Overcoming Social Anxiety: How Virtual Reality and Game-Based Elements are Revolutionizing Patient Therapy

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Abstract: In this paper, we reflect upon the design process and the game-elements for developing a tool for patients. These reflections are based upon a case in where we developed six different Virtual Reality (VR) scenarios as a combined tool for treatment of social anxiety disorder (SAD) for usage within the Danish healthcare system. The core theory for this development is based upon behavioral therapy as a standardized treatment method and the exposure that occur within this. This research is a part of a larger funded project titled VR8, which also contains integration of biofeedback and the application of the practice in where the tool should be applied. The main goal of this paper is to explain the development of the six scenarios, to provide a deeper understanding for the patients on how their anxiety triggers unfolds when exposed to a variety of different scenarios. And to provide a tool for both patients and practitioners to use as an addition to existing treatment methods. The reason for this development is due to (among others) the cost-reduction, time-reduction, heighten of effectivity and user experience in using VR as a tool for treatment compared to regular in-vivo exposure therapy in where the practitioner guides the patient in a physical environment. In this environment a lot of factors can't be controlled and often results in the patient giving up and abandoning the treatment. With VR it is a controlled and closed environment making it more suitable for the patient to interact and level out their anxiety. The combination of iterative design thinking, filmmaking methods, game-based elements and agile software development are used as the core methods to develop the six scenarios. The six scenarios are developed with the aid of specific game-based elements, such as: mapping, level-design, audio control and remote action triggers.

Keywords: Virtual reality, Game-based elements, Social Anxiety Disorder, Cognitive behavioral therapy

1. Introduction

Virtual Reality (VR) has been used as a tool for various purposes, including entertainment, training, and education. However, in recent years, it has been recognized as a potential tool for treating mental health disorders, such as social anxiety disorder (SAD). SAD is a common mental health condition that affects millions of people worldwide. Behavioral therapy, particularly exposure therapy, has been shown to be an effective treatment for SAD. Exposure therapy involves gradually exposing the patient to anxiety-provoking situations until they learn to manage their anxiety. However, traditional in-vivo exposure therapy can be expensive, time-consuming, and challenging for both the patient and the practitioner.

The aim of this paper is to reflect on the design process and the game-elements for developing a tool for patients with SAD. The tool is a combination of six different VR scenarios designed to be used as an adjunct to existing treatment methods. The core theory for this development is based upon behavioral therapy as a standardized treatment method and the exposure that occurs within it. The development of this tool is part of a larger funded project titled VR8 (VR 8 2022), which also integrates biofeedback and its application in the practice where the tool should be applied. To ensure consistency and specificity, an additional goal that might be relevant for this overall research has been identified - investigating how SAD manifests within this type of tool. This is however not a part of this paper since this is a research question on its own and the focus for this paper is mainly on the design and development.

This tool's evolution is a component of a broader funded project titled VR8 (VR 8 2022), which further incorporates biofeedback and its application in the clinical setting where the tool is intended to be used. The multifaceted objectives of this paper are thus aimed at a comprehensive understanding of this tool and its contribution to SAD treatment.

2. Background

Social anxiety disorder (SAD) is a debilitating mental health disorder that affects approximately 7% of the population worldwide (Kessler et al., 2005). Individuals with SAD experience excessive fear and anxiety in social situations, which can significantly impact their daily life, work, and relationships (American Psychiatric Association, 2013). Behavioral therapy is the gold standardized treatment method for SAD, which involves exposing patients to feared social situations. In-vivo exposure therapy involves the patient being guided by the

practitioner in a physical environment. However, in this environment, a lot of factors can't be controlled, which often results in the patient giving up and abandoning the treatment (Kandalaft et al., 2019).

The use of VR technology for the treatment of SAD has gained increasing attention in recent years due to its ability to create a controlled and closed environment (Gerardi et al., 2010; Reger et al., 2011). The use of VR for exposure therapy has been found to be equally as effective as in-vivo exposure therapy, with the added benefit of greater patient satisfaction and engagement (Powers et al., 2008). The use of VR technology in therapy has been shown to be a cost-effective and efficient alternative to traditional in-vivo exposure therapy (Botella et al., 2005). With VR, practitioners can create specific scenarios that trigger the patient's anxiety, making it more suitable for the patient to interact and level out their anxiety (Garcia-Palacios et al., 2007).

VR has many definitions, but one of them is told to be a computer-generated simulation of a three-dimensional environment that can be interacted with in a seemingly real way (Botella et al., 2005). VR technology allows for a controlled and closed environment that can be tailored to the individual's specific needs. This speaks into the usage of VR for various treatment methods due to its controllable nature. In recent years, VR has been used as a tool for treating mental health disorders, such as before mentioned SAD (Gerardi et al., 2010; Reger et al., 2011).

Exposure therapy is a behavioral therapy that has not only been shown to be effective in treating SAD but also dominates as the gold standard for treating SAD (Kampmann et al., 2016; Maples-Keller et al., 2017). Exposure therapy involves gradually exposing the patient to anxiety-provoking situations until they learn to manage their anxiety. These situations are difficult to control in a live environment and provides a lot of challenges for the practitioner. Furthermore, traditional in-vivo exposure therapy can be expensive, time-consuming, and challenging for both the patient and the practitioner due to its many uncontrollable factors (Lindner et al., 2017). Virtual reality (VR), however, provides a more stable environment that can simulate anxiety-provoking situations and allow the patient to practice coping skills in a safe and controlled environment (Parsons et al., 2017). VR also provides a cost-effective and time-efficient alternative to traditional in-vivo exposure therapy (Morina et al., 2015).

The six scenarios in this case were developed to provide a deeper understanding of how the patient's anxiety triggers unfold when exposed to a variety of different scenarios. The scenarios were designed to simulate real-life social situations, such as interacting with unknow people, giving a presentation, and facing public transportation. Each scenario was designed to gradually increase in intensity, starting with low-level anxiety triggers and progressing to high-level anxiety triggers. The patient was guided through each scenario by a therapist, who provided support and guidance throughout the exposure. The criteria for developing these six scenarios were that the scenarios should reflect everyday situations in which the patients were to experience in real life settings. Furthermore, the reason for developing six scenarios was that it was a demand from the overall goal setting within the project of VR8 as mentioned before.

3. Methods

The iterative design process is a methodology that involves repetitive cycles of prototyping, testing, and refining a product or service until a desirable outcome is achieved. This approach is widely used in various fields, including engineering, product design, and software development. According to research by Ramesh et al. (2014), the iterative design process is an effective approach for addressing the uncertainties and complexities involved in product development. The authors suggest that by using iterative design, engineers and designers can improve their understanding of the design problem, test different solutions, and gain feedback from users and stakeholders. Similarly, research by Rouse et al. (2017) highlights the importance of iteration in software development, particularly in agile methodologies. The authors argue that by using iterative design, developers can quickly respond to changing requirements and improve the quality of their software. Overall, the iterative design process has proven to be a valuable approach for creating effective products and in this case with developing a tool that combines both software, filmmaking and testing this method proves to be the most effective for the development and therefore this method was chosen as the core backbone for the process. In this project, we aim to develop a tool that integrates software, filmmaking, and testing. Each of these areas is complex and dynamic, with unique challenges and uncertainties that require a flexible and adaptable approach. The iterative design process, with its cyclic structure of continuous refinement, enables us to systematically address these challenges, test different solutions, and refine our product based on real-world feedback. This cycle of testing and refinement allows us to respond promptly to changing requirements, technological advancements, and evolving user needs, ensuring the development of a

high-quality, user-centered product. Thus, due to its flexible and user-focused nature, the iterative design process has been chosen as the fundamental backbone of our development strategy.

Game elements have been increasingly used as a method for developing 360-degree videos, offering an immersive and interactive experience to users. By incorporating game mechanics, such as points, rewards, and challenges, developers can engage users and motivate them to explore the video content more deeply. According to research by Sánchez-Mena et al. (2018), game elements can enhance the user experience and improve user engagement in 360-degree videos. The article suggests that incorporating game elements can increase users' motivation, sense of achievement, and enjoyment. Similarly, research by Liu et al. (2018) highlights the potential of game elements in 360-degree videos for education and training purposes. The authors argue that game elements can facilitate learning and skill development by providing users with feedback, repetition, and progression. Overall, game elements offer a promising approach for enhancing the development of 360-degree videos and providing a more engaging and interactive user experience. In this case the usage of game elements was incorporated into the guidance and the enhancement of immersion and interaction of the patients using the different scenarios.

The different scenarios were filmed with a 360-degree camera, Insta OneX2 (Insta OneX 2023), and developed in Unity 3D (Unity 3D 2023), which is an opensource game-engine making it possible to add the different game-based elements into the scenarios.

4. The Use of Game-Elements

The use of game-based elements in the development of virtual reality scenarios for the treatment of social anxiety disorder (SAD) has gained increasing attention in recent years. Studies have shown that incorporating game elements such as mapping, level design, audio control, and remote action triggers can enhance the user experience and increase the effectiveness of virtual reality therapy (Hone-Blanchet & Wensing, 2018; Rizzo & Shilling, 2017). Mapping and level design are particularly important in providing a realistic environment for patients to interact with and gradually desensitize themselves to anxiety-provoking situations. Audio control, on the other hand, can help create a more immersive experience, making the scenarios feel more real and heightening the patient's emotional response (Krijn et al., 2004). Remote action triggers, such as the use of handheld controllers, can allow patients to actively participate in the scenarios and provide real-time feedback to practitioners, enhancing the effectiveness of the therapy (Lopes et al., 2020). In this case the remote action triggers were used as the therapist had the opportunity to use the keyboard on the stationary computer while the patient was inside the simulation to make choices the patient couldn’t see.

5. Mapping as Instructions

Mapping is a crucial game element that has been extensively studied in game design and education literature. In games, mapping involves creating a virtual representation of a game world, which players navigate to complete objectives and progress through the game. Studies have shown that mapping can enhance spatial and cognitive skills, as well as increase player immersion and engagement. For example, a study by Kato and Kato (2014) found that game-based mapping exercises improved spatial orientation and navigation skills in high school students. In another study by Ritterfeld et al. (2009), mapping was identified as a key factor in creating a sense of presence and immersion for players. These findings demonstrate the importance of mapping as a game element and its potential to enhance learning and engagement in gaming contexts.

In this case mapping was used as instructions for the therapist to make sure that they knew which choice to make for the patient and what path to take within the simulation. the way it was made was with an “overlay” only visible for the therapist and not for the patient. This overlay provided the therapist with all the information that he needed to know where in the simulation the patient was. Below is a figure (figure 1) illustrating the overlay seen on the therapist’s screen directing them of what to do next. The green text is not visible to the patient within the headset.

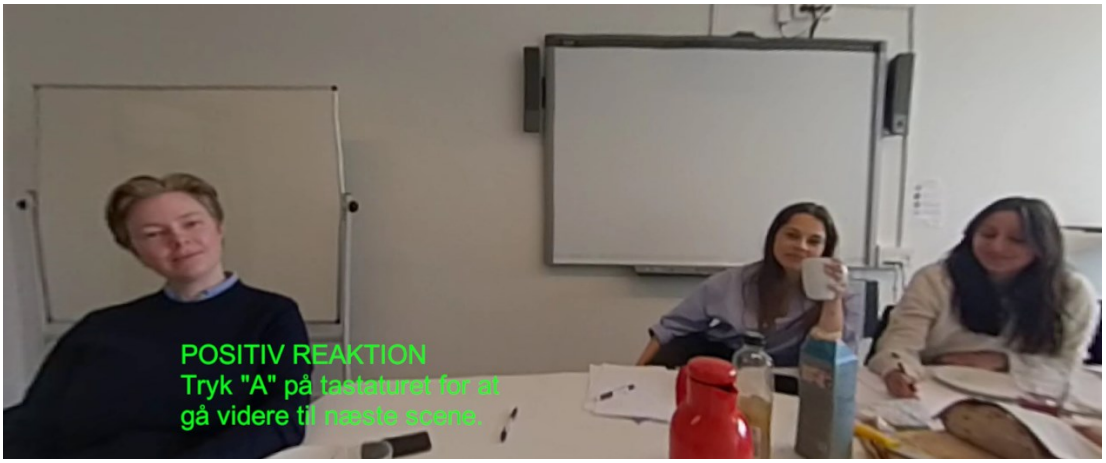

Figure 1: Picture from the "Job Interview" showing the green overlay which tells the therapist to press "A" on the keyboard to provide a positive reaction to the patient's presentation

6. The Design Process

The design process for developing the VR tool for SAD treatment involved several methodologies and approaches, which have been extensively studied and applied in the fields of design, filmmaking, game design, and software engineering. The iterative design thinking process has been widely used in product and service design and involves continuously refining and improving a design based on feedback and user testing (Kumar, 2019). Filmmaking methods, such as storyboard development and shot planning, have been applied in the development of VR experiences, as they help to create a narrative structure and visual coherence (Jerald, 2015). Game-based elements, including mapping, level-design, audio control, and remote action triggers, have been used in game design to create immersive and interactive experiences (Fullerton, Swain, & Hoffman, 2008). Finally, agile software development has been widely used in software engineering, as it enables the development team to quickly respond to changing requirements and deliver software in iterative cycles (Beck, Beedle, Van Bennekum, Cockburn, & Cunningham, 2001).

The design process for the VR tool began with user research, including interviews and surveys with patients and practitioners, which is a common practice in user-centered design (Norman & Draper, 1986). This research helped to identify the target audience and specific needs of patients with SAD, as well as anxiety-provoking scenarios based on their real fears. The data gathered from these research methods was used to develop six different VR scenarios, which were tested and refined based on user feedback. The use of agile software development ensured that the software met the design requirements, and that the development process was closely tied to the design process, enabling quick changes and improvements to be made.

7. The six VR Scenarios

The six different VR scenarios were designed to simulate anxiety-provoking situations commonly experienced by patients with SAD. The scenarios were designed to be used in conjunction with traditional in-vivo exposure therapy as an adjunct treatment method. The scenarios were as follows: 1: A bench scenario: In this scenario the patient is placed on a bench in a park with an unknown person who then interacts in various ways with the patient, inducing confrontational fears and gradually makes it possible for the patient to be challenged within the simulation. This scenario consists of 14 different scenes. 2: A Job interview: This scenario simulates a job interview and is designed to help patients overcome their fear of interacting with people whom they don't know and to share personal details with other people. This scenario consists of 21 different scenes. 3. A presentation scenario: In where the patient is induced to the fear of public speaking and are to hold a presentation in front of an audience. To cope with the fear, it is possible for the patient to choose doing the presentation in a sitting or standing manner. This scenario consists of 15 different scenes. 4. A shopping scenario: This scenario simulates a shopping experience, which is gradually increasing situations with asking store personnel, getting confronted with awkward situations while waiting in line, asking for help, and smashing an egg in front of other costumers. This scenario consists of 20 different scenes. 5. A Café Scenario: In where the patient is confronted with ordering and receiving food they didn't order. The choices are varied in different ways challenging the patient to say no. This scenario consists of 34 different scenes. 6. Public transportation: This scenario simulates a train public transportation situation and is designed to help patients

overcome their fear of awkward situations and being on a public transportation in where they cannot flee. This scenario consists of 30 different scenes.

8. Overview of Game-Based Elements and User Guidance in the Product Distributed on the Scenarios

Below is a table (table 1) showing the different game elements within the scenarios. And how they are used as guidance for both the patient and the therapist. In the table there are short descriptions of the various game-based elements used within each of the scenarios.

Table 1: Game-Based Elements occurring within each scenario, including the user guidance for both the patient and the therapist

Scenario	Game-based element	User guidance (Patient)	User guidance (Therapist)
1. A bench Scenario	Mapping, arrows for direction, textboxes, remote action triggers.	Arrows for direction, textboxes for prompting choices.	Mapping with text as instructions, remote action triggers to make choices.
2. A Job interview	Mapping, sound effects, arrows for direction, textboxes, remote action triggers.	Arrows for direction, textboxes for prompting choices.	Mapping with text as instructions, remote action triggers to make choices. Sound effects.
3. A presentation scenario	Mapping, arrows for direction, textboxes, remote action triggers.	Arrows for direction, textboxes for prompting choices.	Mapping with text as instructions, remote action triggers to make choices.
4. A shopping scenario	Mapping, arrows for direction, textboxes, remote action triggers.	Arrows for direction, textboxes for prompting choices.	Mapping with text as instructions, remote action triggers to make choices.
5. A Café Scenario	Mapping, arrows for direction, textboxes, remote action triggers.	Arrows for direction, textboxes for prompting choices.	Mapping with text as instructions, remote action triggers to make choices.
6. Public transportation	Mapping, arrows for direction, textboxes, remote action triggers.	Arrows for direction, textboxes for prompting choices.	Mapping with text as instructions, remote action triggers to make choices.

In the table (Table 1), various game-based elements are outlined as follows: mapping, directional arrows, text boxes, sound effects, and remote action triggers. These components were perceived in the following ways in this case. Mapping, with an overlay, was accessible to the therapist, enabling them to guide the path or choices within the simulation. This system acted as a navigational aid, allowing the therapist to have a continuous understanding of the patient's position within the simulation. Furthermore, it permitted the manipulation of anxiety-inducing scenes by offering choices within the scenario, increasing, or decreasing the intensity as necessary. Directional arrows, akin to those utilized by Google Maps (Google Maps, 2023), were employed to facilitate the patient's comprehension of movement within the scenes, and to enable teleportation to the next location. An "eye-gaze mechanic" within the VR simulation assisted this process, causing scenes to fade and transition smoothly as the patient moved and focused on the arrows. Sound effects were deployed to enhance anxiety levels in the job interview scenario, specifically using the sound of a drill to increase the challenge for the patient when interacting with other characters. This auditory stimulus was managed by the therapist and could be toggled on or off via a keyboard command. Text boxes were used to make the patient's choices explicit, effectively breaking the immersive quality of the simulation. Hence, when the patient was given a choice, a text box with either Choice A or Choice B appeared before them, with the eye-gaze mechanic enabling selection. Lastly, remote action triggers allowed the therapist to make decisions on behalf of the patient without their knowledge, using keyboard commands. This feature afforded the therapist the ability to modulate the anxiety levels within each simulation, thereby facilitating gradual exposure of the patients to fear-inducing situations.

The game elements indeed play crucial roles here. However, to better illustrate their application in terms of Social Anxiety Disorder (SAD), it's important to emphasize how each game mechanic interacts with the triggers and symptoms of this condition. For example, the sound effects can simulate a stressful social environment, potentially mirroring the patients' experiences during real-life social interactions. Similarly, the directional

arrows and text boxes can serve as metaphors for the struggle of choice-making in social scenarios often experienced by individuals with SAD. Therefore, these game elements not only construct a replicative virtual scenario but also facilitate the therapeutic process by systematically challenging and alleviating the patients' fears and anxieties in a controlled, safe environment.

9. Summary and Conclusion

The use of game-based elements such as mapping, level design, audio control, and remote action triggers in virtual reality scenarios for the treatment of social anxiety disorder (SAD) has been drawing attention in recent years. Studies suggest that incorporating these elements can heighten the user experience and augment the efficacy of virtual reality therapy. Mapping and level design offer a realistic environment in which patients can interact and gradually desensitize themselves to anxiety-provoking situations, while audio control contributes to a more immersive experience. Remote action triggers, like handheld controllers, empower patients to actively engage in the scenarios and provide real-time feedback to practitioners, thereby amplifying the therapy's effectiveness.

These concepts are currently being explored further in the context of a larger Randomized Control Trial (RCT) study within the VR8 project. This ongoing study has been instrumental in the design process for developing the VR tool for SAD treatment, involving a variety of methodologies and approaches, including user research, iterative design thinking, filmmaking methods, game-based elements, and agile software development.

In the context of this study, six different VR scenarios simulating anxiety-provoking situations commonly experienced by patients with SAD were designed and subsequently refined based on user feedback. It's worth noting that these scenarios are a part of this larger RCT study and are yet to be fully tested, with the results not due yet. The design intention is for these scenarios to be used in conjunction with traditional in-vivo exposure therapy as an adjunct treatment method.

In conclusion, the use of game-based elements in the development of virtual reality scenarios appears to have immense potential in enhancing or perhaps even revolutionizing the effectiveness of therapy for social anxiety disorder. As the findings from the ongoing RCT study are not yet available, the true potential of these innovative tools remains to be seen.

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