

# Cybersickness and Anxiety in Virtual Environments

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## Abstract

The question whether feelings of anxiety are confounded with cybersickness in studies on virtual reality exposure therapy (VRET) was raised since the questionnaires used to measure them contain overlapping items. In the experiment, 88 participants were asked to talk in front of a virtual audience. Previous research has shown that this task may induce feelings of anxiety (Slater, Pertaub, & Steed, 1999). A significant correlation between levels of experienced anxiety and the nausea subscale of the Simulator Sickness Questionnaire was found for people who reported no cybersickness in a virtual neutral world. Therefore it must be concluded that when cybersickness is measured in VRET experiments, the results may partly be explained by feelings of anxiety rather than cybersickness per se.

## 1. Introduction

The Simulator Sickness Questionnaire (SSQ) (Kennedy, Lane, Berbaum, & Lilienthal, 1993) is an extensively used protocol for measuring cybersickness in virtual environments. However, symptoms included in the SSQ questionnaire are quite similar to symptoms commonly found when people experience anxiety. Since the aim of VRET is eliciting anxiety in patients, there is a concern that the SSQ measurements are not ‘purely’ measuring *cybersickness* when used in the context of VRET, but that they are confounded with feelings of anxiety. Earlier studies already reported significant correlation between anxiety and cybersickness (Busscher, Vliegheer, Ling, & Brinkman, 2011; Kim, Kim, Kim, Ko, & Kim, 2005). Some VRET treatments even found a decrease in SSQ from pre- to post measurement (Brinkman, Hattangadi, Meziane, & Pul, 2011; Busscher, et al., 2011). Participants were relieved rather distressed after the therapy which might have affected their SSQ score. So whether the participants’ reported cybersickness is affected by their anxiety or not needs to be tested.

## 2. Method and results

Eighty-eight volunteers, i.e. 35 females and 53 males, from the Delft University of Technology participated in the experiment. Their age ranged from 18 to 70 years old ( $M = 28$  years old,  $SD$

= 6.3). Two participants were removed from the data set because they did not perform the task according to instructions. Participants were naive with respect to our hypotheses. Written informed consent forms were obtained from all the participants and they received a gift for their contributions. The virtual worlds were shown via an eMagin Z800 head mounted display. The participants' head position was tracked at 125 Hz update speed. Sounds were played through desk mounted speakers. Participants were first immersed in a neutral room (Busscher, et al., 2011) and then in the virtual public speaking world twice: once with stereoscopic rendering and once without stereoscopic rendering, in a counterbalanced order. The participants were asked to give a 5min talk in each public speaking world. The SSQ questionnaire developed by Kennedy et al. (1993) was used to evaluate cybersickness after viewing each virtual world. A modified version of the Personal Report of Confidence as a Public Speaker (MPRCS) was used to measure participants' anxiety after their talk (Paul, 1966). The MPRCS consisted of 16 items, and a higher score meant a higher level of anxiety.

Participants who reported no cybersickness in the virtual neutral world were selected to test the anxiety effect on SSQ in the virtual public speaking world. This selection resulted in only 14 participants (7 males, 7 females;  $M = 30$  years old,  $SD = 6.2$ ). For these participants, we calculated the correlations between the MPRCS and the SSQ scores and its three subscores: nausea, oculomotor and disorientation. A significant positive correlation was found between nausea and MPRCS in both viewing conditions ( $r = .77, p = .001$  &  $r = .58, p = .029$  for non-stereoscopic and stereoscopic viewing respectively). The results thus suggest that reported cybersickness is affected by people's anxiety in the virtual public speaking world. No significant ( $p > .05$ ) correlation was found between the MPRCS and any of the SSQ (sub)scores for the other participants, who did report cybersickness in the neutral world.

### 3. Conclusion

For participants who reported no cybersickness in a neutral virtual environment, the reported cybersickness in the virtual public speaking environment seems to be affected by their anxiety. To limit the bias of anxiety in scoring cybersickness, a new method seems required. Further, caution is advised in interpreting the results on cybersickness in studies involving anxiety, and vice versa in interpreting the results on anxiety in studies that are susceptible to inducing cybersickness in participants.

### References

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