

# Predicting Learner Engagement during Well-defined and Ill-defined Computer-Based Intercultural Interactions

Benjamin S. Goldberg<sup>1</sup>, Robert A. Sottilare<sup>1</sup>, Keith W. Brawner<sup>1</sup> and Heather K. Holden<sup>1</sup>

<sup>1</sup> United States Army Research Laboratory-Human Research & Engineering Directorate-Simulation and Training Technology Center, Orlando, FL 32826

## Method:

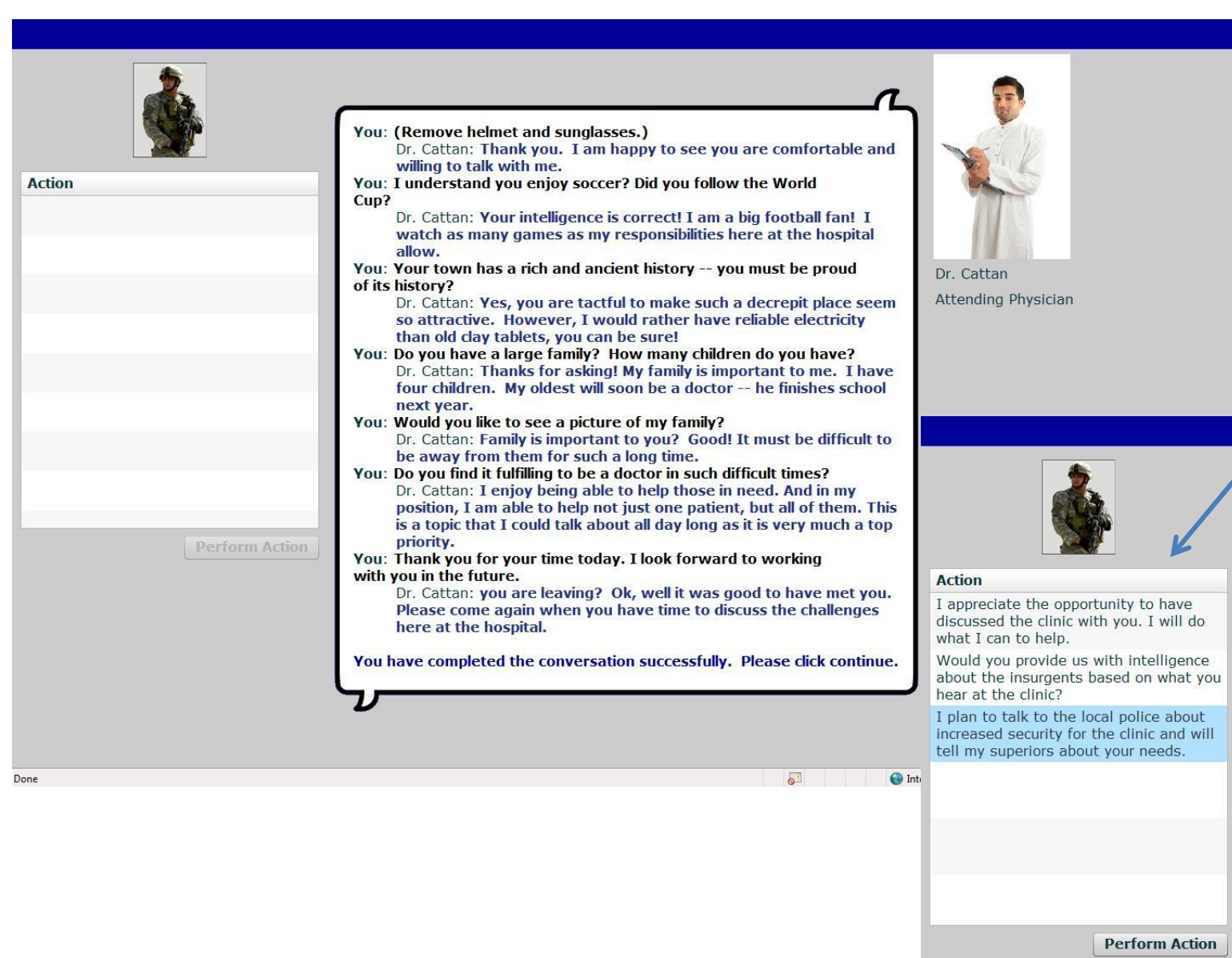
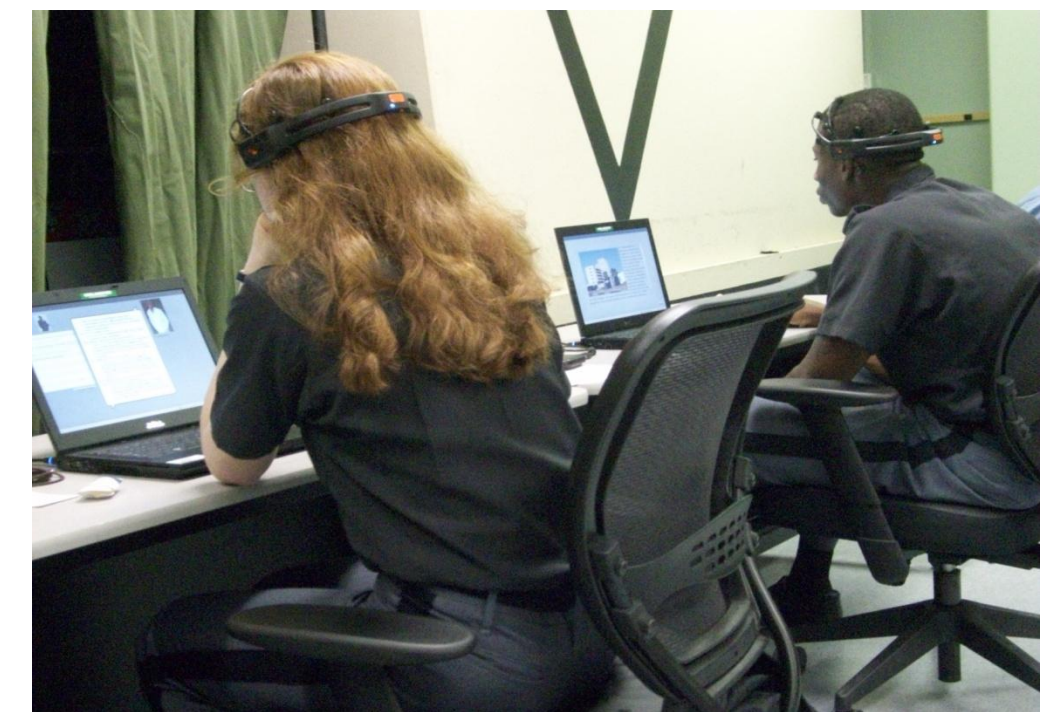
Adult learners were the target population for this study. The design focused on training bilateral negotiation techniques. Twenty-one adults participated in the experiment with seventeen providing usable data. Of the 17 participants, 11 were males (age  $M = 34$ ,  $SD = 9.5$ ) and 6 were females (age  $M = 40$ ,  $SD = 12$ ). No subjects reported experience in inter-cultural conversations or negotiations in response to the demographics questionnaire.

Each participant interacted with the Cultural Meeting Trainer (CMT), a web-browser-based training system prototype in which the learner engages in bilateral conversations with virtual characters representative of Middle Eastern culture. A counterbalanced within-subjects experimental design evaluated the effectiveness of an individual cognitive-state sensor during three conversations of (a) varying clarity (one well-defined and two ill-defined) and (b) the

presence or absence of interruptions. A well-defined task was one which followed an unambiguous series of steps, where success was clearly defined. An ill-defined task was one in which the task was vague or ambiguous, where objectives were not clearly stated and there were many possible paths to success for the learner. Participants interacted with CMT characters through static dialogue choices.

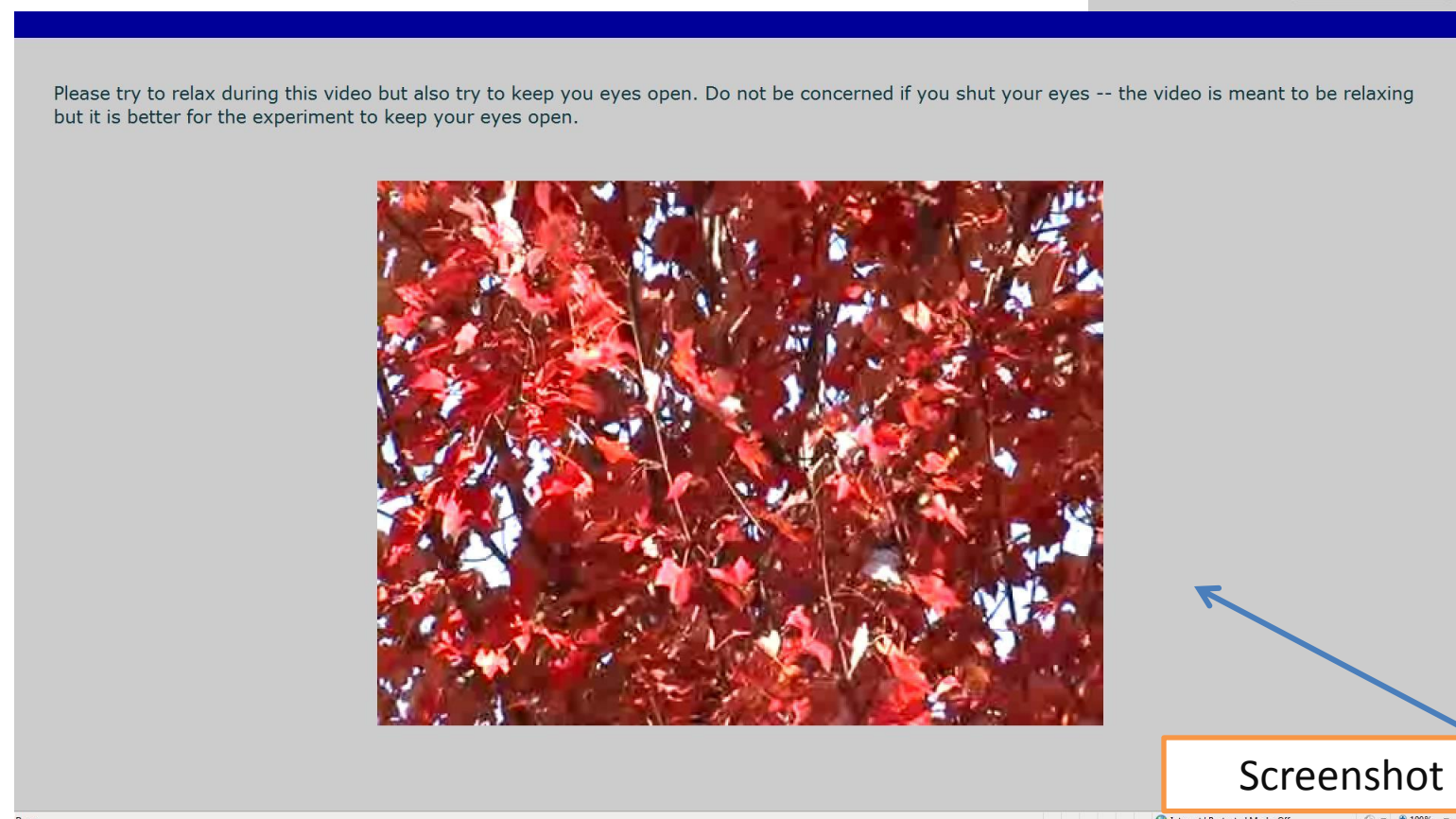
Before each conversation, participants observed a relaxation video for one to two minutes to place them in a state of calm before conducting the next conversation. This video was intended to mediate the mood state experienced in the previous scenario. At the start of each conversation, participants were given a background briefing on the character they would be conversing with along with guidelines and the purpose of the meeting.

## Cultural Meeting Trainer (CMT) Testbed



### Well-Defined No Interruption (WDNI):

Required participants to maintain casual small talk with an in-house physician and to avoid any information gathering or business discussion



### Ill-Defined No Interruption (IDNI):

Required participants to have conversation with the lead physician for the purpose of gathering information on the insurgent attack without making commitments directly to the doctor



Screenshot of Resting Video

### Trainee Action Selections

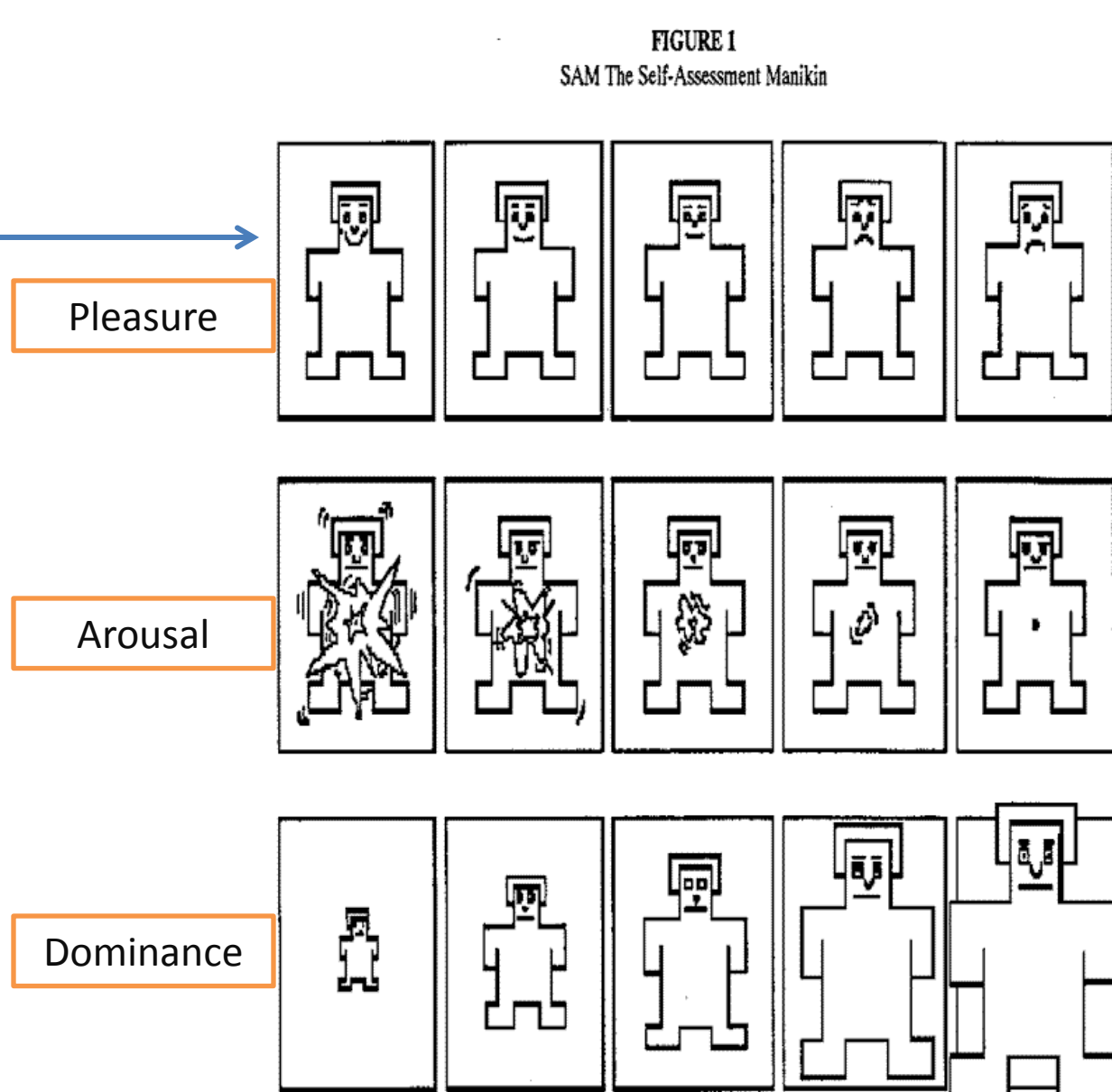
Dr. Alsafi: It's about time someone from the U.S. came here. The situation is bad, very bad. I try everything to make someone pay attention, but too many times I hear only empty promises or help that never comes.  
 You: I could ask about some humanitarian aid for this area and the clinic.  
 Dr. Alsafi: Your promises mean nothing. If you want to help the clinic, then make it safe enough for us to receive our own supplies regularly.  
 You: Tell me more about how we can make you feel safer.  
 Dr. Alsafi: It is like I have been saying. Too many doctors are kidnapped or killed and it scares the rest away. It is crazy that I have to make threats before anyone decides to do anything about the fact that we are running out of people who can heal. We need more protection.  
 You: I want to help the clinic. I know you have been frustrated with us in the past, but I want to help you.  
 Dr. Alsafi: Can you offer me anything other than promises? Others have said they wished to help as well.  
 You: We do not have the resources to provide bodyguards for your doctors. Would it help to talk with the local police?  
 Dr. Alsafi: Yes, that might work. We would be willing to continue the clinic to give you some time to work this out with them.  
 You: What can you tell me about the insurgent attack two nights ago?  
 Dr. Alsafi: It was terrible! These people are barbarous. That, suspect, you already know.  
 You: Other than improved security, what would you suggest you most need for the clinic?  
 Dr. Alsafi: The hospital in general needs supplies and medicine. The clinic especially needs antibiotics for the children.

### Character Interruption

Dr. Mahdi: I do not know what good it would truly do, but I am sure that many would be grateful. It's the long term solution I have no doubt, and I appreciate the desire to respond to the public's desires.  
 You: We have every intention of helping you improve the situation at the hospital.  
 Dr. Mahdi: Your eagerness to help would be proven by some additional support for the hospital.  
 You: I have influence with my commanders and can get you the help you need.  
 Dr. Mahdi: And what could this influence mean for us? I do not know what you would want in exchange.  
 You: ...  
 Dr. Mahdi: Listen, my friend. May I trust you? Do you have the authority necessary to address our needs at the hospital?  
 You: I must check with my superiors before making any definite promises for expensive supplies.  
 Dr. Mahdi: I know that you have procedures, but people will die if they have to wait much longer.  
 You: Who should I speak with to learn more about the supply threat?  
 Dr. Mahdi: I do not know. Perhaps the thief? I will share any information I come across after you leave, and I ask you to do the same.  
 You: Tell me, specifically, what you need for the hospital to return to normal?  
 Dr. Mahdi: To return to normal, we need normal access to the Diyala bridge and our normal shipments of supplies. This last is key. Thank you for your interest in helping us

### Ill-Defined Interruption (IDI):

Required participants to have discussion with the hospital administrator intended for gaining U.S. support and identifying what the hospital needed to function efficiently. This conversation was designed with an interruption in task flow where the character spoke out of turn.



## Hypotheses

In order to understand the influence of personality, mood and EEG measures on predicting engagement, this study anticipated the following:

**H<sub>1</sub>:** Assessed measures of personality via Big Five Personality Test and mood via the SAM would correlate with self-reported measures of engagement

**H<sub>2</sub>:** Aggregate physiological data (STE, LTE and Engagement from EMOTIV) would correlate with self-reported engagement levels. (e.g., *feeling of not just watching*)

**H<sub>3</sub>:** Self-reported measures of engagement would be significantly higher in the interruption condition (IDI) when compared to scenarios with no interruption (WDNI and IDNI)

**H<sub>4</sub>:** Self-reported measures of engagement would be significantly higher in the ill-defined scenarios (IDNI and IDI) when compared to the measures of engagement in the well-defined scenario (WDNI) due to unspecified routines for achieving task objectives

## References:

[1] Woolf, B., Burleson, W., Arroyo, I., Dragon, T., Cooper, D., Picard, R.: Affect-Aware Tutors: Recognizing and Responding to Student Affect. *International Journal of Learning Technology*, 4, 129–164 (2009)

[2] Stevens, R.H., Galloway, T., Berka, C.: Integrating Innovative Neuro-Educational Technologies (I-Net) into K-12 Science Classrooms. In: Schmorow, D., & Reeves, L. (eds.) *Foundations of Augmented Cognition, Third International Conference, FAC (2007)*

[3] Rowe, J., Shores, L., Mott, B., Lester, J.: Integrating Learning and Engagement in Narrative-Centered Learning Environments. In: *Proceedings of the 10th International Conference on Intelligent Tutoring Systems, Pittsburgh*, pp. 166–177 (2010)

[4] Chaouachi, M., Chalfoun, P., Jraidi, I., Frasson, C.: Affect and Mental Engagement: Towards Adaptability for Intelligent Systems. In: *Proceedings of the 23rd International FLAIRS Conference*. Daytona Beach: AAAI Press (2010)

[5] Peters, C., Asteriadis, S., Rebollo-mendez, G.: Modelling user attention for human-agent interaction. *10th Workshop on Image Analysis for Multimedia Interactive Services*, pp. 266–269 (2009)

[6] Dragon, T., Arroyo, I., Woolf, B.P., Burleson, W., el Kaliouby, R., Eydgahi, H.: Viewing Student Affect and Learning through Classroom Observation and Physical Sensors. In: *Proceedings of the 9th International Conference on Intelligent Tutoring Systems*. Jhongli, Taiwan, Springer-Verlag (2008)

[7] Berka, C., Levendowski, D.J., Lumicao, M.N., Yau, A., Davis, G., Zivkovic, V.T., Olmstead, R.E., Tremoulet, P.D., Craven, P.L.: EEG Correlates of Task Engagement and Mental Workload in Vigilance, Learning, and Memory Tasks. *Aviation Space and Environmental Medicine*, 78(5), B231–B244. (2007)

[8] McCrae R.R., John O.P.: An Introduction to the Five-Factor Model and Its Applications. In: *Special Issue: The Five-Factor Model: Issues and Applications*. *Journal of Personality*, 60, 175–215 (1992)

[9] Zhang, L.: Thinking Styles and the Big Five Personality Traits Revisited. *Personality and Individual Differences*, 40, 1177–1187 (2006)

[10] Mehrabian, A.: Pleasure-Arousal-Dominance: A General Framework for Describing and Measuring Individual Differences in Temperament. *Current Psychology*, 14, 261–292 (1996)

[11] Tang, A., Biocca, F., Lim, L.: Comparing Differences in Presence During Social Interaction in Augmented Reality Versus Virtual Reality Environments: An Exploratory Study. In: *7th international workshop on Presence*. Valencia, Spain (2004)

[12] Lombard, M., Ditton, T. B., Weinstein, L.: Measuring (Tele)Presence: The Temple Presence Inventory. In: *Twelfth International Workshop on Presence Los Angeles, California, USA (2009)*

[13] Lessiter, J., Freeman, J., Keogh, E., Davidoff, J.: A Cross-Media Presence Questionnaire: the ITC-Sense of Presence Inventory. *Presence*, 10(3), 282–297 (2001)