



Social evaluations of embodied agents and avatars

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ABSTRACT

The purpose of this study was to examine social evaluations (i.e., perceptions of empathy and positivity) following peoples' interactions with digital human representations. Female research participants engaged in a 3-min interaction while immersed in a 3-D immersive virtual environment with a "peer counselor." Participants were led to believe that the peer counselor was either an embodied agent (i.e., computer algorithm) or an avatar (i.e., another person). During the interaction, the peer counselor either smiled or not. As predicted, a digitally-rendered smile was found to affect participants' social evaluations. However, these effects were moderated by participants' beliefs about their interaction partner. Specifically, smiles enhanced social evaluations of embodied agents but degraded them for avatars. Although these results are consistent with other findings concerning the communicative realism of embodied agents and avatars they uniquely demonstrate that people's beliefs alone, rather than actual differences in virtual representations, can impact social evaluations.

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1. Introduction

Facial expressions play an important role in communication and social interaction. Facial displays express participants' emotional states, involvement, responsiveness, understanding, and validate their thoughts and feelings (Bavelas, Black, Lemery, & Mullett, 1986; Fridlund, Ekman, & Oster, 1987). As a pervasive facial expression, smiling has received considerable attention in the literature. The ability to smile and to recognize a smile is well-developed early in life (Srofe & Waters, 1976). Moreover, a smile is a readily understood gesture of friendliness (Thompson & Meltzer, 1964) and is an important antecedent to interpersonal attraction (Byrne, 1971). Smiling affects the ways individuals are perceived and evaluated by others (Lau, 1982; Reis et al., 1990). There are many types of smiles and subtly different ones are associated with different feelings and functions. Ekman and Friesen (1982), for example, distinguished between Duchenne (i.e. genuine) and non-Duchenne (i.e. false) smiles and noted that Duchenne and non-Duchenne smiles involve different facial muscles. Although research examining the effect of different kinds of smiles on social evaluations is limited, Frank, Ekman, and Friesen (1993) found that individuals can reliably distinguish between Duchenne and non-Duchenne smiles and that Duchenne smiles are associated with more positive impressions and evaluations of others.

In the current study, female research participants engaged in a short session with a peer counselor within an immersive virtual environment. Participants' beliefs about their interaction partner were manipulated. Half were told that they were interacting in real-time with a digital representation of one of our undergraduate research assistants. In this condition, both the participant and research assistant were represented by a 3-dimensional virtual human or avatar, which is a digital representation of another actual person in real time. The other half were led to believe that their peer counselor was a computer-generated "embodied agent" (a digital representation of a computer algorithm designed to look like a person; Blascovich et al., 2002). During the interaction, the digital peer counselor either smiled when it was socially appropriate to do so, or never smiled. The digitally rendered smiles were animated so as to approximate a Duchenne smile. Following the interaction, research participants evaluated their peer counselor on a number of dimensions including perceived empathy and positivity.

1.1. Study goals

Although there is much research examining how communicative realism – the extent to which a virtual human acts like a real person – affects the way people evaluate and respond to virtual humans (Bailenson, Blascovich, Beall, & Loomis, 2003; Bailenson et al., 2005; Baylor & Soyung, 2009; Blascovich, 2002; Blascovich & Bailenson, 2011; Fridlund, 1991; Garau, 2003; Guadagno, Blascovich, Bailenson, & McCall, 2007; Von der Pütten, Krämer, Gratch, & Kang, 2010), most previous research examining communicative realism has focused on the role of eye gaze or head movements. Much less is known about how the inclusion of facial non-verbal

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behaviors affect evaluations of embodied agents compared to avatars. Thus, this study adds to the existing literature by examining a socially-important non-verbal behavior, namely smiling, and compares people's reactions to identical digitally-rendered smiles that are exhibited by embodied agents and avatars.

1.2. Predictions

Based on previous research examining the effect of smiling on social evaluations (Lau, 1982; Reis et al., 1990; Srofe & Waters, 1976; Thompson & Meltzer, 1964), we expected participants to evaluate virtual humans more positively when the latter smiled than when they did not. We also expected an interaction between the presence of smiles on the part of virtual humans and participants' beliefs regarding the virtual humans with whom they interacted.

Previous research has shown that communicative realism manipulations such as facial expressions and other non-verbal behaviors such as mimicry (Bailenson, Yee, Patel, & Beall, 2008; Stel et al., 2010) sometimes affect people's perceptions and evaluations of embodied agents and avatars differently (Bailenson et al., 2003; Guadagno et al., 2007). As a result of these prior research findings, we were interested in examining the effect of smiling and agency beliefs (i.e., beliefs about whether one's virtual partner was a human or computer) on social evaluations such as perceived empathy and positivity. Given its social nature (Fridlund, 1991), smiling may have a greater impact on people when they believe they are interacting with another person, an avatar, relative to a computer, an agent. Thus, we might expect smiling to result in more positive evaluations for avatars. However, research has also shown that the fidelity of representations of actual others enters the mix (Slater & Steed, 2001). Because people may be more sensitive to the slightest imprecision in animations of avatars compared to agents, we might expect even slightly imperfect renderings of avatars' facial expressions to elicit less positive or even negative feelings. Given these competing hypotheses that we examined the interaction between smiling and agency beliefs without making an a priori directional hypothesis in terms of smiling effects on interactants by avatars vs. agents.

2. Method

2.1. Participants

Participants were 38 undergraduate women whose average age was $M = 20.2$ ($SD = 1.55$). They received psychology course credit or were paid for their participation. Owing to women's greater sensitivity to non-verbal behavior (Hall, 1978), we only used female participants. This provided us with a methodologically cleanest test of our hypotheses.

2.2. Design

A 2 (Type of Interaction Partner: agent vs. avatar) X 2 (Smile Condition: present vs. absent) between-subjects factorial design was employed. Type of interaction partner referred to participants' beliefs about whether their interaction partner was a computer algorithm (embodied agent) or an actual person in real time (avatar). The smile condition, reflected whether the virtual peer counselor smiled (smiles present) or not (smiles absent).

2.3. Procedure

Participants were greeted by a female experimenter, blind to condition, and escorted to a private room. After providing consent, participants completed the first part of the study on a desktop

computer. Participants read information on the computer research involving digital virtual humans and the difference between an avatar and an embodied agent was explained. They were also informed that immersive virtual environment technology (IVET) had advanced such that it was difficult for people to tell whether they were interacting with a computer or another person.

Participants were told that they would be discussing a personal topic with a digital representation of a peer counselor in an immersive virtual world and that following their interaction they would provide feedback about their partner and the interaction. They were presented with three discussion topics (aspects of yourself that make feel you uncomfortable or embarrassed; an event that damaged your sense of self-worth; or problems with a past or current relationship) and were asked to rank them in the order of discussion preference. Everyone discussed her second-choice topic. Next, participants were given 3 min to prepare by identifying their discussion points.

Participants assigned to the avatar condition were told that their peer counselor, "Beth," was an undergraduate research assistant who would join them in a virtual world and that both of them would be represented by a 3-dimensional virtual human during their real-time interaction. Participants in the embodied agent condition, were told that they would be interacting with a peer counselor named "Beth" and they were asked to imagine what it would be like visit a counseling-oriented website to discuss their thoughts and feelings with a computer-generated counselor who looked and acted like Beth. Regardless of condition, all participants actually interacted with a human research assistant, blind to condition, who was trained to respond in a consistent manner during the interactions.

After the partner type manipulation, participants were brought into another room for the peer counseling session. To provide the participant with privacy, the experimenter left the room after helping her don a head-mounted display. During the session, the research assistant "smiled" via the digital representation when it was socially appropriate to do so by pushing gamepad button. In the smiles enabled condition, the button triggered a smile response on the virtual human. In the smile disabled condition, nothing happened when she pushed the button. After the interaction, participants filled out post-interaction measures using RiddleMeThis (Loewald, 2009), were debriefed, and released.

2.4. The virtual environment

All participants were immersed in the same 3-dimensional virtual world for their interaction and they all interacted with the same peer counselor. The virtual environment and virtual human bodies were created using 3D Studio Max and Blaxxun Avatar Studio, respectively (see Fig. 1). The heads and faces of the virtual humans were created using 3D Me Now Software (see Fig. 2). The selected face was rated as above average on a variety of interpersonal traits (i.e., warm, kind, supportive, open-minded, attractive, intelligent, etc.) during pre-testing.

2.5. Equipment

Participants and the research assistant donned Virtual Research V8 stereoscopic head mounted displays (HMDs). The HMDs featured dual 680 horizontal by 480 vertical pixel resolution LCD panels that refreshed at 60 Hz. The display optics presented a visual field subtending approximately 50 degrees horizontally by 38 degrees vertically. Perspectively correct stereoscopic images were rendered by a 450 MHz Pentium III dual processor computer with an Evans & Sutherland Tornado 3000 dual pipe graphics card and were updated at an average frame rate of 36 Hz. The simulated viewpoint was continually updated as a function of the

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