Accessible Virtual Reality Therapy Using Portable Media Devices

Susan BRUCK\textsuperscript{a,1} and Paul A.WATTERS\textsuperscript{b}

\textsuperscript{a}Macquarie University, Sydney, Australia
\textsuperscript{b}University of Ballarat, Victoria, Australia

Abstract. Simulated immersive environments displayed on large screens are a valuable therapeutic asset in the treatment of a range of psychological disorders. Permanent environments are expensive to build and maintain, require specialized clinician training and technical support and often have limited accessibility for clients. Ideally, virtual reality exposure therapy (VRET) could be accessible to the broader community if we could use inexpensive hardware with specifically designed software. This study tested whether watching a handheld non-immersive media device causes nausea and other cybersickness responses. Using a repeated measure design we found that nausea, general discomfort, eyestrain, blurred vision and an increase in salivation significantly increased in response to handheld non-immersive media device exposure.

Keywords. Non-immersive portable media device, cybersickness, virtual reality exposure therapy

Introduction

Virtual Reality Exposure Therapy (VRET) \cite{1} has immense potential, however, it inherently has the drawback that it can be expensive to establish and requires specially trained counselors and technicians to efficiently run a clinic and is not always accessible for all clients due to distance or work/study or family commitments.

In Australia, in 2007 anxiety disorders affected approximately 14\%, and depression 6\% of the population \cite{2}. Comparably, in America during 2007 anxiety disorders affected 18\% and major depressive disorder affected about 6.7\% of the population over one year \cite{3}. The task of providing clinical options to clients is one that challenges health professionals. Access to treatment in a virtual environment could be improved for greater sections of the community if safe, reliable, mobile and relatively inexpensive tools were available.

Although virtual reality anxiety treatment studies \cite{4,5} are reporting significant client improvement, and with ever improving technology \cite{6} that is more compact, health and safety concerns still need to be addressed in order that practitioners are not unwittingly confounding research results.

\textsuperscript{1}Corresponding Author: E-mail: sbruck@science.mq.edu.au.
Cybersickness is a collection of symptoms that are reported in response to simulated immersive environments [7]. The Simulator Sickness Questionnaire (SSQ) [8] is a standardized sixteen symptom questionnaire that is used to identify the severity of responses specific to exposure to immersive computer generated environments. Previously, our studies have suggested that moderate simulated motion in an immersive virtual environment can significantly increase a client’s reports of anxiety [9], as well as a range of unpleasant cybersickness symptoms such as nausea and general discomfort [10].

This study proposes that use of a small, inexpensive apparatus such as a handheld non-immersive media device may be an alternative to using well equipped clinics for VRET. It is hypothesized that there will be no reports of cybersickness in response to simulated movement on a handheld non-immersive media device.

Our aim is to identify whether handheld non-immersive media devices have the potential to be used as a safe, reliable, easily transportable and cost effective treatment tool.

1. Method

Forty (Experimental condition: 13 male, 16 female; Control condition: 4 male, 7 female) healthy Macquarie University students (18 – 35 years) voluntarily participated in the Macquarie University Human Ethics Committee approved experiment. Participants had normal or corrected to normal vision.

A within-subject design was used to compare self reported measures of cybersickness using the SSQ. Participants completed the SSQ before and after watching a 6 minute video [9] on a handheld non-immersive device. Participants were either shown the control or the experimental condition. The control condition showed a video of a flight over a snow scene with low simulated movement. The experimental condition presented a video of a rollercoaster ride with substantial simulated movement. In order to compare participant’s responses, we used the same video environments that were used in our previously reported studies in a CAVE virtual reality environment [9,10].

Students were invited individually to sit at a desk in a quiet office opposite the experimenter. Firstly the participants were asked to complete the SSQ and to report on how they were feeling at that moment. The participant was then given the handheld non-immersive device to hold, and asked to watch a video for 6 minutes. The participant was informed that if they wished to stop there would be no penalty. After the handheld non-immersive device video finished the participant completed another SSQ and reported how they were feeling after viewing the video. Each participant was given a chocolate bar as an acknowledgement of their participation.

2. Results

The hypothesis was tested using a Wilcoxon Matched Pairs Signed Rank Test. The prediction that there would be no significant difference between the Pre-Test SSQ and the Post-Test SSQ scores for the experimental condition (high simulated motion) was not supported on five SSQ symptoms (Table 1), thereby suggesting that participants did experience some level of discomfort when viewing high levels of simulated motion on
the handheld non-immersive device. Eleven of the sixteen symptoms did not however appear to cause an increase in symptoms in response to a high levels of simulated motion. The control condition did not identify any significant changes in symptom severity, confirming our previous research findings [10].

The results indicate that exposure to a handheld non-immersive device can cause significant discomfort for individuals exposed to considerable simulated movement.

### Table 1. Wilcoxon Matched Pairs Signed Rank Test

<table>
<thead>
<tr>
<th>SSQ Symptoms</th>
<th>Experimental (n = 29)</th>
<th>Control (n = 11)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(High simulated movement)</td>
<td>(Low simulated movement)</td>
</tr>
<tr>
<td>General Discomfort</td>
<td>$z = -2.000$, $p = 0.046^*$</td>
<td>$z = 1.000$, $p = 0.317$</td>
</tr>
<tr>
<td>Eyestrain</td>
<td>$z = -3.000$, $p = 0.003^*$</td>
<td>$z = -1.414$, $p = 0.157$</td>
</tr>
<tr>
<td>Salivation</td>
<td>$z = -2.449$, $p = 0.046^*$</td>
<td>$z = 0.000$, $p = 1.000$</td>
</tr>
<tr>
<td>Nausea</td>
<td>$z = -2.121$, $p = 0.034^*$</td>
<td>$z = 0.000$, $p = 1.000$</td>
</tr>
<tr>
<td>Blurred Vision</td>
<td>$z = -2.121$, $p = 0.034^*$</td>
<td>$z = 0.000$, $p = 1.000$</td>
</tr>
<tr>
<td>Fatigue</td>
<td>$z = -1.890$, $p = 0.059$</td>
<td>$z = 1.000$, $p = 0.317$</td>
</tr>
<tr>
<td>Headache</td>
<td>$z = 0.000$, $p = 1.000$</td>
<td>$z = 0.000$, $p = 1.000$</td>
</tr>
<tr>
<td>Difficulty in Focusing</td>
<td>$z = -1.667$, $p = 0.096$</td>
<td>$z = -1.633$, $p = 0.102$</td>
</tr>
<tr>
<td>Sweating</td>
<td>$z = -0.577$, $p = 0.564$</td>
<td>$z = 0.000$, $p = 1.000$</td>
</tr>
<tr>
<td>Difficulty in Concentrating</td>
<td>$z = -1.890$, $p = 0.059$</td>
<td>$z = -1.890$, $p = 0.059$</td>
</tr>
<tr>
<td>Fullness of Head</td>
<td>$z = -1.667$, $p = 0.096$</td>
<td>$z = -1.414$, $p = 0.157$</td>
</tr>
<tr>
<td>Dizziness Eyes Open</td>
<td>$z = -1.000$, $p = 0.317$</td>
<td>$z = -1.732$, $p = 0.083$</td>
</tr>
<tr>
<td>Dizziness Eyes Closed</td>
<td>$z = -1.000$, $p = 0.317$</td>
<td>$z = -1.414$, $p = 0.157$</td>
</tr>
<tr>
<td>Vertigo</td>
<td>$z = 0.000$, $p = 1.000$</td>
<td>$z = 0.000$, $p = 1.000$</td>
</tr>
<tr>
<td>Stomach Awareness</td>
<td>$z = -1.667$, $p = 0.096$</td>
<td>$z = -1.000$, $p = 0.317$</td>
</tr>
<tr>
<td>Burping</td>
<td>$z = 0.000$, $p = 1.000$</td>
<td>$z = 0.000$, $p = 1.000$</td>
</tr>
</tbody>
</table>

*Significant $p < 0.05$

### 3. Discussion

The results indicate that a portable non-immersive media device can cause cybersickness symptoms when the client is exposed to significant simulated motion. The participants reported a significant increase in General Discomfort, Eyestrain, Salivation, Nausea, and Blurred Vision, however, the symptoms were not severe.

Interestingly, in our previous study with an immersive CAVE virtual reality environment using three dimensional spectacles [10] we reported ten of the sixteen symptoms to have increased in symptom severity. In common with both the CAVE and the handheld device are four symptoms: General Discomfort, Nausea, Eyestrain and Blurred Vision suggesting that the perceived motion was producing the feeling of general unwellness in high simulated motion environment by similar physical mechanisms. It would appear that the illusion of motion on the screen, known as vection [11], is as robust on a non-immersive handheld screen as on an immersive CAVE setting and thus able to invoke the symptoms of nausea and general discomfort. Increased eyestrain and blurred vision may be an indication that the participants felt they needed to watch the screen intently for six minutes, and this might account for the increased reports of changes in visual acuity, as corroborated by other researchers [12, 13]. Although previously reported findings [10,12] did not report significant changes in salivation in response to a virtual environment, our data indicated participants...
experienced increased salivation, an autonomic nervous system symptom associated with an increase in nausea [14].

Appreciating which elements of the environment influence the health of the client continues to be a major question for clinicians and researchers [13]. Despite recently published works [15] including meta-analysis studies [1,5] finding cybersickness not to be a problem in the newer generation of hardware and software, our studies are reporting mild, but statistically significant increases in symptoms associated with the experience of vection.

Vection induced cybersickness symptoms may be explained by the sensory conflict theory [16]. Dual axis virtual motion has been reported to increase the scale of the cybersickness symptoms [17] when self motion and a pseudo-Coriolis effect is perceived in response to vection in a virtual reality environment. Although, we did not specifically design our experiment to assess the effects of observing the changing axis of the scene, the fact that the central axis of the virtual environments in the experimental condition was significantly rotating, as compared to the control condition, may be one cause for the increase in symptom severity associated with general discomfort associated with nausea and an increase in salivation. Future experiments are needed to investigate the effect of rotation around an axis on non-immersive handheld devices.

Access to safe, reliable, valid and economical treatment with well qualified, clinically experienced therapists, who have expertise in virtual reality treatments may be one part of the solution to providing psychological assistance in communities disadvantaged by distance or economic adversity, through mobile equipment. Furthermore, as Wiederhold [18] advocates, the use of virtual reality handheld devices may offer therapists and ultimately bureaucracy an effective tool that could also be used for pre-disaster preparedness and post-impact recovery.

Further work is required to determine whether exposure to less capricious simulated movement would provide a more comfortable experience, and to test whether these results are applicable to a clinically diverse population. The advantage of mobile, cost effective equipment in conjunction with competent counselors may offer greater accessibility of treatments to a broader community. Therapists will forever remain the most important element in any therapeutic situation, for it is their expertise that will ultimately determine the quality of the treatment.

Acknowledgment

The authors are extremely grateful to the Apple University Consortium for providing the Apple iPod Touch® for this experiment. iPod Touch® is a trademark of Apple Inc., registered in the U.S. and other countries.

References


