

# Influence by others' opinions: social pressure from agents in immersive virtual environments

Christos Kyriltsias\*

GET Lab, Cyprus University of Technology

Despina Michael†

GET Lab, Cyprus University of Technology

## ABSTRACT

Virtual Reality is used in fields of cognitive sciences to study participants' reactions. In such cases, existence of other avatars in the virtual environment is a crucial factor. In this study we investigate whether agents have social influence on the participants by performing the Asch conformity experiment (1951) in an immersive virtual environment. Findings are demonstrating that participants' response times were affected by the judgments of agents existing in the virtual environment.

**Keywords:** Virtual Reality, Computer Agents, Social Influence

**Index Terms:** [Computer Graphics]: Graphics systems and interfaces—Virtual Reality; [Applied Computing]: Law, Social and Behavioral Sciences—Psychology

## 1 INTRODUCTION

Virtual Reality has been exploited in various ways in aspects related to psychology and cognitive sciences for investigating humans' behavior. Blascovich et al. [4] believe that social psychologists can overcome methodological by adopting immersive virtual environment technologies as a research tool. Moreover, according to Wilson & Soranzo [5], VR is compelling due to the almost limitless possibilities for the creation of stimuli and this has led to spread of VR into domains of psychology.

Humanoid representations in VR are classified into avatars and agents. Avatar is a digital representation whose behaviors reflect those executed by a specific human being. An agent is a digital representation whose behaviors are determined by a computational algorithm [2], [3]. However, the distinction between avatars and agents is not clear due to the inability of today's technology to accurately reflect all human actions on avatars [2].

Exploitation of VR in psychology assumes that a human being perceives and reacts in a virtual world as in the physical world [12]. According to the Threshold Model of Social Influence [3], [6], a human in a virtual environment react socially only to avatars. The extent of belief of the user that other human representations represent real people is mentioned as "social presence". An agent cannot cause social reactions to humans, unless his behavior is very realistic. The degree to which human representations behave like the real world mentioned to as "behavioral realism".

A study by von der Putten et al. [3] showed that whether the participant believes that interacted with an avatar or an agent, did not affect his social behaviour. However, the level of "behavioral realism" affects participants' social behaviour. The results of a study of Guadagno et al. [8], showed differences in social evaluation of participants for an agent and an avatar.

Among the most famous psychology experiments is the Asch conformity experiments [1]. Conformity is the act of matching attitudes, beliefs, and behaviors to group norms. Solomon Asch [1] conducted an experiment to investigate the extent to which the social pressure of the majority can influence the person making him to comply. Participants were placed in a room along with seven confederates and were asked to answer some simple line length comparison test. The confederates had agreed in advance what their responses would be when presented with the line task. The real participant was led to believe that the other six were also real participants. Results, demonstrated that the participants were affected by the pressure of the majority of others.

A recent study [13] replicates Asch's experiment in a virtual world application. Results showed that participants were significantly more likely to choose in accord with the confederate's choices.

In our study, we used a similar procedure to Asch original experiment, in an immersive virtual environment to investigate the extent to which social pressure from a group of agents could affect a person to conform. You can find the accompanying video at <https://www.youtube.com/getlabchannel> - VR conformity.



Figure 1: The virtual environment experienced by the participants in the experimental group.

## 2 EXPERIMENT

We designed a VR version of the Asch experiment with a between group experimental design. Each participant was either assigned to the control group, in which case the participant's avatar was in the virtual room alone, or to the experimental group where the participant's avatar was in the virtual room with five other agents. Each participant was experiencing one session of 12 trials. Each trial was a simple visual test with lines' length comparison.

In the experimental group, the participant and the five animated human-like agents were answering in turn to all trials. Participant's avatar is sitting in the end of the row, thus his/her turn was arriving after he/she was listening the answers of the five confederates-agents. The five agents were giving a wrong answer on 8 of the 12 trials. The answers of agents are predefined and always unanimous.

User-avatar selected in advance by the experimenter for each session, between a male and a female character, depending on the gender of the participant. The movement of participants' head is tracked, by the tracker integrated in the HMD device, and they are mapped to the virtual camera. In this way the participant, by moving his head around can observe and explore the environment, his/her virtual body and the virtual confederates.

\* c.kyriltsias@gmail.com

† despina.michael@cut.ac.cy

## 2.1 Procedure

In total 22 participants, between 20 and 42 years old, took part in the experiment; 8 were female and 14 were male.

The participants, after receiving some general information about the experiment, signed a consent form. Then, they completed a pre-test questionnaire. Then, they were informed about the process with written instructions. After the Oculus Rift HMD and the headphones were fitted on the each participant, the experimenter started the application.

The participant was observing the virtual environment from a first person perspective, sitting in front of a desk in a virtual classroom. In case of the experimental group the participants' avatar was sitting next to the five agent-avatars (confederates) while in case of the control group no other avatar besides the participant's avatar was in the room. Thanks to Oculus Rift head tracking functionality, participants were able to visually explore the environment, the virtual room, their avatar's body and the avatars of the agents; the latter only in case of the experimental group. The participants were asked to do so for one minute.

After the familiarization phase elapsed, the first trial appeared on the boards and the agents began to respond in turn. Once the real participant stated his estimate for the visual test of the current trial, the researcher noted his answer and the process continued with the next trial. Agents responded correctly in four of the trials. In the remaining 8 their answers were wrong.

After the completion of all trials, the HMD and the headphones were taken out of the participant and the participant was asked to complete a post-test questionnaire.

## 3 RESULTS

We firstly consider the questionnaires used to assess the participants feeling of owning the avatar body, their sense of immersion within the scene and also their confidence in answering to the visual tests/trials. The sense of body ownership and the feeling of immersion, as measured in the post-questionnaire were high. In addition, participants in both groups stated that they had understood clearly the process and the instructions of the test. Participants declared that they were confident for their estimates for the visual tests. None of the participants of the experimental condition replied absolutely positive in the question if he had the feeling that the other human representations in the virtual world were real people while the median was 2 out of 4. This implies that participants' sense for the social presence of the virtual confederates was medium. There was a positive correlation between participants' 'Confidence' and their 'Response Time'. The more confident the participant felt, the more rapidly he was giving an answer.

By analysing the data, results demonstrated no significant distortion observed on participants' answers. A percentage of 90.91% of the participants responded correctly to all questions.

As a next step we would like to investigate whether the participants' average 'Response Time' is affected by the responses of agents in the experimental group. There was a high significant correlation between 'Participants' Average Response Time' and 'Change of Agents' Error' (ordinal variable which describes the variation of Agents' Error in each trial.) in experimental group.

## 4 DISCUSSION

This experiment was designed to investigate whether social pressure from a majority consisting of agents may influence the judgment of a person in a virtual environment. Our results showed that participants were not replied according to the responses of the majority. Although the correctness of the answers of the participants in the experiment was not affected by agents, the time

it took them to respond to the trials has been affected. In trials where the agents gave the wrong answer, whereas in the previous test were answered correctly, the average 'Response Time' of participants was significantly higher. The reverse is also observed. In trials where the agents were giving a correct answer, while in the previous trial had answered wrong, the average 'Response Time' of participants was significantly lower.

This could be interpreted as a momentary force on the participants' answers, affected by the reliability of agents and their consistency in providing correct or wrong answers. If the agents are breaking the reliability (previous answer was correct and the current answer is wrong) then the 'Response Time' of the participants drastically increases. On the other hand if the agents are recovering the reliability (previous answer was wrong and the current answer is correct) the 'Response Time' of the participants decreases drastically. Moreover, if the agents are consistent in the manner they give an answer to consequent trials, that is either they give continuously correct answers or they give continuously wrong answers, the 'Response Time' of the participants does not change significantly.

## REFERENCES

- [1] S. E. Asch, "Effect of Group Pressure upon the Modification and Distortion of Judgments," *J. Mark. Res.*, vol. 16, pp. 394–400, 1951.
- [2] J. N. Bailenson and J. Blascovich, "Avatars," *Encycl. Human-Computer* ..., pp. 1–15, 2004.
- [3] A. M. Von Der Pütten, N. C. Krämer, J. Gratch, and S. H. Kang, "'It doesn't matter what you are!' Explaining social effects of agents and avatars," *Comput. Human Behav.*, vol. 26, no. 6, pp. 1641–1650, 2010.
- [4] J. Blascovich, J. Loomis, A. C. Beall, K. R. Swinith, C. L. Hoyt, and J. N. Bailenson, "Immersive Virtual Environment Technology as a Methodological Tool for Social Psychology," vol. 13, no. 2, pp. 103–124, 2002.
- [5] C. J. Wilson, A. Soranzo, and S. Sheffield, "The Use of Virtual Reality in Psychology: A Case Study in Visual Perception," *Comput. and Mathematical Methods in Medicine*, vol. 2015, 2015.
- [6] J. N. Bailenson, N. Yee, J. Blascovich, A. C. Beall, N. Lundblad, and M. Jin, *The Use of Immersive Virtual Reality in the Learning Sciences: Digital Transformations of Teachers, Students, and Social Context*, vol. 17, no. 1, 2008.
- [7] C. Nass and Y. Moon, "Machines and Mindlessness: Social Responses to Computers.," *J. Soc. Issues*, vol. 56, no. 1, p. 81, 2000.
- [8] R. E. Guadagno, K. R. Swinith, and J. Blascovich, "Social evaluations of embodied agents and avatars," *Comput. Human Behav.*, vol. 27, no. 6, pp. 2380–2385, 2011.
- [9] C. L. Hoyt, J. Blascovich, and K. R. Swinith, "Social Inhibition in Immersive Virtual Environments," *Presence Teleoperators Virtual Environ.*, vol. 12, no. 2, pp. 183–195, 2003.
- [10] J. N. Bailenson, J. Blascovich, A. C. Beall, and J. M. Loomis, "Equilibrium Theory Revisited: Mutual Gaze and Personal Space in Virtual Environments," *Presence Teleoperators Virtual Environ.*, vol. 10, no. 6, pp. 583–598, 2001.
- [11] J. N. Bailenson, J. Blascovich, A. C. Beall, and J. M. Loomis, "Personality and Social Psychology Bulletin," *Personal. Soc. Psychol. Bull.*, vol. 29, no. 7, pp. 819–833, 2003.
- [12] M. Slater, A. Antley, A. Davison, D. Swapp, C. Guger, C. Barker, N. Pistrang, and M. V. Sanchez-Vives, "A virtual reprise of the Stanley Milgram obedience experiments," *PLoS One*, vol. 1, no. 1, 2006.
- [13] R. Rayborn-Reeves, J. Wu, S. Wilson, B. Kraemer, and P. Kraemer, "Do As We Do, Not As You Think: The Effect of Group Influence on Individual Choices in a Virtual Environment," *J. Virtual Worlds Res.*, vol. 6, no. 1, 2013.