History of motion sickness does not correlate with experienced sickness in a head mounted display

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INTRODUCTION

The purpose of this study was to explore if those with high history of motion sickness reported more simulator sickness when experiencing varying latency in an HMD. Research has shown that varying latency occurs in head-tracked head-mounted displays (HMD) and can create feelings of simulator sickness[1]. While research has studied history of sickness and sickness in a head-tracked HMD, the relationship between the two measures has not been examined thoroughly. This is important because virtual environments are becoming more common as a method for training and often history questionnaires are used to gauge whether or not a trainee will get sick in a simulated environment.

Objectives

- Examine trends between motion sickness and simulator sickness
- Investigate individual differences that lead to simulator sickness
- Improve methodological approaches to measuring simulator sickness

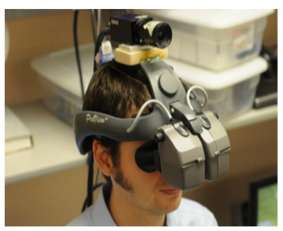

Figure 1. Head-mounted display used in lab paradigm, the top mounted camera allows us to manipulate just latency while showing the real lab space.

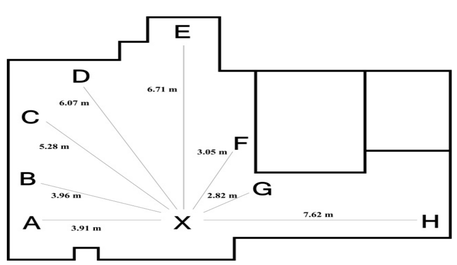

Figure 2. The laboratory set up- subjects stand at X and do a point-and-shoot task with targets A-H

MATERIALS AND METHODS

- 89 subjects (46 male)
- Mean age: 20.7, SD: 4.2

The data used for this experiment came from three studies where participants while wearing the HMD shown in Figure 1 and completing an object location task as shown in Figure 2. The condition used for each involved manipulated variable latency like that of a head-tracked head mounted display.

Motion sickness history was measured using the Motion Sickness Questionnaire (MSQ)[2]

- Ex: *In the last 10 years, how often have you felt sick or nauseated by cars?* (N/A, Never, Rarely, Sometimes, Frequently)

Simulator sickness was measured by the Simulator Sickness Questionnaire (SSQ)[3]

- Ex: *Rate your experience of the following (i.e., right now I feel;): general discomfort.* (None, Slightly, Moderate, Severe)

RESULTS

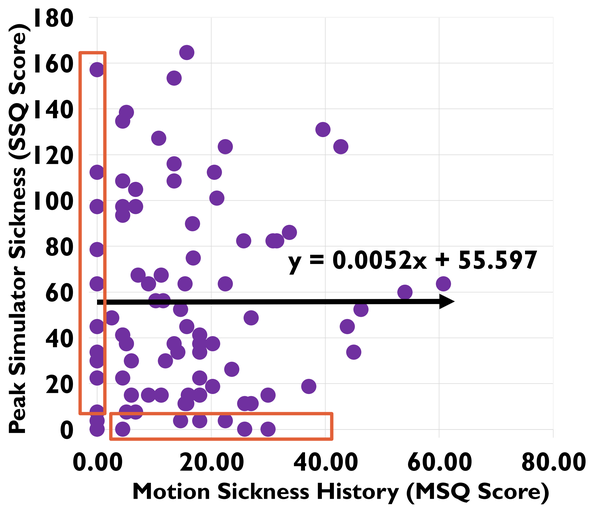

Figure 3. The relationship between MSQ and SSQ. Orange boxes indicate individuals who had a 0 on either measure.

Figure 3 shows scores of motion sickness history and simulator sickness experienced by case. The box highlights the participants who had no history but high sickness, or conversely high history but no sickness. Figure 4 is the same data, but with all 0 points removed (n = 72) and reflects that correlation.

A median split was done separating those into high history of sickness and low history of sickness (at 14 on MSQ). An independent samples t-test was performed to compare the high and low history groups on experienced sickness. There was not significant difference in sickness based on motion sickness history, $t(87) = 1.19$, $p = 0.24$.

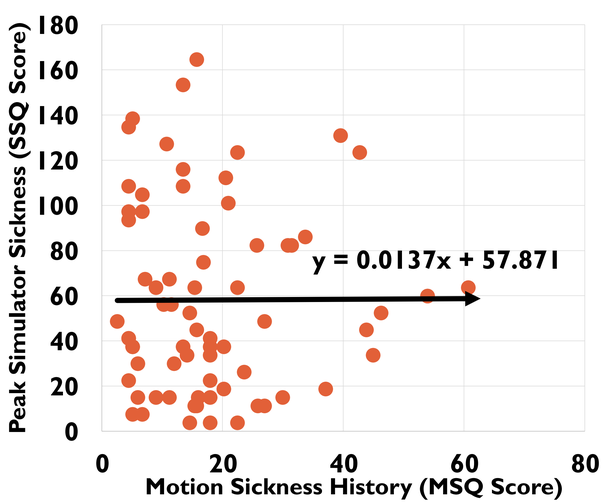

Figure 4. The relationship between MSQ and SSQ with 0s removed from Figure 3.

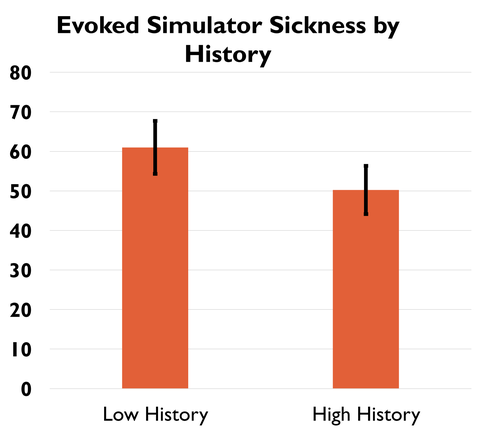

Figure 5. The median split at 14 on MSHQ compared for SSQ scores.

CONCLUSIONS

The expectation that history of sickness would be related to simulator sickness when exposed to varying latency in a HMD was not met. One explanation for this finding is that the MSQ does not account for sickness history in an HMD, or simulator sickness as a possible item to consider. A limitation was that the virtual environment was a real world image with delay, as opposed to a flight or driving simulator, where the relationship between history and sickness could be more pronounced. Individuals with no motion sickness history who experienced simulator sickness and vice versa creates questions about how sensory conflict may differ between different kinds of visual-vestibular stimuli. To better understand this, future research should be done to examine how we process sensory conflicts such as determining what thresholds of variable latency are perceivable and yield sickness will be of use to VR designers.

Further research should be done to examine how to best predict susceptibility to simulator sickness and more generally HMD provoked sickness as these devices become more commonly used amongst the public, especially as training tools.

Key takeaways:

- The use of motion sickness questionnaires may not be helpful for predicting simulator sickness
- More basic research should be done to understand how simulator sickness and motion sickness differ physiologically

REFERENCES

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