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Effectiveness of Virtual Reality in Reducing Public Speaking Anxiety: A Pilot Study

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Abstract: Public speaking anxiety (glossophobia) is a manifestation of social anxiety that affects a significant portion of the population, jeopardizing performance in academic, professional, and social contexts. This pilot study examines the effectiveness of virtual reality (VR) as a therapeutic tool for reducing public speaking anxiety. Over six VR simulation sessions, the physiological responses of 30 participants, including heart rate (HR) and electrodermal activity, were monitored alongside psychometric assessments. Results demonstrated a significant reduction in HR and improved self-efficacy. These findings recommend combining VR with traditional therapeutic approaches and emerging neuroscience-based methods, such as neurofeedback, to create more personalized treatment interventions.

1 Introduction

Public Speaking Anxiety, or Glossophobia, is a prevalent form of social anxiety that negatively impacts individuals' performance in various life domains. Symptoms include dread, insecurity, elevated heart rate, and sweating, which can severely hinder effective communication. Traditional treatments, such as Cognitive Behavioral Therapy (CBT), have been employed to address this anxiety (Knapp and Beck, 2008). However, VR is emerging as a promising tool for anxiety reduction, offering immersive experiences that closely mimic real-life scenarios.

VR technology can elicit physiological responses akin to real-life experiences, making it particularly beneficial in treating anxiety disorders like glossophobia (Maples-Keller et al., 2017). Research indicates that combining VR with mindfulness and cognitive skill training enhances communication abilities (Geraets et al., 2019). Despite these advancements, the effectiveness of VR in broader populations remains underexplored (Hinojo-Lucena et al., 2020). This study aims to assess whether a VR-based intervention effectively reduces public speaking anxiety, measured through physiological markers and psychometric scales compared to traditional methods.

The physiological responses associated with anxiety, such as heart rate HR and EDA, have been well-documented in the literature. Research has demonstrated that VR interventions can effectively reduce physiological arousal while simultaneously enhancing participants' self-efficacy and coping skills (Lim et al., 2023). Furthermore, studies have indicated that EDA, as a measure of emotional arousal, can provide insights into individuals' stress responses during VR exposure (Boucsein, 2012). However, some evidence suggests that while physiological responses may improve, emotional stress may persist, necessitating additional emotional regulation strategies (Dawson et al., 2016).

Given the emerging evidence supporting VR's effectiveness in addressing public speaking anxiety, this pilot study aims to assess whether a VR-based intervention effectively reduces public speaking anxiety, measured through physiological markers and psychometric scales compared to traditional methods. By focusing on the intersection of technology and psychological treatment, this research seeks to contribute to the growing body of knowledge on innovative therapeutic interventions for anxiety disorders.

2 Methods

This pilot study uses a quasi-experimental (Fortin and Salgueiro, 2009) design with convenience sampling of higher education students. Participants must be fluent in Portuguese, aged 18 or older, and experience public speaking anxiety. Exclusion criteria include serious mental health issues and prior VR experience. Participants undergo a VR exposure program, with heart rate and electrodermal activity measured, and complete anxiety and self-assessment scales.

3 Instruments

This study assessed emotional and physiological reactions during simulated public speaking using Biosignalsplux equipment, featuring EDA and ECG sensors to measure electrodermal activity and heart rate, respectively. EDA reflects sympathetic nervous system activity, correlating with stress levels (Dawson et al., 2016). Additionally, virtual reality glasses provided an immersive environment for realistic public speaking simulations.

Participants completed several questionnaires, including a sociodemographic questionnaire for personal and contextual data. The PSSAS (Hofmann, 2000) evaluated perceptions of public speaking ability, achieving a Cronbach's α of 0.90 in Portuguese. The PSAS (Bartholomay and Houlihan, 2016) measured anxiety levels pre- and post-presentation, with a Cronbach's α of 0.97.

4 Procedures

Students interested in the study filled out a sociodemographic form and received a protocol for Virtual Reality Exposure Therapy (VRET) targeting social anxiety. The procedure involved two phases:

- Education on Psychological Aspects: Participants received flyers via email with tips for improving public speaking skills.
- Digital Exhibition: In a virtual reality environment, participants delivered six 3-minute presentations, with a 5-minute preparation period for each topic and one-minute breaks in between. Heart rate and electrodermal activity were monitored using sensors. Participants completed the Public Speaking Self-Assessment Scale and the Public Speaking Anxiety Scale before and after the sessions. They confirmed their participation by notifying the school, and the session date was communicated via email.

5 Statistical Analysis

Data were analyzed using IBM SPSS Statistics (version 29), employing both descriptive and inferential statistics (Marôco, 2018). Descriptive analysis included frequency, percentage, mean, and standard deviation. Non-parametric tests (Kolmogorov-Smirnov test confirmed non-normal distribution) were used: Wilcoxon test for comparing EDA, HR, and Public Speaking Anxiety Scale (PSAS) before and after the intervention; Friedman test for comparing EDA and HR across six public speaking sessions.

6 Results

Sociodemographic and Academic Analysis:

The sample included 30 participants (60% women), with an average age of 24.4 years (SD = 9.2). 73.3% were pursuing a bachelor’s degree, and 26.7% a master’s degree (Table 1).

Table 1: Sociodemographic data

		Min/Max	Mean/SD
Age		19-56	24.4 (9.2)
		n	%
Gender	Male	12	40.00
	Female	18	60.00
Marital status	Single	28	93.30
	Married	2	6.70
Academic degree	Bachelor	22	73.30
	Master	8	26.70

Electrodermal Activity (EDA):

EDA values showed a gradual increase across six presentations (Table 2), suggesting rising emotional or stress responses. Significant differences were found between the first and subsequent presentations (p = 0.001).

Table 2: Electrodermal Activity

Electrodermal Activity (EDA)	N	Mean (S)	SD(S)	p
EDA_Presentation1	30	0.0000058	0.0000034	
EDA_Presentation2	30	0.0000060	0.0000031	
EDA_Presentation3	30	0.0000063	0.0000031	
EDA_Presentation4	30	0.0000065	0.0000030	
EDA_Presentation5	30	0.0000066	0.0000029	
EDA_Presentation6	30	0.0000067	0.0000032	0.001

Heart Rate (HR):

HR decreased from 90.27 bpm (first presentation) to 84.57 bpm (sixth presentation), suggesting reduced stress (Table 3). The Friedman test showed statistical significance (p = 0.001).

Table 3: Heart Rate

Heart Rate (HR)	N	Mean (bpm)	SD (bpm)	p
HR_Presentation1	30	90.27	12.42	
HR_Presentation2	30	87.34	10.59	
HR_Presentation3	30	85.86	11.13	
HR_Presentation4	30	84.84	9.10	
HR_Presentation5	30	85.04	10.35	
HR_Presentation6	30	84.57	8.77	0.001

Public Speaking Anxiety Scale (PSAS):

Anxiety levels decreased after six presentations, with the mean score dropping from 3.18 to 2.66 (p = 0.004). 72% of participants reported lower anxiety.

Public Speaking Self-Assessment Scale (PSSAS):

Self-assessment scores improved, with the mean decreasing from 1.65 to 1.27 ($p = 0.040$), indicating increased confidence in public speaking. 66% reported improved self-assessments.

7 Discussion and Implications

This study explored the effectiveness of VR in reducing public speaking anxiety by assessing both physiological and psychological responses during presentations. Results indicated that EDA, a marker of emotional arousal and stress, increased during VR presentations, reflecting heightened sympathetic nervous system activation (Critchley and Nagai, 2013). This trend suggests that repeated exposure did not lead to habituation, possibly due to the 'insufficient dwelling' model (Boucsein, 2012), where the specific anxiety related to public speaking amplified emotional responses. In contrast, HR displayed a significant downward trend, indicating physiological adaptation to stress (Sánchez-Hechavarría et al., 2019). Literature supports this adaptation, suggesting that repeated exposure in controlled environments, like VR, may lower cardiovascular responses (Lim et al., 2023). While emotional arousal (EDA) remained elevated, physiological adaptation signaled reduced fear-related activation (Boucsein, 2012).

Subjective measures revealed significant adaptation, with PSAS scores reflecting reduced anxiety, aligning with evidence supporting exposure-based interventions (Hinojo-Lucena et al., 2020); (Lim et al., 2023). This gradual desensitization facilitated cognitive restructuring, reducing perceived anxiety (Geraets et al., 2019). Participants' self-efficacy improved, as indicated by the PSSAS, which aligns with Bandura's theory (Bandura, 1997) that enhanced perceived competence can reduce anxiety. Interestingly, VR's effectiveness appears to be consistent across participant profiles, as individuals using anxiety-reducing medications did not differ significantly in their anxiety reduction (Baldwin et al., 2014). Moreover, participants with previous cognitive-behavioral therapy (CBT) experience showed quicker reductions in anxiety symptoms, supporting the combination of VR with CBT for enhanced outcomes (Meyerbröker and Emmelkamp, 2010). Gender differences were noted, with women initially reporting higher anxiety levels but showing comparable progress to men in anxiety reduction during VR sessions. Integrating VR into clinical and educational settings presents significant benefits. In clinical environments, VR offers controlled simulations for practicing communication skills (Maples-Keller et al., 2017) and gradually introducing stressors. In educational contexts, VR helps students develop communication skills, leading to reduced anxiety during actual presentations (Parong and Mayer, 2018). As VR technology becomes more accessible, its application in both fields is increasingly feasible (Liu, 2023). Additionally, occupational therapists can customize VR simulations, and combining VR with techniques such as mindfulness can enhance desensitization to stress (Caiana et al., 2016). Despite these contributions, limitations exist. The small sample size of 30 participants restricts the generalizability of findings and subgroup analyses (Serdar et al., 2021). The artificial nature of VR presentations may not fully capture real-world dynamics, as external factors in live settings can significantly impact anxiety levels (Bell et al., 2020).

Future research should incorporate objective behavioral measures and complementary stress reduction techniques to provide a more comprehensive understanding of VR's impact on public speaking skills. Investigating long-term effectiveness and personalizing VR simulations could enhance the tool's applicability (Meyerbröker and Emmelkamp, 2010). Additionally, examining sociodemographic factors may reveal how gender and age influence responses to VR exposure therapy.

Lastly, this study underscores the potential of VR to reduce public speaking anxiety, demonstrating that regular exposure can improve self-confidence and decrease physical reactions. However, persistent emotional stress, as indicated by rising EDA levels, highlights the need for additional interventions. These findings contribute to the growing body of evidence supporting VR as a therapeutic tool in clinical and educational environments to improve social

anxiety and communication skills.

8 Conclusion

The study focused on physiological measures (EDA and HR) and self-reports (PSAS and PSSAS), omitting external evaluations of speaking performance. Future research should include these behavioral assessments to gain a more comprehensive understanding of VR's impact on public speaking skills. Integrating stress-reduction techniques like relaxation, mindfulness, or cognitive-behavioral training alongside VR may also improve emotional adaptation during exposure. Additionally, investigating the long-term effects of repeated VR sessions, personalizing simulations, and exploring the combination of VR with occupational therapy (OT) and different therapeutic approaches, such as pharmacotherapy and CBT, could enhance treatment outcomes. Lastly, studying sociodemographic factors like gender and age may provide insights into how these variables influence responses to VR therapy, supporting more tailored interventions across different populations.

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