Crafting Virtual Realities: Designing a VR End-User Authoring Platform for Personalised Exposure Therapy

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Figure 1: Two VR exposure therapy scenarios explored with therapists: arachnophobia and fear of public speaking. On the left, the environment started with an empty table, and the therapist started slowly sending out spiders to approximate the patient's avatar. Ultimately, as they were reacting well to the stimuli, the therapist used the authoring tool to create and send a spider to their hand. On the right, we see an almost empty theatre where the patient will deliver a presentation. The therapist exposed the patient to the anticipation of a talk and then asked the patient to perform a presentation while the audience was entering the room and, through the controls of the therapist, showed appraisal or reacted negatively to the presentation.

Abstract

Exposure therapy (ET) gradually introduces people to the objects, animals, or situations they fear to help them overcome the angst with that source of anxiety. VR(ET) enables exposure to various triggers in the safety of the clinical or home environments. While prior work has explored how specific VR environments support therapy in contexts such as social anxiety or arachnophobia, therapy's individualised nature is often overlooked. We used an iterative participatory design approach to develop an authoring platform for therapists, enabling them to tailor VR environments during exposure by changing and parameterising elements and reapplying past scenes. We used this platform as a design probe in a study with ten therapists to elicit discussions about the design of VRET experiences and therapists' authoring needs. Findings highlight the value of controlling the stimuli presented to patients and deviating from stereotypical scenarios, and the importance of further investigating the therapist's virtual representation.

Index Terms: Participatory design, virtual reality, exposure therapy, anxiety disorders, VRET, authoring.

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1 Introduction

Exposure Therapy (ET) is a commonly employed treatment option for phobias and anxiety disorders, which consists of gradually exposing patients to triggering stimuli to decrease exacerbated reactions and behaviours of avoidance. The two most well-established forms of ET intend either to expose patients to the feared stimuli in real-life scenarios (*in vivo* ET) or to imagine such scenarios (imaginal ET). These two approaches present several challenges, such as the high cost and low control of *in vivo* ET and the reliance on patients' creativity of imaginal ET [38].

Virtual Reality Exposure Therapy (VRET) has emerged as an alternative to traditional forms of ET, due to its potential to overcome their limitations. First, it is able to replicate real-world scenarios but with reduced time and human and financial resources. Second, it allows the effectiveness of the intervention to be maintained by not being dependent on the patient's imagination capabilities or their capabilities to express themselves. Third, it promises more significant control over the experience and the variables in the virtual world. For these reasons, VRET has been explored in various domains, such as pain management [1], phobias [32], post-traumatic stress disorder [17] and social skill training for individuals with autism spectrum disorder [40]. While prior work has shown the potential of VRET and results comparable to *in vivo* and imaginal therapies [20, 36, 6], it also shows that current VR settings are often monolithic, affording low flexibility and control over the experience [23]. This limits therapists' capacity to tailor sessions to individual patients, a concern heightened by the diverse needs of patients and the unique nature of their clinical conditions.

In this work, we investigate how to support therapists in preparing and controlling VRET sessions to accommodate their needs and those of their patients. For that purpose, we followed a participatory design approach where we included therapists in the design of a VRET authoring platform. We started with preliminary meetings with therapists to understand their current practices and needs and to provide comments and suggestions about the first prototypes developed by the research team. These meetings resulted in a fully functional prototype supporting the authoring, repetition, and real-time control of VRET sessions under two scenarios: arachnophobia and fear of public speaking (Figure 1). We then conducted a user study with ten therapists (in pairs) where we performed: 1) semi-structured interviews to further understand current practices, challenges, opportunities, and the role of VR in therapy; and 2) a mock-up session using our VRET authoring platform as a design probe, where participants acted as therapists and patients, to elicit feedback about the platform, authoring needs, and the VRET experience itself (one pair did not complete the mock-up session).

Our findings show that therapists value the ability to author sessions tailored to the needs of each patient while also being able to control and adapt the available functions in real time. Re-using and sharing sessions enables replicating specific sessions, optimising session preparation before exposing patients to stimuli, and assessing their progress. In addition, participants highlighted the importance of studying how therapists should be represented virtually and criticised the stereotypical scenarios currently used in similar applications. We discuss how these findings inform the design of authoring platforms for VRET sessions.

Our paper contributes with lessons learned on the authoring needs of therapists when crafting VRET experiences and on the design of VRET platforms. In addition, it further characterises current therapeutical practices and opportunities for VRET, and presents a VRET design probe in the contexts of fear of public speaking and arachnophobia.

2 Related Work

The decreased costs and increased capabilities of VR technologies have made it more affordable to users and more straightforward to include as a medium in various areas. More particularly, VRET has become increasingly more common as an alternative to the more established *in vivo* and imaginal ETs.

Although more established, *in vivo* and imaginal ETs have shortcomings [38, 34, 14]. For example, imaginal exposure, which consists of asking patients to imagine the feared situation, is utterly dependent on the patient's imagination; therefore, there can be an inability to successfully recreate the situation in the patient's mind, which, with the added lack of control from the therapist over what the patient is imagining/experiencing, might not activate the fear response [38]. *In vivo* exposure therapy consists of exposing the patients to the feared stimuli in person, which also entails particular drawbacks. One of the most significant limitations is the loss of confidentiality, as exposure to a real-life scenario can include public scenarios, risking contact with outside people. Additionally, there is a lack of control over external variables in these real-life situations (e.g., for fear of dogs, a dog might not be available) and added costs that come with them (e.g., for fear of flying, the treatment involves multiple flights, which can become expensive) [38, 36, 34]. Furthermore, some patients may find *in vivo* ET too overwhelming, avoiding seeking treatment [38, 34].

VRET has shown great promise in multiple clinical areas. For instance, in PTSD [17, 18], studies revealed that VRET efficacy is comparable to imaginal exposure but with some advantages, such as the perceived levels of anxiety/fear of the patients being lower with VRET. In school phobia, the study by Peñaloza-Salazar et al. [32] managed to lower the school-related fears of children, while also including more reluctant participants due to the more appealing setting of using VR. In obsessive-compulsive disorder [14] results were comparable to *in vivo* exposure, with the caveat of having a more considerable engagement and reduced pre-session anxiety. For both Fear of Flying [36, 35] and Social Anxiety [2, 4, 5, 19], several studies and software have already been designed with the sole purpose of providing ET in these contexts with positive results that are comparable to *in vivo* and imaginal exposure.

In addition, VR allows to easily recreate scenarios that are difficult and/or dangerous to portray in a real-world environment, which can include crossing the street with a red light for children with autism spectrum disorder [40], teaching them how to react to day-to-day situations through social skills training, and war scenarios for PTSD [18, 17]. It is also more affordable and achievable if we consider that *in vivo* ET requires that both the therapist and client have to match agendas, go to the place where exposure will take place (which also can be a time burden), and even after all this effort, conditions might not be perfect at the desired place.

Still, while VR can potentially recreate real-world scenarios more safely, allow for better control [4] and customisation [38], and make patients keener to engage in therapy [31], most scenarios are limited and monolithic. Prior work provides valuable contributions in the customisation of therapy sessions but often restricts the therapist's control to a sequence of predefined actions that can be toggled [34, 15], sometimes associated with varying difficulty progression levels [6, 22]. Although works such as [9] provide greater control in real-time by focusing on higher-level elements such as the type of environment or the weather, also enabling patients to select meaningful objects, they do not allow to control subtle, fine-grained elements such as specific gestures or behaviours that could increase flexibility in real-time and diversity of experiences [1, 23].

In addition, prior work has also focused on giving authoring capabilities to patients. For instance, Choi et al. [13] developed V-Theme Park, which consisted of a virtual environment with graded ET, in which the virtual worlds were constructed directly by the patients, using stimuli particular to themselves. Alves et al. [3] created a mobile application that enables users to create virtual environments by taking photographs with their smartphone, enabling them to replicate environments that they face in their lives. These environments could then be explored and edited by adding text labels, images or videos. These studies were received positively, highlighting the need for more authoring-focused studies.

Lastly, it is of note that the majority of past work (e.g., [5, 32, 36, 15, 22, 9]) focused on presenting and evaluating a specific tool or approach, aiming to understand its efficacy. While these works also provide valuable contributions, we focused on delivering a design probe to elicit knowledge from domain experts, facilitating discussion and insights that inform the design of future platforms for VRET. Prior work [21] shows that technological probes help non-tech-savvy users understand the concepts and provide a proof-of-concept to generate discussion and ideas.

Our work addresses the limitations of current VRET solutions by leveraging the advantages of including therapists in the design process. By developing VRET systems alongside clinicians, we can include necessary session authoring capabilities in these systems, providing flexibility and adaptability to tackle the specificity of patients' conditions.

3 Participatory design for authoring VRET

Our main goal is to understand therapists' needs and preferences when preparing and controlling VRET sessions. We followed a participatory design approach where meetings with therapists supported the design and implementation of a VRET authoring tool and used such tool to elicit further comments and suggestions. This work intends to inform the design of future VRET experiences and authoring platforms. Overall, our specific objectives were to 1) understand the current clinical practices in ET, 2) gain insight into

the potential impact of VR on the future of ET, and 3) understand the requirements for a VRET authoring tool and the respective VR experience.

In this section, we briefly describe our iterative process with therapists, followed by the description of our VRET authoring prototype and a user study conducted with 10 therapists. The whole process took place over 11 months.

3.1 Iterative Process with Therapists

We organised three different sessions with six therapists in total (all with over 10 years of experience, two of them also participating in the final study). During the first two, we identified which anxiety disorders to focus on in our prototype: fear of public speaking, which was often generalised as social anxiety by clinicians, and fear of spiders (arachnophobia). These meetings also helped us to understand and confirm the main limitations of current practices and which features we should include in the prototype.

In the fear of public speaking scenario, clinicians mentioned the possibility of including an empty room as a means to explore anticipation, conveying emotions and eye contact in the virtual audience (i.e., through gestures or facial expressions), and visualising virtual people standing up and leaving the environment in the middle of a presentation, promoting thoughts of doubt on the patient.

In the fear of spiders scenario, therapists emphasised the requirement to create spiders on different surfaces, including on the patient's virtual hand to provide another type of feedback (haptic), changing spiders' size to allow customisation of the intensity in real-time, as well as allowing the patient some control over the spiders to improve the sense of agency (i.e., trapping and killing spiders).

Furthermore, the inclusion of sound and reviewing and replaying past sessions were also frequently mentioned.

The third meeting allowed us to confirm requirements and showcase our initial prototypes to therapists. This gave us valuable insights and suggestions that helped shape the rest of our prototype, refining elements associated with the controls and features of the scenarios before proceeding to the user study.

3.2 VRET prototype

The preliminary sessions guided the design of a tool for authoring VRET sessions. This tool supports two scenarios with two environments each (totalling four environments), and comprises a VR application meant to be experienced by the patient and a computer application meant to be used by the therapists. It allows the environments and non-player characters to be dynamically customised in real-time during a therapy session, promoting authoring capabilities for the therapist. Furthermore, it enables these dynamically generated sessions to be replayed and adapted in the future.

3.2.1 Immersive VR application

The VR application is designed for patients to interact with. It has a training environment for calibrating the HMD (i.e., adjusting straps and connecting the computer application) and explaining controls to patients. It is a simple room with stone walls. We have then developed two VRET scenarios, each with two different environments.

Fear of Public Speaking. The first scenario developed is to be used with patients with fear of public speaking (Figure 1, right side). Here, two environments are presented: a classroom and a theatre. In this scenario, the therapist can create (i.e. people will appear at the door and sit in the audience) and remove (i.e. the people in the audience can stand up and leave - Figure 2a) people in the audience, activate animations among the audience (e.g., clapping, negative and positive gestures, turning towards the patient - Figure 2b), toggle background noise in the audience, and show emotion through emojis in thought balloons among the audience (Figure 2c).

Arachnophobia. The second scenario developed is to be used with patients with fear of spiders (Figure 1, left side). Here, two environments are presented: a living room and an office. In this scenario, the therapist can create spiders in different areas, including on the patient's virtual hands with haptic feedback – providing slight vibrations to the respective controller when the spider moves –, change their size in real-time, and eliminate them. The patient can trap the spiders using a glass and kill them using their virtual hands or a handbag in the living room environment.

(a) Virtual characters leaving the audience.

(b) Virtual characters performing gestures.

(c) Virtual characters showing emotion through emojis.

Figure 2: Patient perspective in the fear of public speaking scenario. Here, while the patient is doing a presentation, the therapist manipulates different elements of the virtual environment to simulate anxiety-inducing behaviours, such as (a) seeing people getting up and leaving the theatre, (b) people expressing boredom and encouragement through body expressions, or (c) emojis

3.2.2 Authoring tool

The computer application is designed for the therapist's use, provides control for each scenario and allows past sessions to be reviewed and replayed.

Controlling scenarios. The therapist is able to control the four different environments in real-time through the computer application. For instance, in the case of the theatre environment, the therapist possesses an interface (Figure 3) with several different buttons and sliders corresponding to each feature, separated into different

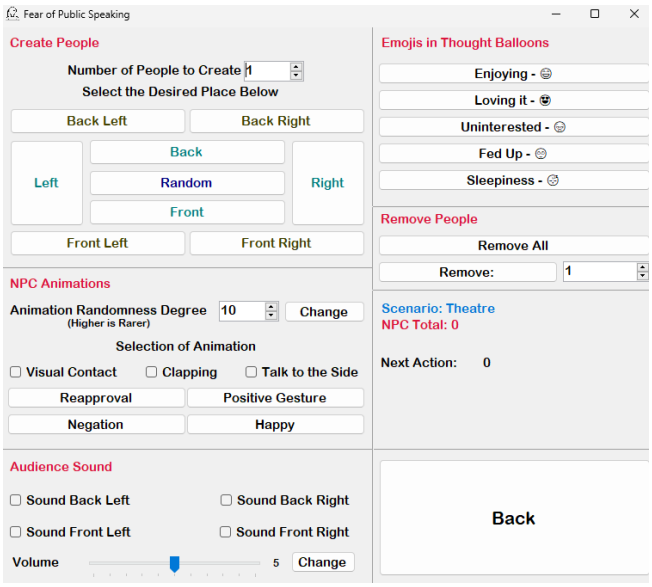

Figure 3: Screenshot showcasing the fear of public speaking interface of the authoring tool.

quadrants: a) Create People - creating people in the audience, b) NPC Animations - toggle gestures among the audience, c) Audience Sound - control sound effects, d) Emojis in Thought Balloons - display emojis in the audience, e) Remove People - eliminate people from the audience, and f) information about the environment. The application logs all interactions to the Firebase database.

Reviewing and replaying past sessions The VRET system allows for previous sessions to be reviewed and replayed with a click of a button while still allowing them to be customised simultaneously. Both features make use of Google's Firebase (cloud), reading logs saved during past sessions.

In addition, the therapist can visualise the patient's screen through Unity's "game" interface or Oculus Casting if using the VR application untethered.

3.3 User Study

The prototype was then used as a design probe for a participatory design study, divided into five sessions with a pair of participants each (n = 10) and comprised of two parts: semi-structured interviews and mock-up sessions.

The semi-structured interviews included questions on topics ranging from the perceived role of technology and VRET in therapy, what level of control clinicians want in VRET, and what future participants see with VRET. We also hypothesised VRET scenarios focusing on probable limitations and desired controls.

In the mock-up sessions, we used our prototype to challenge clinicians to play the roles of a patient and a therapist to get more direct feedback and suggestions and to understand particular dynamics and practices that would be more apparent in an active setting. Lastly, we inquired clinicians on session replayability.

Our study took place at the private clinic facilities where participants were recruited. Sessions took place across two non-consecutive days. Four sessions were included on the first day, while the remaining one happened on the second day. The material list included a powerful gaming laptop, the Meta Quest 2 and a USB-C cable (the Quest Link). While the prototype could run standalone, we used a USB connection to easily control the VR experience and display it on the laptop.

3.3.1 Participants

We recruited ten participants from a private clinic through convenience sampling. Nine were clinical psychologists, and one was an intern, with most having social anxiety disorder as one of their main areas of work (n = 6). Participants were required to be trained and experienced in ET and anxiety disorders to qualify for the study. Two participants were male, while the rest were female, and most had 10 or more years of experience (n = 6), with two having over 20. Three participants had previously used VR technology as a tool during therapy sessions.

3.3.2 Procedure

The study consisted of five sessions, each with a pair of participants (i.e. five pairs). Each session started with the first author describing the study's objectives and providing an overview of participants' involvement, including their rights. Participants were given an information sheet with study details and authors' contact and were asked to read and sign the written informed consent. Participants were encouraged to ask any questions they had.

The session comprised two main phases, each focusing on different objectives.

Semi-Structured Interview. During the first phase, we gathered data on the current clinical practices used in treating anxiety disorders with ET. We also asked participants for their insights on VR as a supporting tool for ET. We aimed to understand and validate the challenges and limitations faced by traditional methods by collecting data and promoting discussions between clinicians. To facilitate this, we used a script divided into five categories to guide the conversation. The following categories were discussed during the interview:

- **Background**: We aimed to understand the participants' background in therapy and their experiences with anxiety disorders. We also discussed which anxiety disorders are more common in their clinical practice.
- **Therapy Characterisation**: We focused on understanding the therapeutic method, initial therapy sessions, and how therapy evolves over time. We also discussed barriers and challenges that current ET methods (*in vivo* and imaginal) raise.
- **Evaluation and Challenges**: These questions were essential to understanding how progress is evaluated and the differences between dealing with children and adults.
- **Technology**: We wanted to understand participants' opinions on technology use in the context of therapy before moving on to the VR-related questions.
- **VR**: Finally, participants were asked about VR in the context of health, as well as its benefits and shortcomings. We also discussed specific applications and controls they would like to have in the virtual environment.

Mock-up Session In this phase, one of the participants in the pair was asked to play the role of a patient and the other of the clinician. Participants were asked to act as they would in a standard setting, following protocols and simulating conversations that typically happen during an ET session. After the participant assigned to be the patient put on the HMD and the connection to the platform was done, the researcher loaded up the public-speaking phobia theatre scenario, and the "patient" was encouraged to explore. Initial conversations between the therapist and the "patient" occurred without input from researchers, as the therapist would tell us what they would like to happen and be able to control. Throughout the session, we demonstrated the features we had developed and sought

feedback from the participants while giving them control over the scenario.

After completing the mock-up session, we demonstrated to participants that we could repeat the session they had just finished, automatically activating the exact timeline of stimuli, and asked final questions about the overall experience and how saving sessions could be leveraged for future use.

We prioritised the fear of public speaking scenario as it is one of the most prevalent anxiety disorders in participants' clinical practice. Despite this, we were still able to show the arachnophobia scenario to two pairs, time-permitting, and get valuable feedback.

3.3.3 Data analysis

Sessions were audio recorded and transcribed. To protect the anonymity of participants, an ID code was assigned to each participant (i.e. P1-P10) and all personal information removed from the final version of the transcriptions.

This data was then coded and analysed using a thematic analysis protocol according to the model proposed by Braun and Clark [10]. This thematic analysis took place over several moments of discussion, including brainstorming sessions among the researchers to rearrange ideas and build connections among themes.

Due to technical problems, we were unable to complete one of the mock-up sessions (with the first pair of participants). Still, we included interview data from the first pair and fixed the technical problems for the following pairs.

4 FINDINGS

Based on the thematic analysis protocol conducted, the following themes were identified:

4.1 Current practices

Participants described their current practices usually by outlining the ET pipeline. For instance, five participants mentioned that therapy always starts with a psycho-education process. In the first sessions, the therapist, alongside the patient (and the parents in the case of children and adolescents), has to build an exposure hierarchy (P2, P4, P5, P6, P10) where they will, as mentioned by P2, "... *identify every situation that he is afraid of and classify it in the degree of discomfort [felt]*". These situations will be ordered in terms of the oatient's ability to face them. Then, the therapist makes a list detailing the order of exposure to each one. Parents, especially in the case of pediatric patients, must also be part of the therapy process as they act as co-therapists and are the most prominent drivers of success or failure. Finally, gradual exposure can begin.

One factor particularly relevant to therapists' practices is participants' readiness, as some patients might not be ready to move from imaginal to *in vivo* ET. In addition, the type of phobia is also a determinant of the kind of approach used. For instance, P2 mentioned that "*in vivo*" exposure is particularly important in disorders such as fear of public speaking, while imaginal exposure can serve as an initial stepping stone for specific disorders such as generalised anxiety to reach a degree of comfort where patients can then be exposed *"in vivo"*.

While exposure is essential, P2 highlighted that it cannot be used alone, and should be used alongside other techniques. Exposure is usually composed of small tasks, such as "... *sending an audio message to a friend...*" (P1) in the case of selective mutism. Still, clinicians raised concerns about current practices using digital interactions, which are disliked by some patients as they cannot judge how the other person might react.

Technology was already present in therapy through the use of videos or even 360º videos with VR. Still, the COVID-19 pandemic temporarily changed care to be exclusively remote, which forced therapists to find solutions. P3 mentioned that exposure, especially for specific disorders, was challenging - "... *for fear of public speaking, [exposure] was very limited because there was not a context that would allow it*" - which still applies to online sessions nowadays.

Participants also mentioned the impact the COVID-19 pandemic and isolation had in regards to mental health. For instance, P3 mentioned: "*I think that with the pandemic (...) not being able to live our normal lives could have aggravated certain traits that maybe were already present*". This idea was also highlighted by P7, who refers:

> *"If we consider anxiety from the subclinical point of view, and not exactly clinical, there is a big aggravation [of mental health issues]. (...) Buying a house, leaving the parents' house, getting a job (...) there is a whole level of situations associated to adulthood where we (...) will most likely find higher subclinical values [of anxiety]".* - P7

Still, clinicians raised some concerns regarding exposure *in vivo*. P1 stressed that "... *sometimes it is hard to put into practice some elements that we think: this would be ideal...*". This can happen for multiple reasons: 1) the environment itself or external organisations do not allow it – e.g., a school may not allow school phobia therapy to be performed in that context; 2) the elements do not cooperate – e.g., in the context of fear of bees, P3 referred that"... *depending on the time of the year, it is a lot harder to perform these exposure moments...*"; 3) it is dangerous to perform the exposure, such as with the case of driving; 4) and in terms of logistics, with exposure often requiring the therapist to "... *get out of the office and go with the person to a certain environment...*" (P7, P8), forcing the clinician to book multiple hours for that specific patient instead of one, with associated costs.

4.2 Feedback on Authoring Capabilities

Therapists praised the authoring possibilities present in our design probe. They highlighted the possibility of controlling the environment itself in the fear of public speaking scenario, such as using lighting and sound to their advantage. For instance, P4 mentioned that "*the fact that the environments are dark is already anxiogenic*". Additionally, the possibility of controlling specific characteristics of the audience, such as eye contact, gestures and behaviours (e.g., virtual characters getting up and leaving the auditorium) and being able to control audience size were found valuable to the experience. In particular, P7 mentioned that:

> "... *having only one person has another effect that is activating, maybe even a little more because it is one person and can only interact with me...*" - P7

On the other hand, P9 directly stated that allowing more people in the auditorium was important.

In the fear of spiders scenario, therapists mentioned positively the ability to trap and free spiders under the glass, giving some control and agency to the patient. Also, P6 mentioned it was important to control the size of the spider, as well as the creation of spiders on the patient's virtual hand, which allows the placing of the phobic element in the patient's virtual hand, providing haptic feedback to increase realism.

When presented with the possibility of replaying previous sessions, participants said it makes total sense as it was interesting to be able to go back and, as referred by P6, "... *understand that a situation that was thought to be more anxiogenic, actually does not cause that much anxiety, or vice versa*".

Notably, the therapists also provided suggestions to implement into our system to improve customisation and authoring capabilities. For the fear of public speaking scenario, participants mentioned including control over lighting and more gestures and inter-

actions to improve authoring and different characters in the audience with varying genders, professions and social statuses, as some patients might struggle with a particular type of person.

For the fear of spiders scenario, participants recommended adding spider webs as part of the exposure to incite anticipation, and controlling the spiders' distance from the patient and their ability to climb the patient's leg.

Additionally, they suggested including music and a relaxation application in the middle of therapy.

4.3 (Stereotypical) Realism

When referring to commercially available VR environments, therapists feel a lack of integration of the therapeutic requirements in virtual environments for ET. P10 referred to a VR application that she had experienced in the context of OCD, with contamination symptoms, highlighting a lack of communication between VR tool developers and therapists.

> *"I work with obsessive-compulsive disorders. There is a myth about contamination that has to do with germs. I experienced not long ago an environment in which there are multiple germs, viruses, among others, that come flying in my direction (...) this won't activate anyone (...) usually, whoever does the design doesn't have clinical experience"* - P10

This disconnection with reality creates a stereotypical realism in these scenarios. In this case, the person is not afraid of the virus itself but of the thoughts of being dirty and in unsanitary situations in their heads, for instance, P10 highlighted situations such as "*... a used tissue on top of a table...*" or "*... someone touching the door knob with their hands dirty...*". Another example one of the participants (P2) gave to exemplify this was, in the context of fear of heights, a New York-like skyscraper, which is a typical environment "*... to appear in VR systems (...) has nothing to do with the buildings that I know of here*". Although it might be able to activate the patient, they might not feel like they fit in and not change their perception of the phobia.

Clinicians also raised concerns about the environments' graphical fidelity (physical realism [26, 16]). It was mentioned by P3 that it would be good if, for some patients, different environments could be used - "*... we could have an environment closer to reality because (...) it is a very cartoony environment, and for some kids having a more realistic environment might help (...) because they would say 'all right, but this is because I know this is fake (...) and it's not a problem here'*".

Moreover, this realism is necessary because some patients might get stuck on judging the environment itself instead of being open to therapy:

> *"Children (...) play, sometimes even VR in other games, right? And the graphical quality is (...) a lot superior (...). Sometimes children themselves can be a little judgmental (...), which means that sometimes they get more stuck in evaluating the environment than actually [being open for therapy].*" - P10

4.4 Holistic experiences

During the exposure process, the patient is taught simple relaxation techniques, such as self-affirmation phrases and breathing exercises (P1, P3, P4), the latter being present even in our mock-up session. Therapists suggested the inclusion of visual aids for these exercises in the virtual environments:

> "*...not really pausing the environment, but something appearing in front that would allow the exercise to be done (...) the hand as an anchor for breathing (...) the hand contour, they follow this line (...) to help them count each breath.*" - (P4)

Therapists also mentioned that the current starting zone of the VR system looked like a dungeon (P7) and that first impressions of the environment were important - "*... entering the VR knowing that I will be exposed and having instantly a scene with a wall made of stone isn't captivating*" (P5). So, it was suggested that, for the case of the fear of public speaking scenario (theatre), the exposure could start from the door, as "*... seeing the turned away audience (...) changes the level of anxiety, as well as being closer to the exit door*" (P4), or even outside the theatre itself, starting in the elevator (P5) towards the theatre, and that the act of walking towards the place that causes anxiety can be the first step of exposure (P6).

Furthermore, while some exposure tasks directly relate to the patient's fears, others are not as direct. For example, for fear of spiders, P4 mentioned that spider webs could be as, or even more, anxiogenic as seeing a spider directly because of anticipation.

4.5 Therapist-Patient dynamic

The therapeutic relationship between the therapist and the patient is one of the producers of success; this dynamic was mentioned directly by six of the therapists (P1, P2, P3, P5, P6, P10). This relationship starts forming in the first session and develops along each session, with some situations that can be the determining factor in the therapeutic relationship (P1), such as the feeling of competence by the patient, for example, by asking the patient directly for help with something.

The virtual representation of the therapist, in both VR and non-VR applications (e.g., self-administered therapy applications [25]), was also a prevalent topic in the conversation.P2 mentioned that having an avatar controlled by someone real, that is not just a bot answering, directly affects the outcome of the therapeutic intervention. This was even more evident when transitioning into the mock-up session with P5 and P6, where the pair assumed both participants would put the HMD on and be virtually represented in the environment at the same time, one serving as the patient and the other as the therapist:

> "*No, but I think we both go, right? (...) How does this work, will it be the both of us?*." - (P5)

These therapists envisioned the therapist authoring the session while also being part of the virtual experience.

Clinicians also highlighted one of the significant limitations of current VRET platforms, emphasising the inability to simulate physical contact. In particular, P10 stressed that they cannot just make their hands part of the environment and experience. While this might not be essential for all patients, for some, the ability to receive assurance and comfort from the therapist can profoundly influence therapy's effectiveness - "*... there are people that need bigger... yes... need more proximity...*" (P10). Furthermore, P6 also raised concerns regarding other stimuli such as odour - "*I imagine that some variables, like odour, that is present in the real situation, we can't reproduce in the VR*".

4.6 The role of VR

One key aspect provided by therapists regarding the use of VR for ET is that it is not here to replace *in vivo* but to help bridge the gap between imaginal and *in vivo* exposure. However, some advantages over *in vivo* and imaginal ET were identified by participants, namely P5 mentioned: " *...controlling some variables, and VR can help here with more real imagery because the person is still in a safe place and, therefore, can remove the glasses [HMD] at any point if they want to stop*". It is better than imaginal exposure but not as invasive and anxiogenic as an in vivo exposure (P2). Still, it is only seen as a middle step since:

> "*... virtual reality is a virtual reality (...) if we don't make the passage into an in vivo context (...), there is no proper way to test if that phobia or if that anxiety has less impact*" - (P5)

Furthermore, P5 raises concerns about patients losing the sense of security when transitioning into the real world - "*... when a person transitions from a virtual world to the real one, they may lose their sense of security (...) This feeling of security can give them a sense of calmness, as it is a major factor that can help ease anxiety.*".

VR is also more than therapy, allowing to bridge a possible distance gap between the patient and the therapist. As P7 mentioned, "*... being able to have the situation of having my client at home, put on his glasses [VR headset], they don't have to be the same as mine, ok? But being able to log into a platform in real-time, just like it was a videoconference with me*" would be significant. Furthermore, P4 and P10 mentioned using VR for playing video games and doing relaxation exercises outside the scope of therapy.

Comfort surrounding the hardware and software was also one of the talking points in the interview. P3 was especially concerned that:

> "*... for some children when they are more anxious and mainly if they already have some hypersensibilities, physical stimuli can be particularly challenging (...) for these kids, the glasses [HMD] in the moment of exposure can be a problem (...) it exudes a lot of pressure on the face, and they become really hot*." - P3

P4 also stressed that the action of putting the HMD on might already make the patient anxious, as they know it is for exposure, leading to negative feelings towards the HMD itself. To tackle the latter, this participant suggested the employment of a more ludic moment before entering the scenario itself, such as a simple game of hitting a hoop with a ball.

4.7 Other scenarios

Clinicians, especially P4, mentioned that they would like both phobia scenarios of dentists and vaccines to be explored in VRET — "*I think this has the potential for something in particular (...), exposure to dentists (...), and to vaccines, where the parents go crazy, the dentists go crazy, and there is nothing like that, at least that I know of*".

Another scenario that was mentioned by P4 was selective mutism - "*We have to do this [VRET] for mutism. Really, it is a winning idea; the kids will take a lot less time to start talking*".

5 Discussion

In this section, we discuss the lessons learned from our participatory design approach with therapists and the user study findings.

5.1 From stereotypes to individualised and meaningful scenarios

Our findings suggest that current VRET applications are based on stereotypes, focusing on exaggeration (e.g., flying virus towards OCD patients) and generalisation (e.g., using virtual skyscrapers for fear of heights in patients who do not have experiences with them). Participants expressed the need for control of subtle things, allowing therapy to be adapted to the individuality of patients to recreate fabricated situations as close to real ones as possible.

This concept is related to ecological validity as it defines realistic and accurate scenarios regarding the physical characteristics and psychological demands encountered in real-life situations [37]. Ecological validity is crucial for the patient to identify itself with the scenario [30], making these scenarios more engaging and effective.

The ecological validity possibilities within VR are immense [30], allowing the replication and complete control of real-life situations and the patient to interact with the environment safely. VRET scenarios must be built alongside therapists, with patients in mind, to personalise stimuli to be effective and promote transfer to the real scenarios faced by each patient.

5.2 The importance of the therapeutic alliance and the therapist's representation in VR

We verified concerns about therapist representation within the virtual environments, as the patient is not able to see the therapist due to the HMD. This needs to be considered since a positive relationship between a therapist and their patient (known as therapeutic alliance) leads to better treatment outcomes. The important of the therapeutic alliance has been supported by over 30 years of research [33, 7, 8]. In our study, therapists emphasise the importance of building this alliance from the first session, which involves getting to know each other and providing psycho-education. This initial period helps patients feel comfortable with their therapist, enabling them to open up and discuss their issues [27].

Our study suggests that the therapist's representation in the virtual environment needs to be carefully studied to ensure the success of this therapeutic alliance. While being represented may bring the pair closer, it may also make it difficult for the therapist to author the session. This finding opens new avenues and questions for future research on the mechanisms to support both the interactions between them and the authoring capabilities (in real-time) of the therapist.

It is known that the therapist's virtual appearance can affect the patient's perceived approachability [27]. While a more cartoonish avatar can promote approachability and accessibility, the seriousness and relatability of a human-like avatar can be equally important, suggesting a need for further studies regarding implications on the therapeutic alliance. There might be a need for another adjustment period for the patient to engage similarly with the virtual representation of the therapist.

Furthermore, there is a concern that virtual interactions cannot replace real-life ones. For instance, healthcare professionals often need to touch patients to calm them down, which is an essential part of the therapeutic relationship. Future research may explore how virtual environments can emulate these stimuli and compare their effectiveness with real-life interactions. In addition, the role of the therapist in these environments should also be explored. More specifically, investigate the differences between a more passive role (e.g., distanced from the patient or close to provide comfort) and a more active one (e.g., being part of the audience in a fear of public speaking scenario).

It is also essential to understand how to monitor the patient in a virtual setting, both in a self-reported and objective way. For the former, possible approaches include the use of shortcuts connected to the physical controllers or a specific object in the virtual environment that the patient could grab to report positive or negative feelings. On the other hand, objective monitoring through the use of physiological sensors or other technologies that allow accurate and objective data might prove to be helpful, as seen in Cullen et al. [14] and McGinnis et al. [28]. However, research into the usefulness of these technologies in VRET is still lacking, suggesting a need for further studies in this field.

5.3 VR as a middle ground in therapy

Research has shown that VRET is highly effective and, in some cases, even better than *in vivo* exposure [5, 14, 35]. Additionally, VRET has been found to be less intimidating and more acceptable to children [32]. Still, our findings suggest that clinicians accept VR in the context of therapy but view VRET as a middle ground between imaginal and *in vivo* exposure. This is mainly due to their

belief that exposing patients to real-life scenarios is necessary due to the perceived lack of stimuli, such as touch and realism in VR.

Therapists also mentioned the use of technology for remote therapy. Remote therapy has been around for a while, albeit through the phone or the internet. Still, it gained more popularity during the COVID-19 pandemic [12], forcing therapists to adapt to the new reality and adopt methods more suited for long distances. There is no apparent disconnection regarding treatment fidelity [39], but it can present some limitations, such as increased therapists' fatigue and lack of emotional connection to the patients [12, 29]. Research shows that using remote VR for rehabilitation and exposure therapy offers benefits over alternative methods like Skype, enhancing realism and patient engagement [31], and is comparable to conventional VRET [24], inducing the same levels of anxiety and anticipation concerning the exposure. Further research into the incorporation of authoring methods for remote VR exposure is needed.

In addition, while VR allows patients to have immersive experiences, it adds to the therapist's workload [11]. The therapist has to 1) pay attention to controlling the virtual environment, 2) interact with the patient, and 3) take notes, all at the same time. By building upon the feature of the developed platform (i.e., replaying and reviewing past sessions), these sessions could also be saved and shared among therapists, with the ability to be customised to fit their needs, possibly reducing the workload of therapists and allowing knowledge to be shared.

5.4 Control possibilities and the importance of holistic experiences

The level of control provided by the authoring tool over the VR experience was highly praised by therapists. Our findings suggest that such control is important to create effective experiences, taking into account the individuality of patients. Still, while our platform possesses several control possibilities, increasing the type and number of interactions may further increase the specificity of possible experiences and their adaptations to unique patients and clinical conditions. However, this may result in increased complexity, so researchers and designers may need to consider the tradeoffs of functionality and complexity, always focusing on usability for the end-users (therapists).

One possible approach is having one person control the virtual avatars dynamically, as explored by Koller et al. [23], where the authors investigated the possibility of a therapist controlling a person in the virtual audience using hand and arm gestures. To tackle the authoring limitations of currently available systems, the authors propose a continuous interaction system that could reduce friction and improve efficiency by enabling direct and partially infinite interactions based on hand gestures and voice communication.

Although it is vital to control specific actions and aspects of the phobia (e.g., controlling spiders, virtual audience), clinicians have emphasised that the importance of control goes beyond this specificity into the possibility of providing a holistic experience to patients during VRET. For instance, controlling the starting zone of an environment is of paramount importance as it is the first interaction that the patient will have with the environment.

5.5 Limitations

One of this study's main limitations lies in the quantity and specificity of the recruited participants. Although we gathered data on current practices and views towards VR itself, these are narrowed within the institution that hosted both our study and the preliminary sessions to build the prototype. Still, the participants were diverse, with multiple differences in years of experience and areas of expertise within anxiety disorders.

In addition, we focused on functionality as we wanted to understand what types of features would be valuable to control in a VRET session. We did not focus on the usability of the authoring tool, which may impact the acceptability of this approach. Future research and development may investigate how the usability of the authoring tool relates to the attrition felt by clinicians.

6 Conclusions

We explored authoring in VRET to provide more control and adaptability for tailored interventions. To achieve that, we used a participatory design approach with therapists that allowed us to obtain feedback in different stages, helping us to build a platform that was already aligned with their needs. We used this platform as a tool to further enrich our knowledge with mock-up sessions with therapists. Our findings highlight the importance of designing VRET solutions with therapists to reduce stereotyped scenarios and develop effective solutions.

This work paves the way for the presence of VR in therapy while maintaining the agency of therapists in creating, manipulating, and reviewing sessions toward more effective longitudinal therapeutical approaches. It also highlighted several misconceptions on the benefits of current VR environments and how these can be improved to be more realistic, not just in terms of graphics but of its closeness to real life, and aligned with the therapeutic workflow. Future research should also include patients in all phases to get further valuable insights.

Acknowledgments

This work was supported in part by a grant from Fundação para a Ciência e Tecnologia through LASIGE Research Unit, ref. UIDB/00408/2020 (https://doi.org/10.54499/UIDB/00408/2020), ref. UIDP/00408/2020 (https://doi.org/10.54499/UIDP/00408/2020), the Institutional CEEC, CEECINST/00032/2018/CP1523/CT0003 (https://doi.org/10.54499/CEECINST/00032/2018/CP1523/CT0003), and Project 41, HfPT: Health from Portugal, funded by the Portuguese Plano de Recuperação e Resiliência. We also thank the therapists from Partners in Neuroscience for their participation in the design process and in the user study.

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