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The Effect of Immersion and Presence in a Virtual Reality Public Speaking Task

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Abstract

Three virtual environments (with varying immersive features) of a small teaching classroom with an audience were tested to determine whether higher graphical fidelity (Immersion) improved public speaking anxiety after participating in a mock public speaking task. The UWIST Mood Adjective Checklist (UMACL) was administered from the perspective that participants were going to complete a public speaking task in the immediate future and the Personal Report of Public Speaking Anxiety (PRPSA) were taken before and after along with the iGroup Presence Questionnaire (IPQ). By manipulating technical quantitative elements of Virtual Environment construction, dimensions of presence significantly differed between conditions. Public speaking anxiety did not improve after participating in the task and increased immersion did not significantly reduce fear of public speaking within one session. Participants in all conditions however experienced a positive mood shift after participating in the public speaking task.

Keywords. Virtual Reality, Immersion, Presence, Public speaking, objective elements

1. Introduction

Public Speaking Anxiety (PSA) is a sign of affective dysregulation, stemming from individuals assigning overactive anxiety responses to innocuous stimuli [1]. Although historically treatment of PSA has relied on therapist involvement, technological advancements allow sufferers to seek support at their own convenience. In recent years, there has been a massive growth in Internet-based treatments for various health conditions that is indicative of our rapidly changing technological times. Delivering therapy via the Internet presents numerous advantages, including placing fewer demands on therapists and overcoming geographical barriers [2]. One technology which has only recently become consumer-accessible is Virtual Reality (VR).

Key factors which impact the user experience of VR are immersion and presence. Immersion occurs when part or all of a person's perception is directed towards objects, environments or people created by a human technology and perception is diverted from the real world. Immersion is considered to be objective and measurable, which suggests that it can be manipulated [3]. This begs the question: what is the objective level of immersion necessary to produce a therapeutically useful result? Presence is the "subjective psychological response to a VR system" [4] and can be thought of as the experience of perceiving a reality mediated by technology while failing to accurately acknowledge the role of the technology.

The current study aimed to develop three virtual environments of a teaching classroom with emotionally-neutral audience members, whilst manipulating immersion features. The environments were designed to alleviate mild PSA using the CBT concept of exposure therapy. It was predicted that: H1) Participants will experience greater reduction in PSA in higher immersive VR environments H2) participants will experience a greater sense of presence in VR environments with higher immersion.

2.1. Method & Materials

The current study employed opportunity sampling of a student population at the University of Wolverhampton. Ten participants were recruited for each condition, accruing a total of forty participants (9 male, 31 female) aged 19-47 ($M = 25.5$, $SD = 8.65$). PSA was measured using the PRPSA [5], a measure of mood was obtained using the UMACL [6] and presence was measured using the IPQ [7].

2.2. Procedure

Participants completed the PRPSA and UMACL and were then instructed to complete a mock public speaking task to a virtual audience while wearing the Tepoinn 3D glasses. The virtual environment was delivered using the Samsung Galaxy S7 Edge Smartphone. Individuals were expected to speak for five minutes about their first week at university. After completing the task participants then completed the IGP, PRPSA and UMACL. The real-life (control) condition followed the same procedure but instead participants stood and delivered the speech to the researcher.

2.3. Environment construction

Technical aspects to maximise immersion were considered and manipulated across the three VR conditions [8]. Resolution, pixel density and average frames per second were maintained across the three environments. Baked global illumination and ambient occlusion lighting methods were implemented in only the high immersion condition and the corresponding light maps had a value of $35 \times 1024 \times 1024$. Eight light probes were utilised in the high condition with a Texels per unit value of 300. No light probes or units were included in the low or medium condition. The SetPass Calls for low, medium and high were 1, 28 and 104 respectively. The triangles present in low, medium and high conditions were 35.2k, 79.1k and 79.1k respectively.

3.1. Results

A one-way between groups ANOVA was conducted to compare the effect of the three VR conditions (low/medium/high) on spatial presence, involvement, realness and general presence (IPQ measures). There were significant effects of spatial presence ($F(2, 27) = 9.68$, $p < 0.01$), realness ($F(2, 27) = 8.80$, $p < 0.01$) and general presence ($F(2, 27) = 4.08$, $p < 0.05$), but not involvement. A post-hoc comparison using the Bonferroni correction indicated that the mean score for spatial presence in the low condition ($M = 11.3$, $SD = 6.18$) differed from medium ($M = 20.8$, $SD = 4.87$) and high conditions ($M = 20.6$, $SD = 5.42$) at $p < 0.01$ for both comparisons. The mean score for realness in the low condition ($M = 7.7$, $SD = 3.27$) differed from the high condition ($M = 14$, $SD = 2.26$) at $p < 0.01$. The mean score of general presence in the low condition ($M = 2.8$, $SD = 1.99$) differed to the medium condition ($M = 4.6$, $SD = 1.35$) at $p < 0.05$.

A one-way mixed ANOVA examined the effects of condition (low/medium/high immersion and face-to-face control) on PSA (measured using PRPSA) before and after the task. There was no significant within-groups main effect of PSA before and after the task, no significant interaction between condition and PSA before and after the task and no significant between-groups effect of condition.

A one-way mixed ANOVA was conducted on the three subscales of UMACL (hedonic tone, energetic arousal, tense arousal). There was a significant within-groups

main effect of hedonic tone before and after ($F(1,36) = 5.05, p < 0.05$) with hedonic tone increasing in all conditions. The mean values before were (9.5, 10.5, 10.5, 9) and the mean values after were (10.4, 11.1, 11.8, 10.2) for “control, low, medium and high” conditions respectively. There was no significant interaction between condition and time of measurement (before/after) for Hedonic Tone. There were no main effects or interactions for all other scales of the UMACL (energetic arousal and tense arousal).

4.1. Discussion

Spatial presence was significantly higher in the medium and high conditions. The low condition was built with limited technical features and a very unrealistic look, to determine what level of immersion would be too weak to produce presence. Despite this, presence was still experienced, although to a lesser extent, however this highlights the potential of VR environments and the importance of future research to focus on elements of presence and how to maximise the experience. The medium condition was built as an attempt to load onto spatial presence, along with a progressive increase in technical elements; the room was block-coloured with no textures but coloured as to highlight the differences in space. The medium environment achieved a significantly higher result for spatial and general presence than the low condition. The high environment was built with the goal of producing the most texturally real-to-life environment with the inclusion of more sophisticated technical elements given the time and computing power constraints present in the current study. The results did not reflect these ambitions however, with realness in the medium and high conditions being numerically different but not significantly. Hedonic tone increased significantly in all conditions indicating that participants felt a more pleasant mood after completing the task which is encouraging for the efficacy of this approach. Manipulating objective elements produced a subjective psychological response change; however further longitudinal research with increased exposure to the public speaking task is needed to determine whether this response change can influence PSA.

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