Minimizing Cybersickness through Increased-Intensity Habituation

REU fellows: Erin Neaton[1], Mohammed Baidas[2], Jeffrey Chen[3], Edwin Jain[4], Stephan Brown[2]

Faculty Mentors: Drs. N. Sertac Artan[2], Ziqian Dong[2], and Helen Gu[2]

Affiliation: [1.] University of Michigan, [2.] School of Engineering and Computing Science, NYIT, [3.] University of California, Berkeley, [4.] Tufts University

Emails: eneaton@umich.edu, mbaidas@nyit.edu, jeffreydchen@gmail.com, ejain49@gmail.com, stephanrb3@gmail.com, nartan@nyit.edu, ziqian.dong@nyit.edu, hgu03@nyit.edu

ABSTRACT

Habituation is an effective method in decreasing cybersickness in virtual environments (VEs). It has not been explored in depth because users are often opposed to continued use following an initial use resulting in cybersickness. Recent research indicates decreasing the field of view (FOV) decreases symptoms, but also decreases presence. We hypothesize incorporating increased FOV settings into habituation will result in less cybersickness without affecting presence. This method of increased-intensity habituation will be valuable to therapy patients who, in order to receive effective treatment, need to stay in the VE for about 30-60 minutes without experiencing symptoms of cybersickness. We created a VE which has the capacity to manipulate both the FOV and blur edges. We tested it in this exploratory study to determine its potential effectiveness. The experiment shows the time a user spent in a VE increased over time without increased cybersickness. The visual manipulations did not seem to affect presence. We present a protocol to extend this research.

BACKGROUND

Cybersickness

- Sensory conflict theory [1]
- Headaches, dizziness, nausea, fatigue
- Sex and age differences

Habituation

- Decrease in response to stimulus over repeated exposure
- Therapy and seasickness [2]

Field of View Manipulations [3, 4]

- Lowering visual inputs decreases cybersickness
- Decreases presence

Rotational Blurring [5]

- Decreased cybersickness
- Minimal loss of presence

Fig 1: Example of FOV Changes [3, 4]

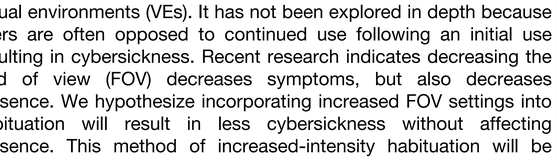


Fig 2: Example of Rotational Blurring [5]

VIRTUAL ENVIRONMENT

Software

- Unity game engine
- Assets from high quality residential environment pack
- Script to vignette/blur edges

Hardware

- Oculus rift
- Touch controllers

Laptop Specs

- i7-6700HQ CPU and GTX 1060 GPU running at 60

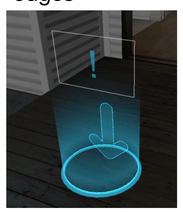


Fig. 3: Example of teleportation spot, the form of locomotion in the environment

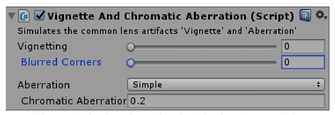
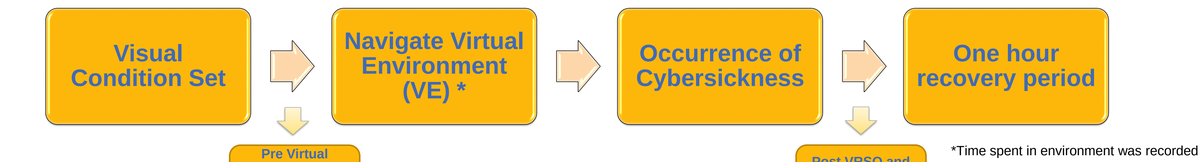


Fig. 4: Script for Vignetting for Blurring Screen Edges

METHODOLOGY



Condition 1: Vignetted Screen	Condition 2: Blurred Screen Edges
Day 1: 50% and 40% Day 2: 30% and 20% Day 3: 10% and 0%	Day 4: 50% and 40% Day 5: 30% and 20% Day 6: 10% and 0%

Fig. 5: Virtual Environment with Vignetted Edges

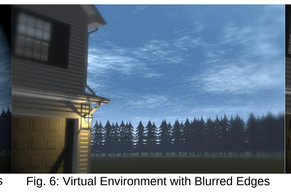


Fig. 6: Virtual Environment with Blurred Edges

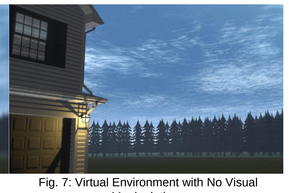


Fig. 7: Virtual Environment with No Visual Manipulations

PRELIMINARY RESULTS

Field of View Manipulations (Vignette)

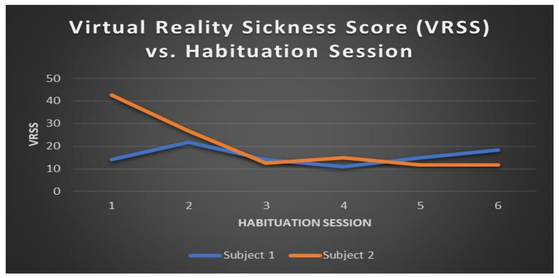


Fig 8: Virtual Reality Sickness Score Across Sessions

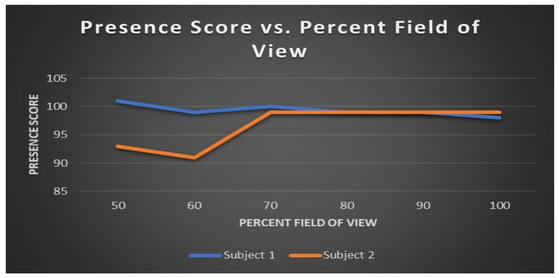


Fig. 9: Presence Score Across Increased Field of View.

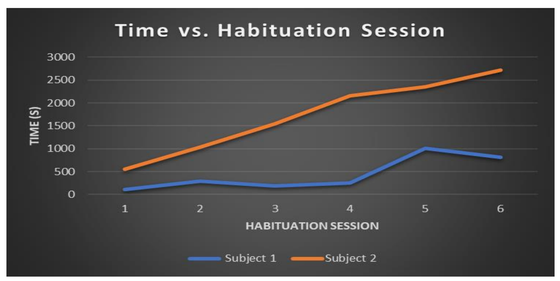


Fig. 10: Time Across Habituation Sessions

Blurred Edge Manipulations

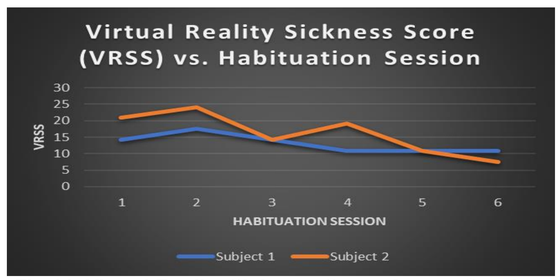


Fig 11: Virtual Reality Sickness Score Across Sessions

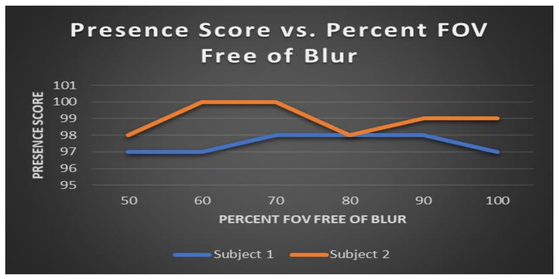


Fig. 12: Presence Score Across Increased Field of View.

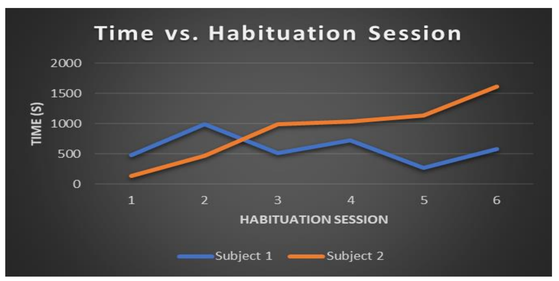


Fig. 13: Time Across Habituation Sessions

DISCUSSIONS

- By the end of the habituation sessions, we were able to stay in the environment for times over 30 minutes which is a typical length of a therapy session [8,9].
- Exploratory study so results are trends, not experimentally proven
- Task performed in the virtual environment
- Consider effects of postural sway

CONCLUSIONS

The results of this exploratory study indicate that this increased-intensity habituation method has the potential to be effective in minimizing cybersickness. We have shown in a limited context that for both conditions, blurring and vignetting, presence remains approximately constant while symptoms tend to decrease. The maximum time either subject spent in the VE was about 45 minutes. Based on these preliminary results, our hypothesis that increasing the intensity and FOV to reduce symptoms of cybersickness seems to be promising. It should be researched further in a controlled study with more users to determine whether or not this can be used as a new technique for therapy patients.

PROPOSED PROCEDURE

- ≥60 subjects to be randomly assigned to each condition
- Conditions: Habituation (control), incrementally increased FOV, and incrementally decreased blurred edges
- Six sessions over a three-day period per subject
- Two hours rest between each session
- Use virtual reality sickness questionnaire before and after each session and presence questionnaire after each
- Measure time spent in environment without cybersickness

REFERENCES

[1] J. T. Reason and J. J. Brand. *Motion Sickness.* Academic Press, Oxford, England, 1975.
[2] KJ Hill and Peter A Howarth. Habituation to the Side Effects of Immersion in a Virtual Environment. *Displays,* 21(l):25-30, 2000.
[3] A. S. Fernandes and S. K. Feiner. Combating VR Sickness through Subtle Dynamic Field-of-View Modification. In *2016 IEEE Symposium on 3D User Interfaces (3DUI),* pages 201-210, March 2016.
[4] Nahal Norouzi, Gerd Bruder, and Greg Welch. Assessing Vignetting as a Means to Reduce VR Sickness During Amplified Head Rotations. 2018.
[5] Pulkit Budhiraja, Mark Roman Miller, Abhishek K. Modi, and David A. Forsyth. Rotational Blurring: Use of artificial blurring to reduce cybersickness in virtual reality first person shooters. CoRR, abs/1710.02599, 2017.
[6] Henry Been-Lirn Duh, Donald E. Parker, and Thomas A. Furness. Presence: Teleoperators & virtual environments. The MIT Press Journals, 13(5):578 – 588, Oct 2004.
[7] Michael J. Singer Bob G. Witmer. Measuring presence in virtual environments: A presence questionnaire. MIT Press Journals, 7(3):225 – 240, June 1998.
[8] Carlos M Coelho, Carlos F Silva, Jorge A Santos, Jennifer Tichon, and Wallis Wallis. Contrasting the Effectiveness and Efficiency of Virtual Reality and Real Environments in the Treatment of Acrophobia. *PsychNology,* 6(2):203-216, 2008.
[9]Sophie Côté, Stéphane Bouchard. Documenting the Efficacy of Virtual Reality Exposure with Psychophysiological and Information Processing Measures." *Applied psychophysiology and biofeedback* 30.(3): 217-232, 2005.

ACKNOWLEDGEMENT

This research was supported by the National Science Foundation (NSF) Research Experiences for Undergraduates (REU) program. We would like to thank our mentors and research fellows at the New York Institute of Technology who have provided valuable advice which strengthened our research path.

This project is funded by National Science Foundation Grant No. CNS-1559652 and New York Institute of Technology.