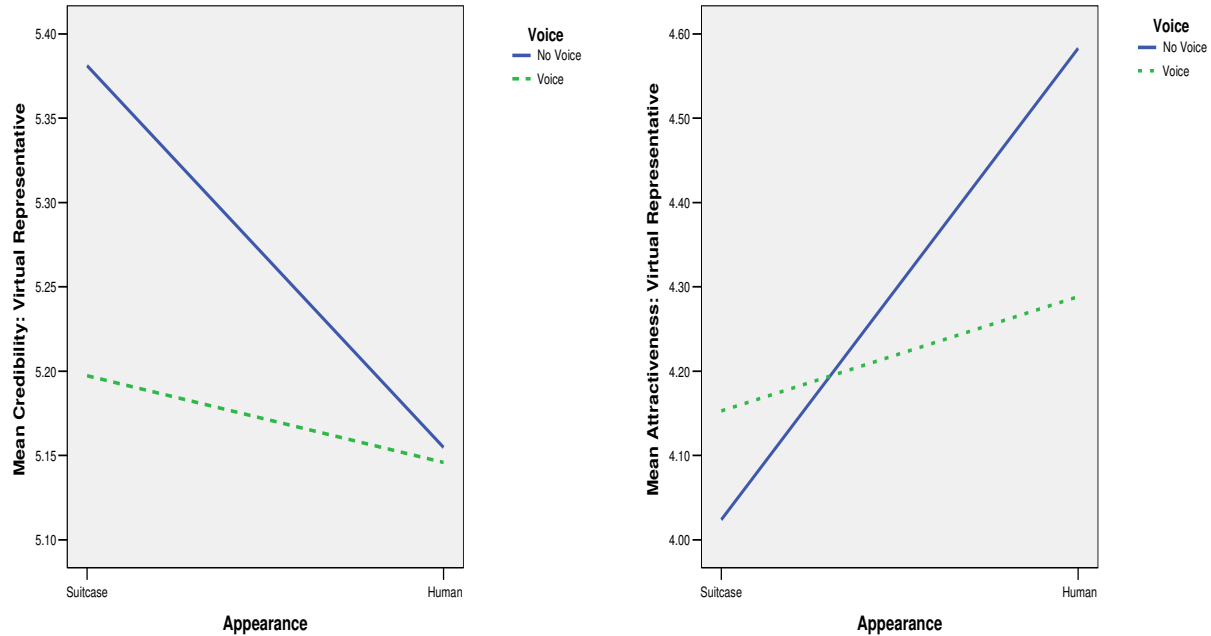


Figure 2. Effects of Anthropomorphism Cues on VR Evaluations

If RS users do not distinguish between the VR and the system, direct effects of the anthropomorphism cues might be present. Voice feedback was found to be a significant influence on users' perceived liking of the system ($F(1,135) = 4.36$, $P = .039$). Descriptive results show that the group of users who received voice feedback liked the RS more ($M = 5.83$, $SD = .91$) than the group of users who did not receive voice feedback ($M = 5.51$, $SD = .88$). The main effect for the human-like appearance of the VR and the interaction effects did not reach statistical significance (see Table 4).

	df	F	P
Appearance of VA => Perceived credibility of RS	1, 135	1.598	.208
Appearance of VA => Perceived liking of RS	1, 135	2.262	.135
Voice of VA => Perceived credibility of RS	1, 135	0.045	.832
Voice of VA => Perceived liking of RS	1, 135	4.361	.039*
Appearance*Voice => Perceived credibility of RS	1, 135	0.176	.675
Appearance*Voice => Perceived liking of RS	1, 135	0.203	.653

Table 4. Effects of Anthropomorphism Cues on RS Evaluations

Voice feedback affects overall system liking equally for the suitcase and the human conditions but only has a small, positive effect on system credibility perceptions in the case of the human representative (Figure 3). Even though the effect is not significant, system credibility and liking perceptions are higher for the suitcase condition, which is completely unexpected.

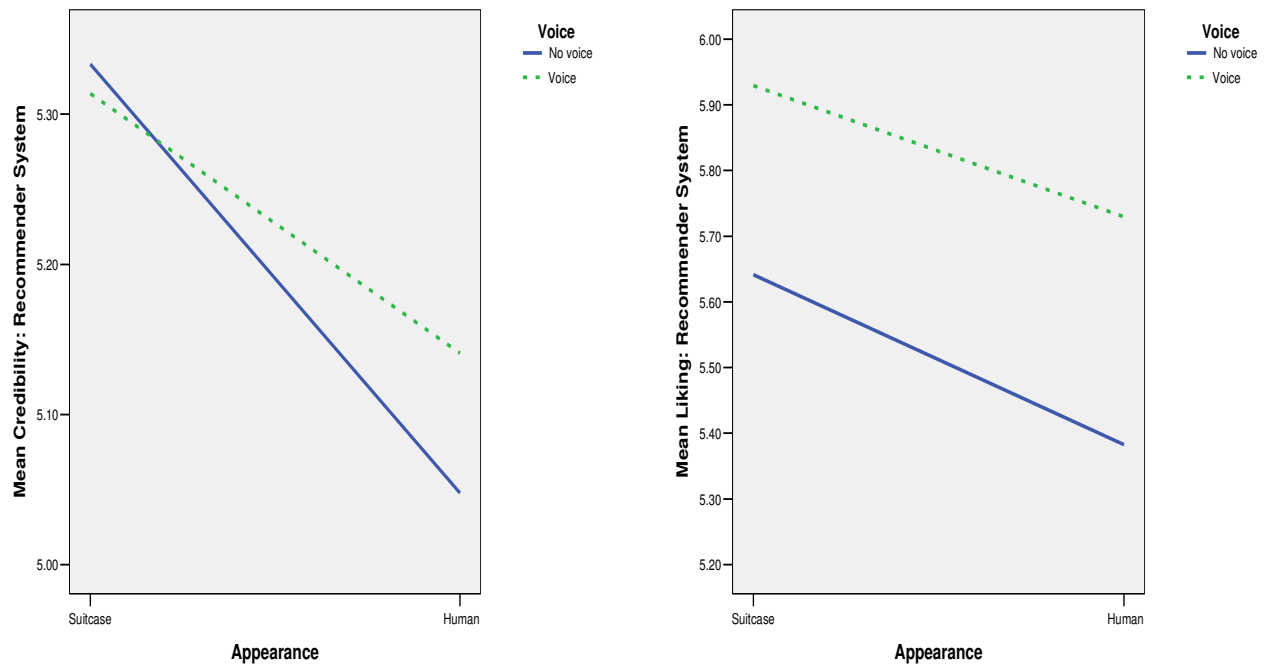


Figure 3. Effects of Anthropomorphism Cues on RS Evaluations

CONCLUSION

The findings partially support the influence of the VR's anthropomorphic cues on users' evaluations of the VR and the RS. Results show that the human-like appearance of the VR positively influences a user's VR attractiveness ratings (H2a) but not VR credibility ratings and RS evaluations. Also, voice feedback was found to influence only overall system liking but not credibility (H4b). However, the results show a positive relationship between perceived VR credibility and perceived RS credibility (H5), which suggests an important relationship between VR evaluations and overall system evaluations.

Stevens (1980) noted that insignificant results may be due to poor power of the test for detecting the difference. To investigate whether our insignificant results were caused by poor power, effect sizes were calculated using eta squared. The resulting eta squared values were less than .017 for all cases, which in Cohen's (1988) terms would be considered a small effect size. With given effect sizes and the sample size, a power analysis was conducted using the G*Power3 analysis software. The results show that the insignificant results are indeed due to poor power (less than 33% for all cases). This indicates that the sample size might have to be increased. While poor power can be one reason to explain the insignificant results, another possibility may be the limited interactivity of the VR. The VR manipulations in our study were static images which did not employ any nonverbal behavioral cues such as gesture, posture and facial expression. When the overall interactivity of the VR increases, anthropomorphic cues could be more apparent to system users.

Instead of clarifying contradictory findings of past research, the current study confirms that more research is needed to test specific manipulations, and especially combinations of cues, that might influence credibility perceptions. It certainly emphasizes the importance of carefully considering the design of VRs as they can critically influence trust and overall system evaluations.

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