
The Effect of Avatar Realism of Virtual Humans on Self-Disclosure in Anonymous Social Interactions

Sin-Hwa Kang

Institute for Creative Technologies
University of Southern California
13274 Fiji Way
Marina del Rey, CA 90292
kang@ict.usc.edu

Jonathan Gratch

Institute for Creative Technologies
University of Southern California
13274 Fiji Way
Marina del Rey, CA 90292
gratch@ict.usc.edu

Abstract

In this paper, we illustrate progress in research designed to investigate interactants' self-disclosure when they communicate with virtual humans or real humans in computer-mediated interactions. We explored the effect of the combination of avatar realism and interactants' anticipated future interaction (AFI) on self-disclosure in emotionally engaged and synchronous interaction. We primarily aimed at exploring ways to promote interactants' self-disclosure while securing their visual anonymity, with timely nonverbal feedback of virtual humans, when interactants anticipate future interaction. The research examined interactants' self-disclosure through measuring their verbal behaviors. The preliminary findings indicated that interactants revealed greater intimate information about themselves in interactions with virtual humans than with real humans. However, interactants' AFI did not affect their self-disclosure, which does not correspond to the results of previous studies using text based interfaces.

Keywords

avatar realism, anonymity, affective behavior, rapport, self-disclosure, anticipated future interaction, virtual humans, contingency, nonverbal feedback, evaluation

ACM Classification Keywords

I.2.12 Artificial Intelligence: Distributed Artificial Intelligence---Intelligent agents; J.4 Computer Applications: Social and Behavioral Sciences---Psychology.

General Terms

Experimentation

Introduction

Previous studies indicate that people are more likely to engage in mediated environments when their interaction partners are represented by visuals, as visuals increase interactants' feelings of co-presence (feeling of being connected and together) [14]. It also has been discovered that anonymity has a crucial role in shaping social bonds via feeling of co-presence [2,9,10]. Researchers argue that securing anonymity elicits greater self-disclosure [2,3], which is defined as any private information that can be revealed to be shared knowledge between or within communicators [7,12]. Walther [18] further states visual anonymity provides interactants with a way to create a positive impression of their interaction partners, and elicits greater affection with their communication partners even with minimal cues under no time limitation if they are informed of future interactions with their interaction partners. Other studies indicate that self-disclosure is critical in shaping social ties and is a pre-requisite for verbal psychotherapy [2,4].

In mediated interactions, the use of virtual humans is proposed to secure visual anonymity; further, the nonverbal behavior of virtual humans is considered a key factor in complementing the verbal communication [5,6]. Previous studies have reported that virtual

humans could create interactants' rapport by producing timely nonverbal feedback that is obtained by behaviors (e.g., head nods and postural mirroring) generated by a human interaction partner [5,6]. Furthermore, recent studies have shown that virtual humans can facilitate social interactions among people who have difficulty in forming social bonds or help develop their social skills via virtual practice [5,6]. Therefore, we examined what form of avatar realism of virtual humans would contribute to the most effective communication, revealing interactants' personal information in their anonymous social interactions.

Research Problem and Hypotheses

Researchers [2,5,9,10,14,15] have addressed that the use of avatars (controlled by a real human) augments interactants' feeling of being connected and together in some mediated interactions. Bailenson and his collaborators [2] describe a videoconference image (raw video) as the most effectual way to produce high realism in mediated communications and include it as an avatar. Avatar realism is composed of visual appearance and behavioral attributes of a human [9,10,14,15].

The conclusions of previous studies imply that behaviorally correct anonymous (e.g. animated drawing) avatars should communicate a greater emotion with interactants when they have AFI than in a face-to-face condition, although they present fewer cues compared to non-anonymous (e.g. raw video) avatars. No studies of virtual humans have explored whether the combination of avatar realism and AFI affect interactants' social responses, specifically self-disclosure.

Researchers addressed that interactants disclosed their personal information more when they interacted with their partners via a text-only interface than via face-to-face [7] or via a voice-only interface than via a video-conference [2] perhaps because a text-only interface and a voice-only interface secure interactants' visual anonymity. These outcomes lead to the hypothesis:

H1: People will be more likely to reveal intimate information about themselves when they interact with partners represented by anonymous avatars, rather than by non-anonymous avatars.

Walther [18] argues that peoples' AFI enhances more self-disclosure in initial computer-mediated interactions than in initial face-to-face interactions and it also affects the level of intimacy. Shaffer and Ogden [16] also state that interactants' AFI causes more self-disclosure. These claims lead to the hypothesis:

H2: People will be more likely to reveal intimate information about themselves when they are informed of the possibility of future interactions, rather than when informed that there is no possibility of future interactions.

Furthermore, it has been found that rich media exposed interactants' privacy and elicited less self-disclosure of the interactants [7]. This outcome indicates that people may wish to reveal their personal information more when they interact with visually less realistic virtual humans [2]. Moreover, the "hyperpersonal communication" perspective [18] holds the idea that people feel more liking and emotion with their interaction partners when they have fewer cues, while arguing that people's AFI promotes more self-disclosure in initial computer-mediated interactions. This argument leads to the hypothesis:

H3: People will be more likely to reveal intimate information about themselves when they interact with partners via media with "fewer cues" than with "more cues," if they anticipate future interactions with partners.

Experimental Design

The experimental design was a 3 (avatar realism) x 2 (AFI versus No AFI) factorial between-subjects experiment involving two factors: i) three levels of avatar realism – a raw video, a degraded video, and a virtual human (Rapport Agent); ii) two conditions of future interaction – anticipation of future interaction and no anticipation of future interaction. In the AFI conditions, subjects were informed that they would have a second interaction session with their partner after a first session. In the no AFI conditions, subjects were not informed of another session and would not expect to interact further with their partner. A confederate interviewer was used in the Raw Video and Degraded Video conditions. An experimenter controlled buttons that retrieved pre-recorded voice messages to generate speaking behaviors of an interviewer in the Virtual Human condition. The participants were informed that their appearance would be presented in the same way as the interviewer was presented to them. The participants were further told that the Rapport Agent was an avatar controlled by another participant [5,6,8]. Each experimental condition was presented to same gender combinations of dyadic partners: male-male and female-female.

One hundred and eight people (50% women, 50% men) from the general Los Angeles area participated in this study. The paired participants never met each other beforehand and were randomly assigned to one

of six experimental conditions in the 3 x 2 design. The interaction took place in two separate rooms where the paired participants were placed at different times, to avoid any initial face-to-face contact. Participants were given a hypothetical conversational scenario where each assumed the role of a person (subject, interviewee) who sought to find out if the other person could be a suitable match with whom an apartment could be shared, and who might possibly become a friend. The other person was a confederate or an agent (interviewer) who asked subjects ten questions requiring self-disclosure of the subject [12,17] (see the image (a) in Figure 2). Participants in all conditions saw the video images of their partners displayed on a 30-inch computer monitor. They wore a lightweight close-talking microphone and spoke into a microphone headset. The monitor was fitted with a stereo camera system and a camcorder. The typical conversation was allowed to last about thirty minutes, but subjects were not informed of any specific time limitation.

Avatars included an unmodified videoconference image [2,9,10] and its alterations with special video effects in the types of avatars. In terms of avatar realism, three types of visual images (raw videos: non-anonymous images; degraded videos: anonymous images; and virtual humans: anonymous images) were provided to represent visual identity. For the degraded videos, we utilized the findings of Zhao and Stasko, which defined an edge-detected image (see the image (b) in Figure 1) as a lower actor identification than a pixelized one frequently used for identity hiding [9,10]. To generate the avatar movement of this degraded video, a webcam (Logitech QuickCam Orbit MP) captured participants' facial expressions and visual effect software (WebcamMax) degraded video using an edge-

detector filter. To allow video chat conversation, video conference software (Skype) was used.



Figure 1. (a) a raw video; (b) a degraded (edge-detector filtered) video; (c) virtual humans (Rapport Agents: male & female)

For the virtual humans, we utilized the Rapport Agent, created by Gratch and his colleagues [5,6], whose system architecture is described in the next section (see the images (c) in Figure 1), as it has been found that the contingent feedback of an agent elicits greater social bond of interactants in human-agent interaction than in face-to-face situation [5,6,8].

To generate listening behaviors of an interviewer in the virtual human condition, the Rapport Agent first collected and analyzed the attributes from an interviewee's voice and upper-body movements (see the image (b) in Figure 2). Two Videre Design Small Vision System stereo cameras were placed in front of the interviewee. The interviewee's head orientation and position were tracked by the Watson image-based tracking library using a stereo camera [13]. Watson also incorporated learned motion classifiers that detected head nods and shakes from a vector of head velocities. Acoustic features were derived from properties of the pitch and intensity of the speech signal using a signal processing package, LAUN [5].

To generate speaking behaviors of the interviewer in the virtual human condition, an experimenter controlled buttons that retrieved pre-recorded voice messages.

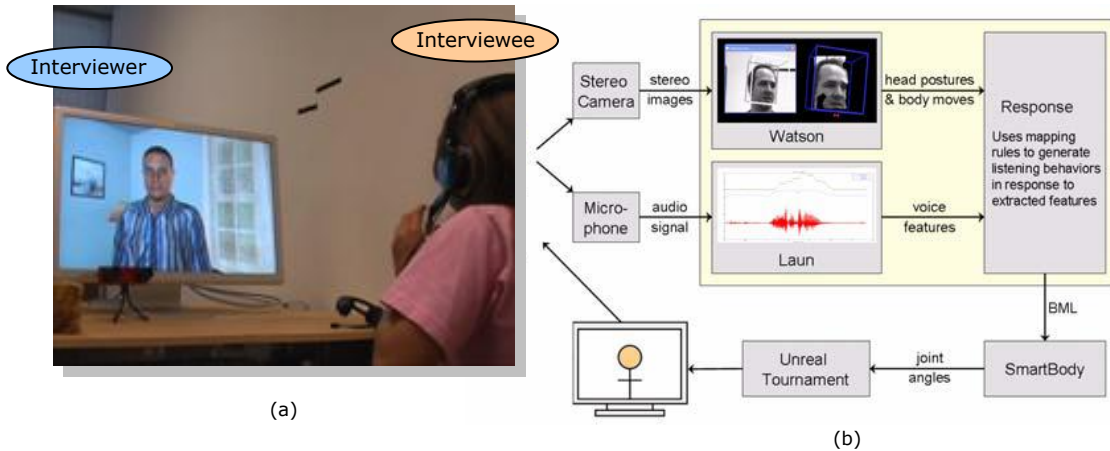


Figure 2. (a) video “interview” interaction; (b) system architecture of the Rapport Agent

The video avatars and Rapport Agents were displayed on a 30-inch Apple display to approximate the size of a real human sitting 4 feet away.

We measured the intensity of interactants’ verbal self-disclosure [12,17] as a response variable, whose outcome is reported in this paper. We also assessed other self-reported measurements as response variables and interactants’ dispositional characteristics as explanatory variables, whose analysis is in progress.

Preliminary Findings and Potential Implications

Manipulation Check: AFI

The results showed ninety six percent of participants believed that they would have another interaction with their partners.

Content Analysis and Inter-Coder Reliability

The intensity of self-disclosure was rated by two coders independently using Altman and Taylor’s three-layer categorization scheme [1]. Altman and Taylor [1] constructed a three-layer categorization scheme to define the intimacy level of self-disclosure, which is composed of a peripheral layer (low intimacy), an intermediate layer (medium intimacy), and core layer (high intimacy). The results of Krippendorff’s alpha [11] showed good inter-coder reliability between two coders disagreements: Alpha = .84; Do (Observed Disagreement) = 232.37; De (Expected Disagreement) = 1483.14.

Our preliminary findings using between-subject ANOVA analysis showed that interactants revealed intimate information about themselves more when they interacted with partners represented by virtual humans (Rapport Agent), which secured high visual anonymity between interactants [$F(2, 102)=3.46, p=.035, \eta^2=.064$]. This supports H1 and corresponds to some of previous outcomes that visual anonymity could elicit more self-disclosure which in turn results in bonding social ties. However, these earlier studies explored this subject using no visual image at all.

Contradictory to previous conclusions, our preliminary findings further showed that AFI didn’t affect interactants’ self-disclosure across the conditions. Thus, H2 is not supported. This outcome may indicate that visual presentations differ from text in their effect. We suppose the null result of this study might be due to the kinds of intimate, self-disclosure questions asked of interactants that have never been investigated with AFI in previous studies. Although there was no main effect of AFI on self-disclosure, we suggest that virtual humans conveying less cues via timely nonverbal feedback would

be able to enhance greater self-disclosure than real human video avatars based on the results of H1. Therefore, we argue that H3 is partially supported in that sense.

Based on the preliminary findings of this study, we propose to discuss with the researchers and audience of the CHI community that the types of intimate questions might not elicit any difference on the interactants' self-disclosure between AFI and non-AFI situations. If this is the case, we would like to further discuss how to design future studies to investigate this subject better.

The findings have implications for determining the most efficient combination of interactional fidelity of a virtual human that would allow interactants to reveal personal information which may in turn lead to enhancing their social ties.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No. 0713603.

References

- [1] Altman, I. & Taylor, D. *Social penetration: Development of interpersonal relationships*. Holt McDougal (1973).
- [2] Bailenson, J.N., Yee, N., Merget, D., & Schroeder, R. The effect of behavioral realism and form realism of real-time avatar faces on verbal disclosure, nonverbal disclosure, emotion recognition, and copresence in dyadic interaction. *PRESENCE: Teleoperators and Virtual Environments* (2006).
- [3] Bargh, J. A., McKenna, K. Y. A., & Fitzsimons, G. M. Can you see the real me? Activation and expression of the "True Self" on the Internet, *Journal of Social Issues*, Vol. 58, No. 1, 33-48 (2002).
- [4] Digiuseppe, R. & Bernard, M. REBT assessment and treatment with children in *Rational Emotive Behavioral Approaches to Childhood Disorders: Theory, Practice, and Research*, Ellis, A. & Bernard M. E. (Eds.), Springer (2006).
- [5] Gratch, J., Okhmatovskaia, A., Lamothe, F., Marsella, S., Morales, M., van der Werf, R., et al. *Virtual Rapport*. Proc. 6th International Conference on Intelligent Virtual Agents (2006).
- [6] Gratch, J., Wang, N., Gerten, J., Fast, E., & Duffy, R. Creating rapport with virtual agents. Proc. 7th International Conference on Intelligent Virtual Agents (2007).
- [7] Joinson, A. N. Self-disclosure in computer-mediated communication: The role of self-awareness and visual anonymity. *European Journal of Social Psychology*, Vol. 31, 177-192 (2001).
- [8] Kang, S., Gratch, J., Wang, N., & Watt, J. H. Does the contingency of agent's nonverbal feedback affect users' social anxiety? Proc. 7th International Conference on Autonomous Agents and Multiagent Systems (2008).
- [9] Kang, S., Watt, J. H., & Ala, S. K. Social copresence in anonymous social interactions using a mobile video telephone. Proc. *Computer-Human Interaction* (2008).
- [10] Kang, S., Watt, J., & Ala, S. K. Communicators' perceptions of social presence as a function of avatar realism in small display mobile communication device. Proc. *Hawaii International Conference on System Sciences* (2008).
- [11] Krippendorff, K. *Content Analysis, an Introduction to its Methodology*, 2nd Edition. Thousand Oaks, CA: Sage Publications (2004).
- [12] Moon, Y. Intimate exchanges: Using computers to elicit self-disclosure from consumers. *Journal of Consumer Research*, Vol. 26, No. 4, 323-339 (2000).
- [13] Morency, L.-P., Sidner, C., Lee, C., & Darrell, T. Contextual Recognition of Head Gestures. Proc. 7th International Conference on Multimodal Interactions (2005).
- [14] Nowak, K. & Biocca, F. The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators and Virtual Environments*, Vol. 12, No. 5 (2003).
- [15] Nowak, K. & Rauh, C. The influence of the avatar on online perceptions of anthropomorphism, androgyny, credibility, homophily, and attraction. *Journal of Computer-Mediated Communication*, 11(1), (2005).
- [16] Shaffer, D. R. & Ogden, J. K. On sex differences in self-disclosure during the acquaintance process: The role of anticipated future interaction. *Journal of Personality and Social Psychology*, Vol. 51, No. 1, 92-101 (1986).
- [17] Tidwell, L. C. & Walther, J. B. Computer-mediated communication effects on disclosure, impression, and interpersonal evaluations. *Human Communication Research*, Vol. 28, No. 3, 317-348 (2002).
- [18] Walther, J. B. Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research*, Vol. 23, 1-43 (1996).