Editorial: The Use of Virtual-Reality Interventions in Reducing Anxiety

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1. Introduction

Virtual-reality (VR) therapy for anxiety disorders has emerged with the advent of VR technology. Its superior efficacy to waitlist and comparable efficacy to *in vivo* exposure therapy (Carl et al., 2019) make VR therapy a viable psychological intervention. VR therapy offers several accessibility benefits to encourage help-seeking among those who are less inclined to engage in face-to-face therapy and those with mild-to-moderate and/or sub-clinical levels of anxiety who might not reach threshold for clinical referral. This special issue aimed to understand the advantages and limits of VR therapy in improving symptoms of anxiety. Anxiety is the anticipation of real threat (Penninx, Brenda W. J. H. et al., 2021, Hamm, 2020). Anxiety is characterized by 'muscle tension and vigilance in preparation for future danger and cautious avoidance behavior' (American Psychiatric Association, 2013), there being a cognitive element, including a fear of the worst happening, and a physiological element, such as heightened arousal, sweating and feeling faint (Creamer et al., 1995). The objectives of this special issue were to understand:

- the theoretical significance of VR therapy for clinical and sub-clinical levels of anxiety,
- the efficacy of VR therapy for reducing anxiety,
- the mechanisms of response to VR therapy for reducing anxiety, and
- the technological limits of VR therapy.

2. Theoretical underpinnings of VR therapy for anxiety

Research on virtual reality for anxiety disorders must be guided by theory because the 'wow' factor of the technology can lead people to develop virtual environments for clinical applications acontextually. An early randomized clinical trial using virtual reality for fear of heights (Rothbaum et al., 1995) relied on emotional processing theory (Foa and Kozak, 1986), which suggests that exposure therapy modulates a dysfunctional fear structure and provides information that is incompatible with the fear-associated memory. In this issue, Jerath and Beveridge (2021) draw on theories of the philosophy of mind and of global and spatial cognition to inspire future research on

how virtual reality can improve anxiety through the creation of massive virtual spaces, such as looking at a clear sky at night. The authors suggest that anxiety is characterized by vicious cycles that can be interrupted by transcendent experiences created in expansive virtual spaces, like the cosmos, using slow deep breathing and biofeedback. Advances in VR technology to create massive spaces through testable hypotheses would yield exciting possibilities to investigate the benefits of transcendent virtual experiences.

3. Efficacy of VR therapy

VR technology holds promise for self-guided VR therapy where the user has full control over increasing their exposure to threat in the absence of a therapist (Zainal et al., 2021, Premkumar et al., 2021). Participants with high self-reported public-speaking anxiety increased their exposure to the modifiable virtual threats over two sessions of self-guided VR therapy. Improvement in public-speaking anxiety and social anxiety was shown after sessions and sustained one month after the intervention. Where anxiety is brought about by chronic physical illness, such as cancer, VR therapy can construct positive virtual environments. MIND asserts (2021) that "spending time in green space or bringing nature into your everyday life can benefit both your mental and physical wellbeing" (Naor and Mayseless, 2021). It is within this context that Wilson and Scorsone (2021) explored the benefits of bringing people closer to nature through immersive VR therapy and inducing positive emotions and reducing pain levels. Selecting among a wide range of nature-inspired immersive audio-visual experiences to promote relaxation during treatment via chemotherapy, participants receiving intravenous chemotherapy felt more calm, relaxed, and content, as well as less tense, thereby improving adherence to treatment. This anxiety-reducing impact of VR therapy during treatment for physical condition is true of other related conditions, such as stroke rehabilitation (Standen et al., 2017).

4. Mechanism of VR therapy

There is a need to understand more precisely the mechanisms of anxiety reduction that can be incorporated into VR therapies. To this end, Pfaller and colleagues (2021) highlighted the role of social presence in evoking emotional responses to specific agent social interactions. Thus, manipulating social presence may lead to more effective interventions in improving social interaction. A further mechanism of VR therapy is to gain control over anxious thoughts through attention training. Wechsler and colleagues (2021) examined the effect of external-focus attention training in participants with high public-speaking anxiety. Training participants to attend to members of the audience in the virtual environment increased the time they spent looking at the virtual audience during a post-training public-speech and enhanced their positive affect. Thus, attending to a virtual core threat is a key mechanism of VR exposure therapy.

There are also physiological mechanisms that alter anxiety response. Joeng and colleagues (2022) examined the impact of diaphragmatic breathing (DB, increasing breathing volume and allowing more air to the body) and progressive muscle relaxation (PMR, sequentially alternating muscle tension and relaxation) exercises in a VR-based relaxation training program. Levels of tension after PMR were lower in those who trained in VR compared to a control group. DB decreased tension in the VR group, particularly when they practiced in virtual outdoor anxiety-provoking environments. DB primarily strengthens the parasympathetic response, whilst also improving sustained attention

and decreasing negative affect (Ma et al., 2017). Thus, incorporating both physiological techniques as training elements to facilitate additional coping strategies, would aid VR-based anxiety exposure therapies.

5. Technological underpinnings of VR therapy

The strengths of VR therapy are hampered by the experience of cybersickness, such as dizziness and motion-sickness. Controlling for cybersickness in research on VR therapy requires a validated measure of cybersickness that delineates cybersickness from the target psychological symptoms of the intended intervention. Whilst confirming the two-factor structure of the simulation-sickness questionnaire (SSQ, study 1), Bouchard and colleagues (2021) also revealed that anxiety during stress-exposure (the Trier Social Stress Test, study 2) was confounded by cybersickness. They found that most items (11 out of 16) of the SSQ correlated with state anxiety during stress-exposure, and these correlations were split evenly across the two factors of the SSQ. Scores on the SSQ increased after stress exposure and before immersion in a virtual environment. Thus, cybersickness may be confused with anxiety during administration of VR therapy and such symptoms need to be controlled for when examining the efficacy of VR therapy.

This special issue has revealed the potential for theoretically-meaningful innovations in VR therapy. The creation of new realistic virtual environments that allow the anxious person to encounter and dissipate their fears in safety is an enduring strength of VR therapy.

6. Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

7. Author Contributions

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9. Reference

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders: DSM-5. Arlington, VA, US: American Psychiatric Publishing, Inc.

Bouchard, S., Berthiaume, M., Robillard, G., Forget, H., Daudelin-Peltier, C., Renaud, P., Blais, C., Fiset, D. (2021). Arguing in Favor of Revising the Simulator Sickness Questionnaire Factor Structure When Assessing Side Effects Induced by Immersions in Virtual Reality. Frontiers in Psychiatry 12, 739742. doi: 10.3389/fpsyt.2021.739742.

Carl, E., Stein, A.T., Levihn-Coon, A., Pogue, J.R., Rothbaum, B., Emmelkamp, P., Asmundson, G.J.G., Carlbring, P., Powers, M.B. (2019). Virtual reality exposure therapy for anxiety and related disorders: A meta-analysis of randomized controlled trials. J. Anxiety Disord. 61, 27-36. doi: 10.1016/j.janxdis.2018.08.003.

Creamer, M., Foran, J., Bell, R. (1995). The Beck Anxiety Inventory in a non-clinical sample. Behav. Res. Ther. 33, 477-485. doi: https://doi.org/10.1016/0005-7967(94)00082-U.

Foa, E.B., and Kozak, M.J. (1986). Emotional processing of fear: Exposure to corrective information. Psychol. Bull. 99, 20-35. doi: 10.1037/0033-2909.99.1.20.

Hamm, A.O. (2020). Fear, anxiety, and their disorders from the perspective of psychophysiology. Psychophysiology 57. doi: 10.1111/psyp.13474.

Jerath, R., and Beveridge, C. (2021). Harnessing the Spatial Foundation of Mind in Breaking Vicious Cycles in Anxiety, Insomnia, and Depression: The Future of Virtual Reality Therapy Applications. Frontiers in Psychiatry 12, 645289. doi: 10.3389/fpsyt.2021.645289.

Ma, X., Yue, Z., Gong, Z., Zhang, H., Duan, N., Shi, Y., Wei, G., Li, Y. (2017). The effect of diaphragmatic breathing on attention, negative affect and stress in healthy adults. Frontiers in psychology 8, 874.

MIND. (2021). How can nature benefit my mental health?.

Naor, L., and Mayseless, O. (2021). Therapeutic factors in nature-based therapies: Unraveling the therapeutic benefits of integrating nature in psychotherapy. Psychotherapy (Chic) 58, 576-590. doi: 10.1037/pst0000396.

Penninx, Brenda W. J. H., Pine, D.S., Holmes, E.A., Reif, A. (2021). Anxiety disorders. The Lancet 397, 914-927. doi: 10.1016/S0140-6736(21)00359-7.

Pfaller, M., Kroczek, L.O.H., Lange, B., Fülöp, R., Müller, M., Mühlberger, A. (2021). Social Presence as a Moderator of the Effect of Agent Behavior on Emotional Experience in Social Interactions in Virtual Reality. Frontiers in Virtual Reality 2.

Premkumar, P., Heym, N., Brown, D.J., Battersby, S., Sumich, A., Huntington, B., Daly, R., Zysk, E. (2021). The Effectiveness of Self-Guided Virtual-Reality Exposure Therapy for Public-Speaking Anxiety.

Rothbaum, B.O., Hodges, L.F., Kooper, R., Opdyke, D., Williford, J.S., North, M. (1995). Effectiveness of computer-generated (virtual reality) graded exposure in the treatment of acrophobia. Am. J. Psychiatry 152, 626-628. doi: 10.1176/ajp.152.4.626 [doi].

Standen, P.J., Threapleton, K., Richardson, A., Connell, L., Brown, D.J., Battersby, S., Burton, A., Platts, F. (2017). A low cost virtual reality system for home based rehabilitation of the arm following stroke: A randomised controlled feasibility trial. Clin. Rehabil. 31, 340-350. doi: 10.1177/0269215516640320.

Wechsler, T.F., Pfaller, M., van Eickels, R.,E., Schulz, L.H., Mühlberger, A. (2021). Look at the Audience? A Randomized Controlled Study of Shifting Attention From Self-Focus to Nonsocial vs. Social External Stimuli During Virtual Reality Exposure to Public Speaking in Social Anxiety. Front Psychiatry 12, 751272. doi: 10.3389/fpsyt.2021.751272.

Wilson, K., and Scorsone, G. (2021). The Use of Virtual Reality Technologies to Reduce Anxiety and Improve Experience in Chemotherapy Patients During Treatment. Frontiers in Virtual Reality ; volume 2 ; ISSN 2673-4192. doi: 10.3389/frvir.2021.695449; 10.3389/frvir.2021.695449/full.

Zainal, N.H., Chan, W.W., Saxena, A.P., Taylor, C.B., Newman, M.G. (2021). Pilot randomized trial of self-guided virtual reality exposure therapy for social anxiety disorder. Behav. Res. Ther. 147. doi: 10.1016/j.brat.2021.103984.