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Therapists are Makers: Virtual Reality and Virtual Environments Creation Capability for the Treatment of Rare Cases of Phobia and Obsessive-Compulsive Disorders

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Abstract. Virtual Reality Exposure Therapy (VRET) a form of exposure treatment that leverages the technology and immersive properties of virtual reality has been used in mental health for several decades with clinical efficacy. Nowadays, several companies propose ready to use virtual environments (VE) for clinicians. However, in practice, therapists or researchers may face rare demands such as patients exhibiting unusual phobias or OCD that require specific therapeutic VEs not available on the market. Therefore, empowering therapist with the tools of a “maker” to create therapeutic VEs themselves for rare cases may be a potential solution. Consequently, this trial involving 8 rare single cases was designed to test this assumption and has three objectives: to assess if a therapist with no coding skills can construct multiple specific therapeutic VEs with a free game engine, to measure the potential therapeutic efficacy of VRET and the VEs for rare cases of phobias and OCD, and to ensure these VEs yielded presence. Psychometric scales were used to assess the effects of the treatment. There was a discernible reduction of the distinct phobia and OCD for each case and a statistically significant improvement on anxiety, mood and mental quality of life scores. The presence level was satisfactory. Despite these promising results, these were single cases and further research on the game engine accessibility for clinicians and trials with a large sample of rare phobias or OCD are encouraged.

Keywords. Virtual reality, phobia, obsessive-compulsive disorders, presence, game engine, virtual environments

1. Introduction

Since 2016 onward, Virtual reality (VR), a postmodern immersive media, has been gaining momentum with the mass production of VR equipment and pushing its boundaries with the emerging notion of metaverses. VR allows users to interact in real time with computer-generated environments and is increasingly being used by mental healthcare professionals for psychotherapy. Consequently, a growing number of companies have released numerous virtual environments (VE) ready for use by researchers and therapists in the context of virtual reality exposure therapy (VRET) sometimes also called VR assisted cognitive behavioral therapy. This type of psychotherapy enables patients to be exposed to anxiogenic situation for obtaining fear extinction in the framework of cognitive behavioral therapy (CBT) [1]. During the exposure component, reality is replaced by artificially created stimuli inside a computerized world [1]. Past clinical studies demonstrated the effectiveness of VRET in treating participants suffering from many common anxiety disorders (phobias etc.) or obsessive compulsive disorders (OCD) [2]. However, in practice, therapists or researchers may face rare demands such as patients exhibiting unusual phobias or OCD that required specific therapeutic VEs. Indeed, while various anxiety disorders and phobias (aviophobia, agoraphobia, etc.) have been treated successfully with VRET, other

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rarer ones have yet to be tested with this method. Another aspect of this problem is that the virtual environments required are usually not available on the market or not build by private companies as the inherent rarity is not of financial or commercial interest. It is in this context that empowering therapists with the tools of a “maker” able to create themselves therapeutic VEs for rare cases may be a potential solution. Consequently and for facilitating VE creation, Riva et al. proposed NeuroVR, a virtual reality platform that provides clinical professionals with a cost-free VE editor in 2007 [3]. Nowadays, therapists with minimal training can utilize powerful and free 3D game engines with user-friendly editors, making Riva et al.'s first initiative a possible response for treating rare cases in VR. To assess these hypotheses, a trial involving 8 rare single cases was designed with three objectives. Firstly, to evaluate if a therapist with no coding skills can construct multiple specific therapeutic VEs. Secondly, to measure the potential therapeutic effect of VRET and the VEs for rare cases of phobias and OCD. Lastly, this trial aims to ensure these VEs yielded presence with limited cybersickness.

2. Methodology

Prior to the inclusion, each participant signed individually an informed consent form listing the content of the experimental protocol in accordance with the declaration of Helsinki [4].

2.1. Sample

The sample is comprised of a compilation of 8 single case participants (5 women, 3 men) each respectively diagnosed with asbestophobia (fear of asbestos), brontophobia (fear of thunder), coulrophobia (fear of clowns), frigophobia (fear of cold), globophobia (fear of balloons), submechanophobia (fear of submerged human-made objects), harm OCD (fear of harming others) and OCD related to error responsibility. Diagnoses were established by the authors based on a semi-structured interview, the Anxiety Disorders Interview Schedule for DSM-5 (ADIS-5) [5].

The mean age of the sample was 34.0 years (SD 14.30), ranging from 18 to 53 years. The mean duration of the phobia or OCD was 11.25 years (SD 5.65) and the mean age of onset was 22.75 years (SD 12.56).

2.2. Assessments

Pre- and post-treatment measures were assessed using self-rated fear, obsessions, anxiety, mood and quality of life questionnaires with the following self-report scales: *Rare Phobia Related Cues Questionnaires (RCQ)*. As no validated questionnaire related to fear of thunder, asbestos, clowns, cold, balloons and submerged objects existed at the time of this study, questionnaires based on the same format than squalophobia [6] were constructed. Each scale is a 20-item questionnaire and hinges on the description of 20 phobia related situations that provoke anxiety. The items are rated from one to ten points. These instruments have yet to be validated on a large scale of subjects but was utilized nonetheless as there were no alternative solutions.

Yale-Brown obsessive-compulsive scale YBOCS is a 10-item scale administered by therapist in the form of a semi-structured interview to measure the severity of obsessions and compulsions [7]. This scale was registered with the two cases of OCD.

State Trait Anxiety Inventory (STAI Y-A and Y-B) [8]. Form A specifically assesses state-anxiety at the time of the test, and form B assesses trait-anxiety in general.

Beck's Depression Inventory version II (BDI-II) [9]. This 13-item scale allows for a quick self-evaluation of depression symptoms.

SF-12 quality of life questionnaire [10]. Quality of life was assessed with this 12-item scale assessing well-being on two composite scores: physical and mental.

Aside from pre/post measures, the *Subjective Units of Discomfort* (SUD) [11] was recorded at three regular intervals throughout each VR exposure session. It is a 10 or 100 points scale test which measures the perceived level of anxiety at a given time.

Presence level and cybersickness were registered after each session using the *Presence Questionnaire PQ v3.0* [12] and the *Simulation Sickness Questionnaire (SSQ)* [13]. The PQ consists of 32 items rated on a 7-point scale, assessing the participant's perception of presence. The SSQ is a 16-item instrument on a 4-point scale assesses motion sickness related symptoms exhibited in a simulation or virtual environment.

2.3. Procedure

Following the intake assessment and the diagnostic interview, all cases were invited to undergo a standardized treatment protocol consisting of 10 weekly sessions of 30 to 40 minutes for phobia cases and 11 sessions for OCD cases. The first four sessions were devoted to cognitive component of VRET and the methods were identical and executed as outlined by several authors [14, 15]. During these sessions, all participants were taught psychoeducation, anxiety management, cognitive restructuring, positive self-statements, and mental imagery. The two cases suffering from OCD were offered an additional fifth session to cover prevention response, a behavioral component especially aimed at OCD [15].

The procedures in the remaining six sessions comprised VR exposure to different VEs related to each of the rare phobias or OCD. The VR exposure was gradually anxiogenic, as the fear-provoking stimuli varied in difficulty inside a same VE. Participants were instructed, but never coerced, to enter the VE, remain close to the anxiogenic cues until the anxiety level had diminished and were regularly encouraged to review and apply the aforementioned cognitive and behavioral methods acquired during the four/five first sessions, as recommended for the delivery of therapeutic exposure and desensitization [15, 16].

2.4. Apparatus and Virtual Environments

The VR system included a Sony PSVR Head-Mounted Display or HMD coupled with a three degrees of freedom head tracker (latency < 18ms) exploited by the software Trinus.



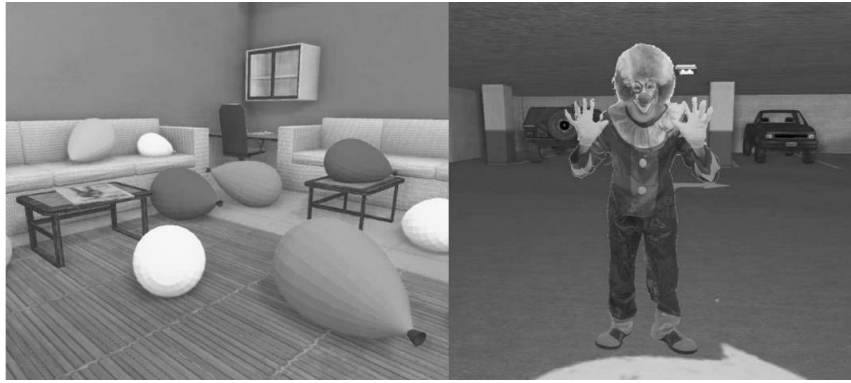


Figure 1,2,3 & 4. Screenshots of 4 out of 9 VEs created for the present study of single cases: several submerged human-made objects (up left), a cloudy sky with lightning (up right), colorful balloons in a living room (down left) and a clown in downtown (down right).

The latter enabled the subject to visually explore the environment in first-person view with the corresponding head movements performed in real time. A wireless remote control with a directional pad was also used, allowing various actions, from walking to swimming, to interacting with different 3D objects (such as grabbing balloons).

All virtual environments were constructed by the first author, a psychiatrist with no coding skills, who was trained in using the free game engine Unreal Engine 4 (Epic Games) specifically to address these disorders. This software was selected because of its accessibility, creation capability, VR compatibility, vast tutorial library, and the power of its visual scripting system [17]. Visual scripting allowed users with no coding skills to program events occurring in VEs. Training in exploiting this game engine for VE creation was carried out in a self-taught manner and for a total duration of 60 hours, using freely available video tutorial on YouTube as well as dedicated forum. VEs construction was based on the account of the situation and cues dreaded by each of the cases of this study. Consequently, the VEs comprised a series of houses with accessible roofs covered with asbestos materials, an accessible house and a coastline with cloudy sky and lightning, a downtown with multiple different clowns, a living room with switchable air conditioning system and refrigerator, a living room full of colorful movable balloons, a beach and a sea with various human-made submerged or floating objects, avatars that can be pushed and placed on a ridge, and a dining room with movable tables and breakable place settings. All VEs were constructed as open worlds where the participants were free to walk, swim or dive about.

3. Results

Seven participants completed the protocol (the participant with frigidophobia opted out due to a high level of anxiety during initial VR exposures). Means and standard deviations of pre-post measures are reported in table 1. Concerning RCQ and YBOCS, pre-post comparison indicated that the treatment was associated with a discernible mitigation of all distinct phobias (42.90%) and obsessions/compulsions (30.87%). For all other measures, the Wilcoxon Signed Rank Test and effect sizes indicated a significant improvement in state-anxiety $Z=-2.37$ ($r=.63$), mood $Z=-2.38$ ($r=.64$) and the mental factor of quality of life $Z=-2.37$ ($r=.63$) following participation in the treatment program (all $p<0.025$). Repetitive SUD measurements for point anxiety (mean and maximum) throughout the 6 VR sessions are shown in table 2. A significant reduction in the mean and maximum level of anxiety was detected over time $Z=-2.36$ ($r=.63$) and $Z=-2.41$ ($r=.64$) respectively ($p<0.025$). Regarding immersion, presence rates were satisfactory (PQ = 116.14, SD = 12.63) and cybersickness was low (SSQ = 3.83, SD = 1.57).

Table 1. Means, standard deviations of the dependent variables and Wilcoxon Signed Rank Test of the results between Pre- and Post-test period (Time)

n	RCQ	YBOCS	BDI	STAI A	STAI B	SF12 Ph	SF12 Me
	Pre-Post	Pre-Post	Pre-Post	Pre-Post	Pre-Post	Pre-Post	Pre-Post
1	143 - 102		21 - 15	46 - 41	45 - 39	36 - 37	34 - 37
2	132 - 71		22 - 13	38 - 30	29 - 28	50 - 50	44 - 53
3	117 - 54		16 - 15	51 - 35	46 - 44	57 - 57	38 - 50
4*	151 - -		18 - -	62 - -	56 - -	38 - -	35 - -
5	126 - 59		14 - 13	45 - 31	29 - 28	51 - 52	41 - 47
6	137 - 88		21 - 16	49 - 39	19 - 19	42 - 40	40 - 43
7		24 - 15	22 - 19	43 - 38	46 - 47	52 - 53	31 - 35
8		28 - 21	23 - 22	46 - 43	51 - 50	50 - 50	28 - 30

n: participants' number, * drop out. RCQ: Rare Phobia Related Cues Questionnaires; YBOCS: Yale-Brown obsessive-compulsive scale, BDI-II: Beck Depression Inventory version 2, STAI-YA and -YB: State Trait Anxiety Inventory; SF-12 mental and physical quality of life questionnaire.

Table 2. Means and maximum scores of SUD Subjective Unit of Discomfort for the 6 VR exposure sessions.

VR session (n=7)	VR S1	VR S2	VR S3	VR S4	VR S5	VR S6
SUDmean	33,76 (15,01)	29,86 (13,20)	27,42	23,90	22,19	18,67
(SD)			(8,98)	(9,38)	(8,48)	(9,87)
SUDmax	60,71 (12,05)	43,57	39,28 (14,56)	35,71	27,14	22,86
(SD)		(15,73)		(15,39)	(12,20)	(10,74)

4. Conclusion

This research provides some evidence of the potential therapeutic effect of VRET for rare cases of phobias and OCD. Moreover, the therapist's self-taught construction of open-world virtual environments (VEs) using a 3D game engine elicited sufficient presence and yielded discernible clinical effects. The outcomes revealed a significant reduction in anxiety, worry, and depression, as well as an increase in the mental factor of quality of life. However, this is a compilation of rare and distinct cases, which limits the generalizability of the conclusions. Therefore, these results should be interpreted with caution until they are replicated in a large sample and with a control condition. Regarding the VE creation capability, the 60 hours needed to become proficient in constructing VEs may be a daunting duration for a therapist. However, with the emergence of Artificial Intelligence (AI) assisted creation of 3D objects using text prompts, such as Point-E from OpenAI also known for ChatGPT, the required training time could be dramatically reduced in the future. Lastly, evaluating the motivation and training time necessary for multiple therapists to acquire the skills to create VEs and the implication of AI would be a relevant initiative for addressing these unusual predicaments and, in doing so, enabling therapists to become makers in this fascinating century.

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