Use of Tethered Virtual Reality Headsets in Exposure Therapy for Agoraphobia and Social Phobia

Beatris Mariell Choo, Ana Margarita Talicol, Elaine Jhon Panganiban, Ethel Chua Joy Ong
De La Salle University
agoracademy@gmail.com

Abstract

People with social phobia are characterized by a fear of being scrutinized, while people with agoraphobia have a fear of situations where escape may be difficult such as being in a crowded area. One way to support them is with the use of virtual reality technologies. Virtual reality (VR) allows people to easily step into and immerse themselves in a completely different environment, simulated by a computer. The ability that VR has to transport a person into a different place and interact with the virtual environment gives it potential as a tool for phobia treatment. In this paper, we explore the use of VR as a platform for people with agoraphobia and social phobia to practice social interactions towards the goal of overcoming their fear.

1 Introduction

Social anxiety disorder, also known as social phobia, is the fear of scrutiny from others [World Health Organization, 2016]. Situations such as meeting new people, being observed by others, and performing in front of a crowd can trigger this fear. People suffering from social phobia fear being thought negatively of by others, getting humiliated, embarrassed, or being rejected [American Psychological Association, 2013]. They tend to avoid social situations as a result of this and thus affecting their way of living.

Agoraphobia, on the other hand, is the fear characterized by situations in which the person perceives to be difficult to escape from if needed. It is highly recommended for people with agoraphobia to have a companion with them, specially when going out. Situations that may trigger their fear include: using public transportation, being in open spaces, being in enclosed places, standing in line, being in a crowd, and being outside home alone [American Psychological Association, 2013]. Like social phobia, agoraphobia can affect the way a person lives. In severe cases of agoraphobia, the individual may completely refuse to go outside of their homes [American Psychological Association, 2013].

Virtual reality (VR) is a computer simulated environment whose goal is to immerse the user in an environment that is different from what they already have around them. Using head mounted displays that are either tethered to a PC or a console, or mobile VR devices that are reliant on a smartphone for both display and processing, VR has been used for many things such as video games (Farlands [Oculus, 2017], Resident Evil 7 Biohazard [Capcom, 2017]), training simulation (High Voltage Switching [Computing, 2017], Virtual Reality Crane & Rigging Simulations [International, 2017]), and healthcare (Bravemind [Rizzo *et al.*, 2010]). Under healthcare, VR has been widely used to treat specific phobias, such as acrophobia [Emmelkamp *et al.*, 2001] [Rothbaum *et al.*, 1995] [Krijn *et al.*, 2004], fear of flying [Baños *et al.*, 2002], arachnophobia [Cavrag *et al.*, 2014] and fear of cockroaches [Wrzesien *et al.*, 2013]. However, it is uncommon to use VR for therapy of other types of phobia, such as social phobia.

Exploring the application of VR in treatment of social phobia and agoraphobia may uncover and answer questions about the impact of interactions with virtual humans on therapy patients, especially with the increased immersion provided by the tethered VR headset. In this paper, we present our work in developing a virtual reality environment as a platform for people with agoraphobia and social phobia to practice social interactions towards the goal of overcoming their fear.

2 Related Works

A way to treat social phobia is by having the patient undergo cognitive behavioral therapy (CBT). CBT is the combination of techniques from cognitive therapy, in which the therapist focuses on changing the patients perception over something; and behavioral therapy, where the therapist instead works on how the patient reacts to things [Lorenzo-Luaces *et al.*, 2016]. CBT consists of four major variations: exposure, cognitive restructuring, relaxation training, and social skills training [Heimberg, 2002]. Each variation focuses on a different aspect. For exposure, the focus is on having the patient face their phobic stimuli. Cognitive restructuring focuses on having the patient reevaluate the way they think about a situation and then develop a different way of thinking towards it. Relaxation training teaches the patient how to relax certain muscle groups in their body. Finally, social skills training focuses on addressing the behavioral deficiencies that a person with social phobia may likely have, such as poor eye contact and having poor conversational skills.

While VR is lauded for its ability to allow humans to do or experience something that is normally impossible, VR in therapy exists primarily because VR allows users to indulge

in everyday experiences that they cannot perform normally because of their condition. For example, a VR environment created for confined or bedridden patients may feature scenes where the patient is traveling from one place to another [VR Kids, 2015]. VR environments in therapy vary in their likeness to the real world; therapy environments for young children often involve the use of animal-like companions [VR Kids, 2015] while therapy environments meant for adults are more realistic and attempt to mimic true experiences [Rizzo *et al.*, 2010] [Freeman, 2008].

Bravemind [Rizzo *et al.*, 2010] is a therapy tool made to recreate situations a soldier would encounter in war. The scenery was made to resemble areas such as Afghanistan or Iraq, in areas where the solder may have encountered traumatic experiences. While Bravemind employs the use of a virtual reality headset, the soldier is asked to stay seated and navigates the environment using a handheld controller. The situations and encounters within the environment are fully controlled by a therapist using a separate device.

[Freeman, 2008] created a simulation to test for symptoms of paranoia. The 4 minute simulation required the patient to ride a virtual version Londons underground train from one station to another. Afterwards, the patient was asked to complete a series of assessment reports about their experience. The results from the assessment reports were found to have been able to predict symptoms of paranoia from physical assault victims over the period of half a year. A separate study using the same simulation found that the simulation did not produce any unwanted effects on the individuals involved in the testing. It was also concluded that the simulation was effective in eliciting reactions that the individuals would have had if they were undergoing a real life train ride [Fornells-Ambrojo *et al.*, 2008]

[Baños *et al.*, 2002] studied the effects of a VR therapy treatment for the fear of flying. The environment allowed the patient to undergo multiple scenarios that may trigger a phobic response regardless of whether or not the patient was actually inside a plane. The researchers involved in the study asserted that regular exposure therapy for the fear of flying is expensive and impractical, and justified the need for VR treatments in exposure therapy.

These studies have shown that VR has been effective in assessing symptoms of and treating different mental illnesses, and therefore allow for the assumption that VR can be used to treat social phobia and agoraphobia.

3 VR for Social Phobia and Agoraphobia

According to [K Beesdo K, 2009], the first onset of anxiety disorders can happen as early as the childhood or adolescent age. Anxiety disorders may also develop following traumatic events. An adolescent may experience trauma if they are the victim of bullying in school, and may develop a phobic response to school-related situations because of this trauma. Students may exhibit symptoms of agoraphobia and social phobia [American Psychological Association, 2013], such as avoidance of the school-related situation unless accompanied by a peer, as a result.

To aid in treating these symptoms, the patient is exposed to a virtual environment resembling a small school. In the school environment, there are four main areas: a cafeteria, a classroom, as seen in figure 1, a hallway and a teacher's office, which will be populated with virtual students, teachers and staff. These areas were selected because of their age neutrality, as opposed to an area such as a playground, which may not be appropriate for older students, and because of the range of social interactions that can happen in these environments. Interactions in the virtual environment happen in the form of conversations between the patient and the virtual humans.

Figure 1: A view of the virtual classroom

Before beginning the implementation, an ethics review was performed in order to ensure the safety of the participants who may be involved in testing the system. A licensed psychotherapist provided their guidance to the researchers during the design and implementation processes.

The Oculus Rift has been selected as an interface for increased immersion and for the use of hand gestures. This will allow the environment to come across as more realistic to the patient. Using voice input, room-scale VR navigation, and hand gestures, the patient is expected to explore the environment and perform various social interactions that they are normally unable to perform.

When the patient first uses the system, they will be asked to provide their name, year of birth, gender, and preferred gender for a virtual peer. This data, which are henceforth be referred to collectively as the patient profile, will be saved and made available for viewing by the psychotherapist later.

To address social phobia, the patient will be presented with a number of social situations that they may encounter in school, such as introducing one's self to a teacher, ordering food from a canteen, or talking to a classmate. Each situation is referred to in the system as an event, and each event may have a prerequisite event that the patient may need to complete beforehand. The patient will be "placed" in the environment and will be asked to perform the selected event's task. There are six events currently defined in the environment. Table 1 shows a list of these events and where they take place.

To address agoraphobia, the system will attempt to adjust the number of virtual humans in the school according to the patient's anxiety level. Before and after the exposure proper, the patient will be asked for their anxiety level on a scale of

Event Name	Location
Introduce to teacher	Classroom
Introduce to classmate	Classroom
Introduce to class	Classroom
Ask anyone for the time	Anywhere
Order food from the cafeteria	Cafeteria
Paying for tuition	Office

Table 1: Events in the virtual environment

0 to 10, or their SUDS score. The SUDS score taken before the session is used to generate the environment and will be inversely related to the crowdedness of the environment; that is, the higher the SUDS score, the lower the number of people in the environment. Through exposure and conversations with the virtual peers in the environment, the patient is expected to gradually be able to adapt to different social environments.

There will be a virtual peer who can guide the patient through the tasks to provide, at the very least, a familiar face in the crowd of otherwise automatically and randomly generated virtual humans. By clenching both their fists, the patient may indicate to the virtual peer that they are feeling overwhelmed. The peer will then guide the patient through a relaxation exercise that can help the patient calm down. The patient may then decide whether to continue with the exposure proper or to end the exposure proper early.

The design of the system presents an opportunity to collect data about the behaviors of the patient during the exposure proper. Apart from the patient profile, the SUDS score before and after each session are collected. Those sessions whose SUDS score is higher at the end than it was at the beginning will be tagged and the psychotherapist can prioritize reviewing these sessions. All conversations between the patient and virtual humans will be also recorded. A list of keywords that may indicate that the patient is at risk of harming themselves or others has been compiled. Any conversations containing these keywords will again be marked and recommended for review to the psychotherapist. Lastly, the system will collect data about how the session was ended, and the number of times the virtual peer facilitated a relaxation exercise for the patient. All collected data will be made available for the psychotherapist to review and use.

4 Issues Encountered

Because only a microphone and the Oculus Rift peripherals are used to take input, the system is unable to detect whether the patient is becoming overwhelmed by the environment. This information is needed in order to prompt the virtual peer to step in and facilitate an exercise to help the patient relax. Therefore, in lieu of other peripherals meant to detect anxiety or fear, hand gestures will be the means by which the patient can prompt the virtual peer.

The presence of wires also poses a problem as the patient is expected to walk around in the environment. This restricts the patient's movements within the environment, and may cause issues in tracking the location of the patient in the environment. While this issue is unavoidable as wireless tethered headsets for VR have not yet been made available for public consumption, it was minimized by re-mapping the areas of the virtual environment to match the playing area of the VR device in such a way that the patient need not step out of bounds. Additionally, it is recommended that a companion stay with the patient in order to ensure that they do not encounter any accidents while using the VR headset, which obscures their vision of their surroundings.

Lastly, the weight of the tethered headset may cause ergonomic problems to the patient if it is worn for an extended period of time. In order to prevent fatigue, each individual session was designed such that it would last no longer than an hour. This restriction, however, presents a detraction from a real life exposure session, which may normally last longer than an hour. This detraction implies that there may be a difference between the patient's reactions and behaviors inside the virtual environment than the data that would be collected if the patient encountered the situation in real life. For example, the patient's behaviors if they are asked to wait in an office for an extended period of time, or the patient's behaviors if they are asked to sit in a 90-minute class will not be monitored beyond the first hour.

5 Ongoing Work

In this paper, we discussed the work we are doing to investigate the potential use of virtual reality systems in exposure therapy for people with agoraphobia and social phobia. Since these anxiety disorders occur at an early age, we designed our environment to simulate places, activities, events and interactions in a school setting.

At present, we are processing needed documents and undergoing ethics reviews with relevant individuals in our university and partner hospital to ensure that field testing with patients will go smoothly. The virtual humans are also undergoing remodeling while the integration with the Oculus Rift is undergoing usability testing to create a more realistic and immersive experience for the patient.

Assuming that a professional can supervise the therapy sessions and guide a cooperative patient, there is evidence to show that VR-based solutions has a positive effect on treatment [Rizzo *et al.*, 2010]. The validity of these findings to our system will be determined through actual testing with participants who will be recommended by the psychotherapist. These participants are students who have been diagnosed with mild agoraphobia and social phobia, and should have undergone cognitive behavioral therapy. It should be noted that the system is meant as a support tool for exposure therapy, and should be evaluated as such. The psychotherapist should retain his/her control over the use of the tool by supervising, designing and reviewing treatment sessions.

Future research can use the data collected during the exposure therapy sessions to discover patterns in behaviors of patients suffering from and trying to recover from agoraphobia and social phobia. The use of other wearables to detect heartbeat or sweat levels to determine anxiety or fear, and use this to adjust the environment dynamically as the patient undergoes the exposure proper can also be explored.

References

[American Psychological Association, 2013] American Psychological Association. *Diagnostic and Statistical Manual of Mental Disorders*. American Psychiatric Publishing, 2013.

[Baños *et al.*, 2002] Rosa M. Baños, Cristina Botella, Concepcion Perpina, Mariano Alcaniz, Jose Antonio Lozano, Jorge Osma, and Myriam Gallardo. Virtual reality treatment of flying phobia. *IEEE Transactions on Information Technology in Biomedicine*, 6:206–212, sept 2002.

[Capcom, 2017] Capcom. Resident evil 7 biohazard, 2017.

[Cavrag *et al.*, 2014] Miroslav Cavrag, Guillaume Larivire, Ana-Maria Cretu, and Stphane Bouchard. Interaction with virtual spiders for eliciting disgust in the treatment of phobias. 2014.

[Computing, 2017] Sentient Computing. High voltage switching, 2017.

[Emmelkamp *et al.*, 2001] Paul Emmelkamp, Mary Bruynzeel, Leonie Drost, and Charles Van Der Mast. Virtual reality treatment in acrophobia: A comparison with exposure in vivo. *Cyberpsychology and Behavior*, 4:335–339, 2001.

[Fornells-Ambrojo *et al.*, 2008] Miriam Fornells-Ambrojo, Chris Barker, David Swapp, Mel Slater, Angus Antley, and Daniel Freeman. Virtual reality and persecutory delusions: Safety and feasibility. *Schizophrenia Research*, 104:228–236, 2008.

[Freeman, 2008] Daniel Freeman. Virtual reality and persecutory delusions: Safety and feasibility. *Scizophrenia Bulletin*, 34(4):605–610, 2008.

[Heimberg, 2002] Richard G. Heimberg. Cognitive-behavioral therapy for social anxiety disorder: current status and future directions. *Biological Psychiatry*, 51(Social Anxiety: From Laboratory Studies to Clinical Practice):101 – 108, 2002.

[International, 2017] Industrial Training International. Virtual reality crane and rigging simulations, 2017.

[K Beesdo K, 2009] DS Pine K Beesdo K, S Knappe S. Anxiety and anxiety disorders in children and adolescents: Developmental issues and implications for dsm-v. *The Psychiatric clinics of North America*, 32(3):483–524, 2009.

[Krijn *et al.*, 2004] M. Krijn, P. M.G. Emmelkamp, R. Biemond, C. de Ligny, M. J. Schuemie, and C. A.P.G. van der Mast. Treatment of acrophobia in virtual reality: The role of immersion and presence. *Behaviour Research and Therapy*, 42:229–239, 2004.

[Lorenzo-Luaces *et al.*, 2016] Lorenzo Lorenzo-Luaces, John R. Keefe, and Robert J. DeRubeis. Cognitive-behavioral therapy: Nature and relation to non-cognitive behavioral therapy. *Behavior Therapy*, 2016.

[Oculus, 2017] Oculus. Farlands, 2017.

[Rizzo *et al.*, 2010] Albert Rizzo, JoAnn Difede, Barbara O. Rothbaum, Greg Reger, Josh Spitalnick, Judith Cukor, and Rob Mclay. Development and early evaluation of the virtual iraq/afghanistan exposure therapy system for combat-related ptsd. *Annals of the New York Academy of Sciences*, 1208:114125, 2010.

[Rothbaum *et al.*, 1995] Barbara Olasov Rothbaum, Larry F. Hodges, Rob Kooper, Dan Opdyke, James S. Williford, and Max North. Effectiveness of computer-generated (virtual reality) graded exposure in the treatment of acrophobia. *Am J Psychiatry*, 152:626–628, apr 1995.

[VR Kids, 2015] VR Kids. Designing for virtual reality and the challenges we face. From http://www.vrkids.org/blog/designing-for-virtual-reality-and-the-challenges-we-face.aspx, jun 2015.

[World Health Organization, 2016] World Health Organization. International statistical classification of diseases and related health problems. 2016.

[Wrzesien *et al.*, 2013] Maja Wrzesien, Mariano Alcaiz, Cristina Botella, Jean-Marie Burkhardt, Juana Bretn-Lpez, Mario Ortega, and Daniel Beneito Brotons. The therapeutic lamp: Treating small-animal phobias. *IEEE Computer Graphics and Applications*, pages 80–86, 2013.