

# Can Social Presence be Contagious?

## Effects of Social Presence Priming on Interaction with Virtual Humans

Salam Daher\*  
University of Central Florida  
Kangsoo Kim†  
University of Central Florida  
Ryan Schubert¶  
University of Central Florida and UNC-Chapel Hill

Myungho Lee‡  
University of Central Florida  
Jeremy Bailenson||  
Stanford University  
Gerd Bruder§  
University of Central Florida  
Greg Welch\*\*  
University of Central Florida

### ABSTRACT

This paper explores whether witnessing a Virtual Human (VH) in what appears to be a socially engaging discussion with another virtual human confederate/accomplice (VHC) can prime a person to feel and behave more socially engaged with the VH in a subsequent interaction. To explore this social priming phenomenon, we conducted an experiment in which participants in a control group had no priming while those in an experimental group were briefly exposed to an engaging social interaction between a VH and a nearby VHC. The participants primed by exposure to the brief VHC-VH interaction reported being significantly more excited and alert, perceiving the VH closer, and showed significantly higher measures of Co-Presence, Attentional Allocation, and Message Understanding dimensions of social presence towards the VH, compared to those who were not primed.

### 1 INTRODUCTION

A VH can be embedded not only in immersive virtual environments but also in the real world via augmented reality technologies to share the physical space with real humans [1]. It is desirable to facilitate a high sense of presence, co-presence, and social presence with VHCs in order to elicit behavior in real humans that matches what can be observed between humans in the real world [2]. Lombard and Ditton define *presence* as the sense of non-mediation, which means that one can perceive presence via a technological medium if one can be oblivious to the existence of the medium [3]. Harms and Biocca illustrated co-presence as one of several dimensions that make up social presence, and they evaluated the validity of their social presence measures by questionnaire [4]. Arimoto et al. used multiple robots to increase social telepresence [?]. While there is no universal agreement on the definitions of these terms, for the purpose of this paper we consider *social presence* to be one's sense of being socially connected with the other, and *co-presence* to be one's sense of the other person's presence. We use the word "Confederate" to indicate that the additional (virtual) human is intentionally part of the experiment even though the participants may *not* think of that person as part of the experiment. We undertook an experiment to test whether *witnessing* a VH participating in a socially engaging interpersonal discussion with a VHC—i.e., exhibiting apparent social presence with the VHC—can subsequently lead to the participant feeling increased social presence with respect

to the VH.



Figure 1: Experimental setup: priming by exposing the participants to a brief conversation between the VHC Michael and the VH Katie.

### 2 METHODS

#### 2.1 Setting

We built a game room (Figure 1) where the virtual 3D character Katie sits behind a shared physical-virtual desk. Katie has a mostly neutral, serious, and polite demeanor during the interaction (not too warm or cold towards the participant) and is capable of producing facial expressions, speaking animations, and body gestures. Specific animations were triggered on demand, along with corresponding pre-recorded and pre-animated phrases, as necessary to play a game of Twenty Questions and to carry out other limited responses as needed before or after the game. The controller pressed buttons behind the scenes to trigger Katie's responses. Katie's image was rear projected onto the screen behind the physical desk using an HD projector. Participants were recruited from a university community. Fifty-eight total participants were randomly assigned to the control ( $n = 29$ ) or VHC experimental group ( $n = 29$ ). Participants' experience with VHCs varied but none of the participants had prior encounters with the specific VHCs (Michael and Katie) used in this experiment.

#### 2.2 Experimental Design and Manipulation

The experimenter briefed the participants on the rules of the game before they entered the room. Participants in the **Experimental Group** were exposed to a background conversation between the VHC (Michael, male), and the VH (Katie, female) inside the game room. Michael acted as if he had just finished a game with Katie. Michael was not present for participants in the **Control Group** and thus they were *not* exposed to any background conversation between the VH and the VHC. When participants from the **Control Group** entered the room they saw Katie seated at the table, and she initiated the conversation with phrases like "Hello. How are you? Nice to meet you." then moved on to playing the game. When participants from the **Experimental Group** entered the room they saw the VH (Katie) seated at the table and the VHC (Michael) standing in the corner of the room. As soon as the participant entered, Michael looked at the participant, then at Katie, and said

\*e-mail: salam@knights.ucf.edu

†e-mail: kskim@knights.ucf.edu

‡e-mail: myungho@knights.ucf.edu

§e-mail: Gerd.Bruder@ucf.edu

¶e-mail: res@cs.unc.edu

||e-mail: bailenso@stanford.edu

\*\*e-mail: welch@ucf.edu

“Oh, you’ve got visitors. I’ll leave you two to play,” then Katie and Michael exchanged phrases such as “It was nice playing with you. Thanks for your time. See you later.” This short exchange constituted the **Social Presence Priming** of the **Experimental Group**. The exposure times to the VH were comparable across groups. The remainder of the interaction was identical for both groups: Katie addressed the participant with the usual introduction, played the game, then indicated the end of the game politely by using phrases such as “this is the end of the game, it was nice playing with you, thanks for your time, see you later, bye”. Participants filled out the post-questionnaires at the end of the experiment, including a social presence questionnaire [4], and an anxiety questionnaire [7].

### 3 ANALYSIS AND RESULTS

Here we present our quantitative results as well as some interesting qualitative comments about the interactions.

We used an independent samples t-test to compare the means between the VHC Experimental Group and the Control Group for Co-Presence (CoP), Attentional Allocation (Att), Perceived Message Understanding (Msg), Perceived Affective Interdependence (Aff), Perceived Emotion Interdependence (Emo), and Perceived Behavioral Interdependence (Behv) dimensions of Social Presence, for the Attractive Affection sense of feeling the VH close (Aff-Close), and for Anxiety Levels of feeling Excited and Alert. The Experimental Group shows statistically significant larger means for:

	Control Group	Experimental Group	t-test
CoP	$M = 6.120$ , $SD = 0.730$	$M = 6.552$ , $SD = 0.558$	$t(56)$ , $p = 0.014$
Att	$M = 5.604$ , $SD = 1.134$	$M = 6.213$ , $SD = 0.641$	$t(44.26)*$ , $p = 0.015$
Msg	$M = 5.873$ , $SD = 0.541$	$M = 6.196$ , $SD = 0.676$	$t(56)$ , $p = 0.049$
Aff-Close	$M = 4.034$ , $SD = 1.295$	$M = 4.759$ , $SD = 1.380$	$t(56)$ , $p = 0.044$
Excited	$M = 5.931$ , $SD = 2.267$	$M = 7.069$ , $SD = 1.668$	$t(56)$ , $p = 0.034$
Alert	$M = 5.241$ , $SD = 2.655$	$M = 6.862$ , $SD = 2.310$	$t(56)$ , $p = 0.016$

Note: the degrees of freedom were approximated since Levene’s test was significant for Att. Levene’s test was NOT significant for the rest of the measures.

The Experimental Group did *not* show a statistically significant larger mean for Aff, Emo, and Behv dimensions of Social Presence.

**Open Ended Questions:** Many participants from the VHC Experimental Group commented that they did *not* actively give much attention to the VHC, Michael. Most people said things such as “I didn’t really give him the time of day. Now I somewhat feel like a horrible person for barely noticing him,” while others said that “Michael was very friendly and heartwarming.” Michael made some participants more excited about the experiment, and one participant said “His response to me walking in and acknowledging me as a guest set the tone as realistic.” Some people from the VHC group said that Katie was expressive, and that she gave them a “friendly vibe.” The comments from the control group were mixed between “Very realistic and friendly.” and “Katie could have been nicer and more friendly.”

### 4 DISCUSSION

**Are there other ways to prime social presence?** Other stimuli might also be powerful social presence priming tools. For example, the VH could exhibit “human-like” traits or characteristics, such as engaging in humor, referencing a recent real world event, reacting to stimuli in the environment, or showing awareness of the person

and their surroundings. It may be possible to strengthen or weaken the priming effect used in this study, for example by making the witnessed conversation appear more exciting or conversely by having the VHC intentionally ignore the VH. Future work also includes experimenting with variations of other aspects of the VH, such as attire, gender, or ethnicity.

**What is the benefit from adding priming using a virtual confederate?** It could be a cost-effective way to improve interactions with VHs by adding another VH on a nearby screen engaging in a small interaction with the original VH. The learning effect of repeated exposure to the same priming needs further investigation.

### 5 CONCLUSION

Virtual humans can often take the place of real humans for training and other purposes. This can be desirable for a number of reasons, such as significantly lower cost, higher repeatability, or lack of access to the necessary real human. A greater sense of presence with a virtual human has the potential to make the training more effective, which can translate into increased performance in teams in a real environment [2]. We explored *social presence priming* by exposing participants to a virtual human participating in a socially engaging discussion with another virtual human *before* the participants interacted directly with the same virtual human. In the case where the Experimental Group was primed with a virtual human confederate, the CoPresence, Attentional Allocation, and Perceived Message Understanding dimensions of Social Presence with the virtual human were found to be significantly higher compared to the Control Group. Participants also felt more excited and alert and perceived the virtual human as affectively closer and more responsive. We believe the results of this study are encouraging for the use of relatively cheap social priming via a second virtual human and could be employed to increase the social presence of virtual humans used for many different applications.

### ACKNOWLEDGEMENTS

The material presented in this publication is based on work supported by the Office of Naval Research (ONR) Code 30 under Dr. Peter Squire, Program Officer. (ONR awards N00014-14-1-0248 and N00014-12-1-1003.)

### REFERENCES

- [1] B. Lok, J. H. Chuah, A. Robb, A. Cordar, S. Lamptang, A. Wendling, and C. White, “Mixed-reality humans for team training,” *IEEE Computer Graphics and Applications*, no. 3, pp. 72–75, 2014.
- [2] G. De Leo, L. Diggs, E. Radici, and T. Mastaglio, “Measuring sense of presence and user characteristics to predict effective training in an online simulated virtual environment,” *Simulation in healthcare: journal of the Society for Simulation in Healthcare*, vol. 9, no. 1, pp. 1 – 6, 2014.
- [3] M. Lombard and T. Ditton, “At the Heart of It All: The Concept of Presence,” *Journal of Computer-Mediated Communication*, vol. 3, June 1997.
- [4] C. Harms and F. Biocca, “Internal consistency and reliability of the networked minds measure of social presence,” in *Annual International Presence Workshop*, pp. 246–251, 2004.
- [5] B. G. Witmer and M. J. Singer, “Measuring Presence in Virtual Environments: A Presence Questionnaire,” *Presence: Teleoperators and Virtual Environments*, vol. 7, pp. 225–240, June 1998.
- [6] K. C. Herbst, L. Gaertner, and C. a. Insko, “My head says yes but my heart says no: cognitive and affective attraction as a function of similarity to the ideal self.,” *Journal of personality and social psychology*, vol. 84, no. 6, pp. 1206–1219, 2003.
- [7] F. H. Wilhelm and W. T. Roth, “Ambulatory assessment of clinical anxiety,” in *Ambulatory Assessment: Computer-assisted Psychological and Psychophysiological Methods in Monitoring and Field Studies*, pp. 317–345, 1996.