Overcoming Acrophobia

Using VR Exposure Therapy to Desensitize Individuals Towards Their Fear of Heights

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Abstract

A large number of people are afraid of heights. Prior research suggests that exposure therapy is effective in helping those with acrophobia. A variety of sources contribute to the phobia, such as a traumatic experience, witnessing parental figures express fear towards heights or natural conditioning to fear falling. Regardless, a VR experience that exposes acrophobes to virtual heights in the comfort of their own home may help those who suffer from the phobia. Studies suggest that the fear of heights is a learned behavior that is enforced over time, eventually making acrophobes more and more scared of high places. The fear can be associated with confusing physiological signs of being up high with signs of anxiety. By attempting to recreate an environment where someone can express their fears safely without consequence, they can start to regain control over the fear. A virtual reality environment can produce similar results to experiencing the fear in person, but is much safer. Unity and C# will be used to develop this Virtual Reality environment. Game-like elements will be used to incentivize the user to interact with heights and get comfortable with them. To test the effectiveness of the VR exposure, human participants with varying levels of acrophobia will try the VR exposure therapy and a feedback survey, administered to participants, will be used to determine its effectiveness. The goal of this project is to help people overcome their fear of heights.

Introduction

Mental health disorders are becoming more and more prevalent in society and greatly affect the lives of individuals that suffer from them. Acrophobia is a mental disorder that causes individuals to have an irrational or extreme fear of heights. It is normal to possess a healthy amount of fear towards extremely high places to some degree as it can be dangerous. That said, the fear acrophobes feel towards heights far exceeds the healthy range. Acrophobes can have panic attacks at the sheer thought of heights, and often go out of their way to avoid them which can be detrimental towards their daily lives. The symptoms of acrophobia include increased sweating, increased heart rate, shaking, feeling lightheaded, dizziness, panic, fear, and anxiety when thinking about or near heights. Around one in twenty people have a fear of heights extreme enough to be considered acrophobic. [3]

If an individual went to a therapist today and were diagnosed with acrophobia, the main treatment methods are exposure therapy, Cognitive Behavioral therapy, and medication. Medications for acrophobia include sedatives and anxiety medicines. Disadvantages to using medicine could be cost and side effects from the medicine. Cognitive Behavioral Therapy teaches patients to reframe their negative thoughts about heights. Cognitive Behavioral Therapy is not for everyone, it involves many hours working closely with a therapist to alter how an individual thinks, which can be costly and invasive. In exposure therapy patients work slowly and confront that which they fear. The end goal is to have the patient become more comfortable with his fears and be able to endure greater amounts of exposure as a result. However, this can be dangerous if patients react too strongly when exposed to their fears. Often exposure therapy is viewed as the best method of treatment for acrophobia.[3]

Acrophobia is still a problem, but all of the current methods for solving it have drawbacks, this could lead to some people not seeking treatment for their condition. Our goal is to make treatment readily available to patients with little-to-no drawbacks. To solve this issue, we began looking towards exposure therapy through Virtual Reality. A method which researchers have recently found to be rather effective. The advantages are monumental. People suffering from acrophobia can do the exposure therapy in VR in the comfort of their own home. This is both more comfortable and less costly than continuous therapy sessions. A Virtual Reality headset can be purchased for $300 or less. As a one-time purchase this is cheaper than many therapy sessions and medications.

To contribute to this solution, we decided to make a VR exposure therapy app that functions like a game. This app will gradually increase an individual's exposure to heights, while also being immersive and incentivizing the user to complete progress through the presented stages. This will function the same as current exposure therapy, but without the need to leave one's home or pay for expensive therapy sessions. This can be done without help and is likely safer for acrophobes as well. In the future VR exposure therapy may be one of the top methods for treating the condition of acrophobia due to its lack of drawbacks.

Background

The project uses Unity as its game engine, and was developed entirely inside the Unity environment. For land generation we utilized Gaia 2, a terrain and scene generation software created by Procedural World. All scripts in the project use C#. The project is compatible with a variety of Virtual Reality headsets and is able to run both wirelessly and through a wired connection.

Related work

People often do not receive ideal treatment for their mental disorders. Psychiatric treatment is both expensive and tedious to receive due to doctor's not being able to take on any more patients or long waits for an introductory session. Consequently, it isn't feasible for everyone to be provided with high-quality psychiatric treatment. A huge benefit of virtual reality is its ease of access for anyone who buys a virtual reality headset. In this study, VR participants interacted with a personal coach while going through the app. After taking the results immediately and giving a survey many months later as well, this study saw significant success among its participants. This further suggests that VR exposure therapy for acrophobia has great value.[2]

While reading the study by Coelho, Waters, Hine, and Wallis, We learned many things that would help enhance our project. Walking near cliffs elicited more fear in participants than just standing still in VR. Confidence can help people overcome acrophobia. Desensitization through exposure therapy is an effective treatment. Subtasks to complete are important to help the participant complete the VR exposure therapy. Virtual Reality environments can produce the same levels of fear among acrophobes as actual heights. It is better in exposure therapy to start from a less threatening scenario and work up to a more threatening scenario slowly. Acrophobes tend to display more head and body sway than average when near heights. Moving laterally at a high height causes acrophobic fears to trigger.[1] All of this information was helpful in learning what caused a fear of heights, so we could design our VR game better.

Design

One of the most common ways an individual develops acrophobia is through a traumatic experience. The system was designed to replicate those terrifying scenarios and invoke a realistic sense of fear in a controlled and safe environment. To do so we tried to emulate various stimuli that can induce fear in acrophobics. Unfortunately, we don't know the specifics of what each player finds the most troubling, and as such we were unable to design an experience that caters to everyone's needs in the most effective manner possible. Nevertheless, we attempted to target general triggers in order to best assist a wide audience.

The platforms the player walks on tend to either be transparent or entirely invisible. This was done so that the player can always see what is below them. Not every player will be willing to look over the edge, and if one refuses to do so they will not truly understand how high they are. To combat this, we made sure that the platforms are almost entirely transparent. This ensures that the player constantly has the world below them at least somewhat in their field of vision. The platforms being invisible forces the player to take a step of faith and trust that the surface will actually hold them. Ideally, having to physically make this first step would evoke a fearful response, as has been the case for some of our test subjects. In a way the purpose of these platforms are to make the player quite literally face their fears by doing the exact opposite of what their natural response is, and stepping into the danger rather than shrinking away from it. Outside of this aspect, these platforms are functionally similar to their transparent counterparts and don't particularly change much. When the player falls from an elevated area, they will hear wind whooshing past their ears. The sound starts off quiet but progressively gets louder the longer the player falls. This was implemented to simulate the sound of the air resistance one would actually hear when falling from a great height. When the player lands, the wind audio will immediately cease and they will hear a light thud. The landing sound effect will only play once the player has fallen far enough. It was implemented to ensure consistency across the play experience and attempt to be as immersive as possible.

On levels that occur on highly elevated, non-accessible platforms, if the player falls, they will immediately be teleported to their starting position upon hitting the ground. We considered having it be a button press, but thought that this works better as it immediately places the player back into action, rather than breaking up the pace with unnecessary pauses. It does not give them time to pause

and recover, which we believe is beneficial as continued exposure will lessen their fear over time. The player's controllers appear in their vision as hands, which the player is able to make a few gestures with by holding specific buttons on the controller. The hands were implemented to add an additional source of consistency to the experience. It's not nearly enough to feel realistic, but having the player's hands constantly be within sight does make the experience feel slightly more immersive.

Each level has a skybox, which displays an evening sun throughout every level. This was done to give another sense of consistency in the world. If the lighting and atmosphere were constantly changing, it'd be rather jarring to the player and likely negatively impact their immersion. The player is able to move through the levels by moving to the directed area. Doing this manner of scene transitioning prevents the player from having to interact with any UI further increasing their immersion. Unfortunately, it comes at the cost of unmoving text floating in space which may be both jarring and distracting to the player.

We used Gaia 2, a terrain and scene generation tool developed by Procedural Worlds, for the creation of the terrain in the final level. We tried to minimize our usage of the tool since it was not something we directly created ourselves and used it mainly for its textures and other useful assets. This tool allowed us to populate the final level with grass, poppies, and trees. The intended effect of this decision was to add some life to the final level, and hopefully ensure that the player finds it more realistic as a result. The terrain generated by Gaia 2, gives the player somewhat realistic terrain to navigate and ascend using the provided platforms. As the player ascends, they are able see everything they have traversed thus far, providing them with a sense of scale of how high they are. Ideally this serves to invoke a greater sense of fear when the player traverses the final invisible platform, unsure whether or not it will actually hold them.

Procedure

The customer uses the system on their own time by trying to progress through each level to expose themselves to a situation where they have to face their fears. The customer can do this on their own system without any outside assistance as long as they have our app and a virtual reality headset. Other than acrophobes there are no other stakeholders in the system, however, anyone who wishes to play through the game would do so in the same way.

Results

Fourteen people participated in our project by testing our VR acrophobia exposure game. Before using our VR game, the participants had to answer questions about their age and fear of heights. After answering the first two questions the participants then played the game. After the game, the participants answered the rest of the survey questions based on their experience. The participants varied greatly in age, so we were able to get good feedback from different demographics. Among the participants we were able to get feedback from users of every age bracket between 13 and 72, with the highest number of participants being between 18 and 25. Only 4 of the 14 participants reported that they were afraid of heights in the survey before starting the experiment. Even with the low number of participants with any fear of heights going into the survey, the results of the survey were positive. Despite the number of acrophobes being low, the participants that did have a fear of heights said that the experience helped them become less afraid of heights. Of course, a follow up survey would be required to get more information about whether this change is temporary or more permanent.

Overall, the fourteen participants rated the survey only a 1.7 out of 5 for fear factor, which is expected with many of the participants not being afraid of heights. Even though the experience was not particularly fearful for the majority of participants, our VR game was rated a 4.2 out of 5 for feelings of immersion. This is pretty high and suggests that participants felt like they were in a similar situation to being at a high location in the real world. Although many of the users did not have a fear of heights, they did say that the game would be helpful for those that do have some acrophobia. Finally, 85% of the users said that they would recommend this VR experience to others. That concludes the data collected from our post game survey.

Conclusion

Our goal before starting was to make a VR game that simulates a fear of heights in a way that is therapeutic for people who do have this fear. Our focus was primarily on making the user feel like they are high up and in situations that may stress acrophobes. We started with an empty Unity project and ended with a 4-level game that has increasing difficulty and realism for those with a fear of heights.

First, we had to make the character controller that makes the player move in game. This also includes getting the hands to work in VR and having the camera follow the

player's headset. Next, we moved to designing levels for the game. This involved a lot of trial and error as sometimes players would fall through planes seemingly randomly or start in weird positions. We had to make sure this game felt good to play as a VR game or it would not be immersive enough for anyone to get value out of it. Next, we had to work on respawning and linking the levels together. Finally, we had to build the project for testing on a VR device without a cord (this means building it to android instead of windows). After that was successful, we set up testing and tested as many people as we could.

Often the younger participants had no trouble completing the game, but some of the older contestants struggled greatly with the experience. This suggests that VR exposure therapy treatments may be less useful for older patients. This is because they may struggle to adapt to VR and is unrelated to the actual quality of the VR experience. The average user was not afraid of our game and this is okay. Our game was only meant to be frightening to users that have some level of acrophobia, so not everyone will feel the same when using it. The results of our post-game survey suggest that VR exposure therapy is a helpful treatment for acrophobes. This conclusion agrees with previous research on the topic.

We designed a VR game that provides exposure therapy to acrophobes. The concept of exposure therapy or VR exposure therapy for fear of heights is something that has been around for a while, and once again it seems to be effective. Our approach is slightly different as it is more game oriented than previous exposure therapy experiments. While this method may be effective for some, older users or users with pre-existing health conditions who have never used VR before should be cautioned beforehand as it can be an intense experience for first time VR users. One of our potential participants declined to participate, as suggested by his wife who did participate, as he was older and experiencing vertigo at the time. The safety of this type of exposure therapy for users that are older or have pre-existing medical conditions, like epilepsy, is unknown.

So, we believe that virtual reality exposure therapy would be more effective on younger people who do not have health conditions that can be affected by screen related methods (ex. epilepsy). Younger users also pick up the controls and understand how the game works much easier. Older users often took much longer to complete the game and struggled with the controls throughout. Overall this experiment helped us learn more about the effectiveness of VR exposure therapy and which demographics it is more effective with.

Future works

Unfortunately, neither of us are artists. As such, it was not feasible for us to model realistic 3D assets to be used in our game. We overcame this obstacle by utilizing assets that we either already owned or were freely available. With an additional year we could greatly improve the graphical fidelity of our game. This would be accomplished through a variety of methods, such as us becoming proficient enough to model the necessary assets ourselves. More realistically, however, we'd likely either commission a professional to create high quality assets, purchase a tool that allowed easy generation of suitable assets, or purchase a previously created asset pack that meets our needs. In its current form the game is not very realistic. This is problematic as we want users to feel as immersed as possible in order to trick them into thinking that what they are experiencing is actually real.

With greater fidelity, the number of possible different stimuli to expose the user to also increases. Ideally, with the additional time, we'd be able to expose users to possible anxiety triggering scenarios such as ascending in a glass elevator, ascending in a hot-air balloon, staring off of a cliffside into the horizon, or standing at the top of a skyscraper. While we could replicate these scenarios at the moment with little difficulty, they wouldn't feel quite right. Without notable landmarks, it's difficult to get a sense of depth or scale. Without depth or scale, a specific scene may fail to live up to its intended impact. We'd like to add a vertigo effect when users stare downwards from a place of high elevation. To do this, we'd utilize a dolly zoom. An effect often used in cinema, achieved by moving the camera back to increase the field of view while zooming in on a specific target. In this case, the focus would be the large open area for an individual to fall. This setting would not be on by default, but we believe that it could be useful. The additional stress this extra stimulus would create could be immensely helpful in the recovery process of some users.

With extra time we would like to do further testing with actual acrophobes and determine how to best trigger their fears so that they can better acclimate to them. Out of all of our test subjects only four were afraid of heights, and none were acrophobic. As such we didn't receive any feedback from the perspective of our targeted audience. We need this insight so we can create an experience that best elicits a fearful response from players by exposing them to exactly what they are afraid of. So far, we have used the research we've reviewed as a basis, but that is not the same as testing on actual acrophobes. Furthermore, if we continually refined the scenes for the same group of acrophobic participants, we could test the efficacy of the exposure to the game. We would like to give users the

ability to scale the level of danger they experience. By doing so, users could progress at their own pace and prevent accidentally exposing themselves to stimuli that causes an unhealthy amount of stress and anxiety.

We would also like to add more game-like elements to our system. With more game-like elements such as jumping puzzles, collectibles, or time trials, we hope to make the experience more immersive. Ideally the player would forget that they were even playing a game and become so immersed that any stimuli feel as realistic as possible. This would hopefully improve the system's overall effectiveness while also increasing enjoyment. We would also like to add stimuli to trigger and desensitize individuals afflicted with other environmental based fears such as aquaphobia, the fear of water, and astraphobia, the fear of thunder and lightning. While aquaphobia would definitely be a stretch to implement, astraphobia would not be overly difficult to add support for. Many of the environments used to expose individuals to heights could be repurposed to be used in conjunction with storm clouds, lightning, and thunder.

We would also like to improve the tracking support. We would like to have full motion tracking support implemented for the player's legs. This would allow for tracking of an individual's balance and weight distribution. This level of tracking would then be used in conjunction with more complex scenes such as a trapeze wire, in which the player has to maintain balance while being virtually suspended in a place of elevation. This scenario would likely invoke an immense amount of fear, rendering it useful for individuals who want to be as desensitized to heights as possible. Following this line of thought, we'd like to add other panic inducing scenarios where the player has to quickly react to a specific situation or fall. For example, the place may be standing in a glass elevator and the floor below them may begin to crumble. If the player is unable to stay calm and focus on escaping the situation, they will not be able to complete level. Hopefully this will both desensitize players and force them to maintain control of their emotions even when they are terrified.

Finally, if possible, we'd like users to test the project in a large open space that allows them to control their character by moving around in real life rather than relying on controller input. Using a controller seems to dampen the fear of ascending, falling, or walking across an invisible platform. It does not require the player to actually commit to actually moving and is instead able to be done by slightly tilting the joystick. From anecdotal evidence, we believe this makes movement across a dangerous space far less daunting, as some test subjects struggled to step onto the invisible platform when instructed to do so physically rather than through the controller. This hurts the overall experience as it prevents the player from experiencing the scenarios as realistically as possible.

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