Social Presence in Mixed Agency Interactions

Andrew Robb*
University of Florida

Benjamin Lok†
University of Florida

Abstract

In this paper, we present the preliminary results of an ongoing study exploring how mixed-agency teams influence feelings of social presence. Participants worked with a team composed of either two virtual humans or a team composed of one virtual human and one real human. We found that while the presence of a human teammate did not affect overall feelings of social presence, the presence of a human teammate did appear to strengthen participants' perceptions that their virtual teammates were not real.

Index Terms: H.1.2 [Information Systems]: Models and Principles—User/Machine Systems; H.5.1 [Information Systems]: Information Interfaces and Presentation—Multimedia Information Systems

1 Introduction

Social presence is an important concept which governs how people interact with virtual humans. Social presence can be defined as "a sense of being with another" [2]. Research has shown that higher feelings of social presence are associated with more realistic social behavior [1, 4] and enhanced feelings of team work [7]. Social presence can be influenced by numerous factors, including an agent's visual appearance [5], the characteristics of an agent's voice [3], and an agent's ability to communicate in a realistic manner [6].

The majority of research studying feelings of social presence with virtual humans has focused on interactions between one human and one or more virtual humans. We will refer to this type of interaction as a virtual-agency interaction, given that all of the interactants are virtual (except for the participant). We will refer to interactions involving two or more real humans and one or more virtual humans as mixed-agency interactions, given that each human participant is interacting with both real and virtual humans.

Given that social presence is influenced by visual and behavioral realism, and that actual humans an inherently more realistic than virtual humans, it seems plausible that a virtual human's ability to evoke feelings of social presence may be influenced by whether they are part of a mixed-agency interaction or are part of a virtual-agency interaction. This is an important question to explore, as existing research related to social presence and virtual humans may not be applicable to mixed-agency interactions if people perceive virtual humans differently in mixed-agency teams.

2 Mixed-Agency Team

We conducted a study to explore if people perceived virtual humans differently in mixed-agency interactions, compared to virtual-agency interactions. As of this writing, 51 operating room nurses participated in the study; 43 of the participants have been female. Participants worked as part of a team preparing a simulated patient for surgery. The simulation was split into two stages: the briefing and the timeout. The team went through a checklist in each stage to ensure that the patient was ready for surgery. Participants' role was to confirm information about the patient for the virtual surgeon.

Participants worked with two other teammates: a surgeon and an anesthesiologist. The surgeon and the anesthesiologist were played by either a virtual human or a real human, depending on condition. The three conditions can be seen below, in Figure 1.

(a) Virtual Anesthesiologist and Virtual Surgeon

(b) Virtual Anesthesiologist and Human Surgeon

(c) Human Anesthesiologist and Virtual Surgeon

Figure 1: The surgeon and the anesthesiologist were played by two different actors. Each actor's virtual counterpart was modeled to resemble the actor's appearance. Each actor also recorded the voice of his virtual counterpart.

Virtual teammates were controlled via a Wizard-of-Oz (WOZ) system; this allowed the virtual humans to be controlled by a real human. A WOZ was employed so that the virtual humans' realism would not be hampered by low speech recognition accuracy or by unanticipated behavior on the part of our participants. Participants were unaware that the virtual humans were being controlled by a human.

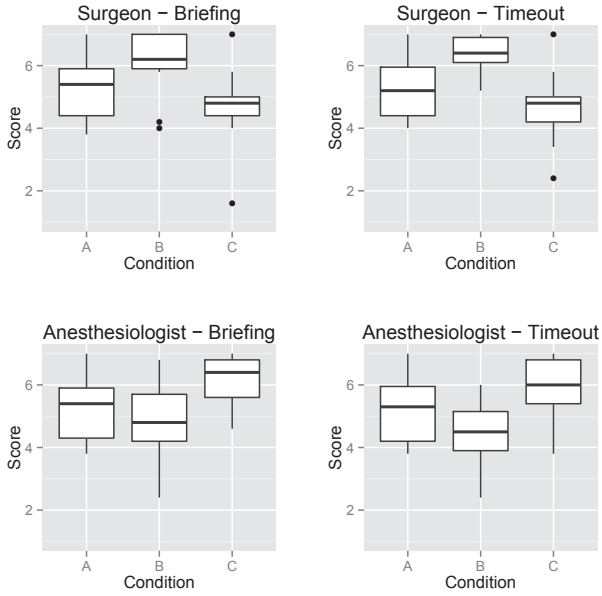
The team participants worked with was led by the surgeon. The surgeon controlled the flow of the interaction, asking questions and giving instructions to both the participant and the anesthesiologist. The participants could interject with comments or questions if they wanted to. The anesthesiologist also interrupted the surgeon at several points with a question. The surgeon and anesthesiologist were able to answer the vast majority of questions posed by participants ($>$95%), due to the constrained nature of the interaction and the use of a WOZ.

*e-mail: arobb@ufl.edu
†e-mail:lok@cise.ufl.edu

IEEE Virtual Reality 2014
29 March - 2 April, Minneapolis, Minnesota, USA
978-1-4799-2871-2/14/$31.00 ©2014 IEEE

3 Results and Discussion

Participants completed a social presence questionnaire after each stage. They rated the social presence of each teammate individually. The aggregate social presence scores for each character, broken down by condition and stage, can be seen below in Figure 2.



A: Both Virtual — B: Real Surgeon — C: Real Anesthesiologist

Figure 2: Social presence results for each condition, grouped by character and stage. The character and stage for each graph are shown above the graph.

As expected, significant differences were seen in social presence scores between the human surgeon and the virtual surgeon, and the human anesthesiologist and the virtual anesthesiologist. This is unsurprising, given the differences between real and virtual humans.

Real humans did not affect aggregate social presence scores. No significant differences were observed in the virtual surgeon's social presence between conditions A and C (the two conditions where the surgeon was virtual). No significant differences were observed in the anesthesiologist's social presence between conditions A and B (the two conditions where the anesthesiologist was virtual). These findings suggests that people experienced similar feelings of social presence when working with mixed-agency teams, compared to teams composed entirely of virtual humans.

Real humans increased feelings that virtual humans were computerized images without affecting feelings that they were "really there". An analysis of participants' responses to the individual social presence questions revealed that participants' responses to two questions were influenced by working with a real human. The social presence questions we asked are shown below; the ellipses were replaced by either "surgeon" or "anesthesiologist", as appropriate.

1. I perceive that I am in the presence of ... in the room with me.
2. I feel that ... in the room is watching me and is aware of my presence.
3. The thought that ... is not a real person crosses my mind often.
4. The ... appears to be sentient, conscious, and alive to me.
5. I perceive ... as being only computerized image, not as a real person.

Significant differences ($p < 0.05$) were observed between conditions A and B for the anesthesiologist on questions 3 and 5. Trends ($p < 0.10$) were observed between conditions A and C for the surgeon on questions 3 and 5. No differences were seen for the other social presence questions between conditions.

These results highlight that people can simultaneously experience virtual humans as both "really there" and as a computerized image. Feelings that the virtual human was "really there" were not influenced by whether or not participants worked with another real human, but working with another real human did influence participants' feelings that their virtual teammate was a computerized image.

4 Conclusion

These findings suggest that virtual teammates are perceived similarly whether or not multiple humans are present. Even though participants did feel more strongly that their virtual teammates were computerized when working with a real human, other important aspects of social presence, including feelings that the virtual teammate was actually present, aware, and conscious, were not influenced by working with a real human. These findings suggests that existing research exploring how people perceive virtual humans in virtual-agency interactions can be generalized to how they perceived virtual humans in mixed-agency interactions.

Questions remain as to whether or not a certain level of realism is required to maintain high feelings of social presence when working with real humans. The virtual humans in this study generated fairly high feelings of social presence when compared to many other studies. Future research should explore if our observations hold true for virtual humans of various levels of realism.

One limitation of our study is the gender imbalance in our participants. Our population (operating room nurses) is strongly skewed towards women. Given that women are often more socially aware, it is possible that men would respond to mixed-agency teams differently. Future research should address this through the inclusion of other populations.

Acknowledgements

The authors wish to thank Rob Wilt and Arne Zarzecki for playing the parts of the human surgeon and anesthesiologist. This work was supported in part by a grant from the National Science Foundation (IIS-12U0172).

References

[1] J. N. Bailenson, A. C. Beall, and J. M. Loomis. Interpersonal Distance in Immersive Virtual Environments. *Personality and Social Psychology Bulletin*, 29(7):819–833, 2003.

[2] F. Biocca, C. Harms, and J. K. Burgoon. Toward a More Robust Theory and Measure of Social Presence : Review and Suggested Criteria. *Presence: Teleoperators & Virtual Environments*, 12(5):456–481, 2003.

[3] K. M. Lee and C. Nass. Designing social presence of social actors in human computer interaction. *Proceedings of the conference on Human factors in computing systems - CHI '03*, (5):289, 2003.

[4] K. M. Lee, W. Peng, S.-A. Jin, and C. Yan. Can Robots Manifest Personality?: An Empirical Test of Personality Recognition, Social Responses, and Social Presence in Human?Robot Interaction. *Journal of Communication*, 56(4):754–772, Dec. 2006.

[5] K. L. Nowak. The Effect of the Agency and Anthropomorphism on Users Sense of Telepresence , Copresence , and Social Presence. *Presence: Teleoperators & Virtual Environments*, pages 481–494, 2002.

[6] Y. Wang, P. Khooshabeh, and J. Gratch. Looking Real and Making Mistakes. *Intelligent Virtual Agents*, pages 339–348, 2013.

[7] D. Whitelock, D. Romano, A. Jelfs, and P. Brna. Perfect presence : What does this mean for the design of virtual learning environments ? *Education and Information Technologies*, 5(4):277–289, 2000.