A Virtual Reality Approach to Pediatric Conflict De-escalation and Anger Management

Heyi Liu
Baylor School
171 Baylor School Road
Chattanooga, TN, USA
+1 4233044928
liuhe@baylorschool.org

Mary Loveless
Baylor School
171 Baylor School Road
Chattanooga, TN, USA
+1 (615) 260-2530
mloveless@baylorschool.org

ABSTRACT

In recent years, anger management has received considerable attention in the school setting. Youth suffering from elevated anger often relates to health problems, typically cardiovascular diseases; physical aggression, negative verbal responses, and drug use have also been reported as a negative consequence of unmanaged anger. While many forms of treatment currently exist, they often require a counselor's assistance in providing suitable de-escalation methods. For public schools, most states have difficulties allocating funding to establish a large enough school counseling program; therefore, anger management services are not commonly accessible in schools. Virtual Reality (VR) creates an immersive experience through computer-generated environments. First popularized as a game enhancement, VR has contributed to academia by recreating a desired atmosphere, notably within psychological research. This study investigates the potential of a virtual reality de-escalation mechanism to increase its accessibility and affordability in a school setting. The program aims to achieve an immediate de-escalation for the youth through a calm room with minimal adult assistance and prepare them to re-enter the real world by creating a solution to a common anger trigger which can hopefully eventually reduce their dependence on the technology.

CCS Concepts

- **Human-centered computing~User interface toolkits**
- **Human-centered computing~Information visualization**
- **Applied computing~Interactive learning environments**
- Hardware~Emerging tools and methodologies

Keywords

VR; virtual reality; anger management; pediatric conflict de-escalation; cognitive behavioral therapy; calm room

1. INTRODUCTION

Anger can be triggered by both external and internal factors, from environmental factors to stress and traumatic memory [1]. The youth suffering from elevated anger often express health problems, typically cardiovascular diseases; they also tend to report more physical aggression, negative verbal responses, and drug use [6, 25]. Three approaches to anger expressions are identified by the American Psychological society: expressive, suppressive, and calming. While expressions of anger in an assertive, polite, and conscious manner releases the stress in children, aggressive actions can result in chronic pathological disorders such as abusive partner relationships and parenting. Moreover, unexpressed or repressed anger can have unhealthy influences children's development [1]. Anger management offers a mechanism to teach children/young adults to express anger and frustration in healthy ways. Anger control, which is referred to as de-escalation strategies, attempts to mitigate the subject's emotional feelings and the psychological arousal that anger causes. Primary research suggests that while it is effective for children to remove themselves from escalated situations, they fail to immediately apply the skills they acquire through coping programs [15].

Currently, a common approach to anger management is cognitive behavioral therapy that often requires a counselor. Proposed school-based anger control programs utilize daily logs, group reinforcement, role-playing, skill building and relaxation techniques [14]. While the most effective treatments focus on social skills, they are not widely used due to the shortage of professionals and the lack of awareness of anger management in some socioeconomically disadvantaged areas. The lack of intervention magnifies recurring issues in the population since the social-cognitive theory suggests that emotion dysfunction and peer victimization influence social cognitive processes that contribute to the development of aggression [9]. Moreover, generalizability and maintenance, ensuring the skills learned persist, are crucial to increase the efficacy of an anger-management program; yet, again, counselors are needed to incorporate specific guidelines in their training progress to maintain the students' anger management skills in an authentic situation (Larson). Therefore, it is paramount to increase the accessibility and efficacy of anger management for under-resourced populations.

Unchecked anger, and by association anger management techniques, has received increasing attention as implications and consequences of anger mismanagement grow as a societal problem [3]. According to Sukhodolsky's study in 2016, two behavioral interventions models were evaluated that target anger/irritability as the treatment subjects based on previous studies and current work. The first model, Parent Management Training, which aims to enhance the relationship between the children and their parents, teaches parents to discourage maladaptive behaviors and praise appropriate behaviors. It has been shown that increased positive parent-child relationship yields the prevention of antisocial behaviors in adulthood. The other model is Cognitive-Behavioral Therapy (CBT) that targets the deficit in emotion regulation and social problem-solving skills, such as attributional processes, biased perception of social cues, and interpersonal conflicts [23, 24]. The main principles consist of teaching a variety of techniques such as relaxation, cognitive restructuring, problem-solving, and stress inoculation [3], though according to Sukhodolsky's meta-analysis [24], instructions on actual behaviors and problem-solving are more effective than education treatments such as relaxation. From a study conducted by Beck and Ferdanez [3], it can be

inferred that CBT improved 76% of the research subjects, thus demonstrating the grand effectiveness of the treatment.

CBT lends itself to the design of a virtual anger management program, as it can be incorporated into technology-aided de-escalation training. The bioresponsive video game platform creates more accurate and visible emotional controls. As the heart rate goes up, the game becomes more and more difficult. When the child's heart rate exceeds the red zone, the game stops, and an animated Dr. Dragon invites the players to do some relaxation exercise. This study shows a significant reduction in outbursts, oppositional behaviors, disruptive behaviors, and parental stress after twelve weeks of experience [18]. The starter program costs a one-time fee of $99 and $19/month of addition after the first month's free-trial as of February 2019. A long-term training would still create financial difficulties for the socioeconomically disadvantaged community, which encompasses the population cited with the highest rate of anger control issues [9]. In addition, the program pays less attention to actual behaviors and problem solving skills and may eventually prolong the training duration.

Virtual reality entails an immersive, three-dimensional, computer-generated virtual environment [27]. Humans' senses and cognition have evolved to create a synchronized experience, which poses challenges in creating immersiveness and realism in the virtual world. Virtual reality has extended out of the field of entertainment, leading the novel discoveries in fields such as architecture, medicine, therapy, and education [13, 21, 8, 5]. A notable development in the education field is to use virtual reality for scientific data visualization [7]. Additionally, Virtual Reality Exposure Therapy provides the veterans suffering from post-traumatic stress disorder an immersive trauma-relevant environment that deconditions patients through habituation and extinction process [22]. Virtual reality also deepens the capacity of emotional skills in children on the autism spectrum, aiming to generate social situations while automatically evaluating the children's emotional states as they are exposed to different situations [11, 17]

Another illustrative example pertains to children with autism that suffer from sensory overload episodes. Places with elevated sensory output or situations (lights, sounds, etc.) can be paralyzing for a child with an autism spectrum disorder. Recently, a VR calm room was presented to offer a "separate", low-sensory environment for children to recover from episodes. This mobile application expands anxiety coping methods to a greater population since 70% of Americans possess a smartphone, and Google Cardboard headset can be bought for $15 [11]. The goal of the work presented here is to offer a similar virtual reality environment that can, both passively and actively, through functional virtual exercises, aid children in anger de-escalation and management.

2. METHODOLOGY

2.1. Passive Calming Environment

Virtual reality development was performed using Unity (Unity Technologies, San Francisco, CA) including Google Cardboard/Google VR (Google, Mountain View, CA) libraries for the mobile application. The calm room experience was designed to engage the users in a different environment with modest interactive controls. The environments were designed to be captivating and distracting while not too engaging such that they become a repeated distraction from other learning or tasks in the real world.

2.1.1. Menu Anteroom

Upon entry to the application, the user enters an anteroom. The anteroom offers a menu of environments that are available, and customizations for time and level of interactivity are available for preset. Thumbnail images of each scene/environment are included on 3-D mesh panel. Entry into the scene is achieved by staring at the image mesh for five seconds.

Details about the experience are customizable; the following can be manually input prior to activating the application: run time (if not selected, the default is 2:00 minutes), music volume, and enable/disable interactive function (such as gaze-walking) to modify the level of interactivity. The variables carry over the scenes as static variables stored in an instance named *GameController* that carries itself over the scenes. The transition between two menus was achieved by the transition of target VR (referred in Unity as XR) devices.

2.1.2. Island Environment

An ocean/island setting was selected as the initial passive calming VR environment, as shown in Figure 1. An analysis of English census data revealed a positive association between the proximity to the ocean and the self-reported physical and mental health status. [28]. The terrain and its accompanying assets by Lylek Games were downloaded from the Unity Asset Store. A custom countdown timer is fixed in the top left corner of the screen to reduce cybersickness from an extended period of time in the room [11]. A piece of ocean-themed calming music complements the visual experience and thus increases the immersiveness [12].

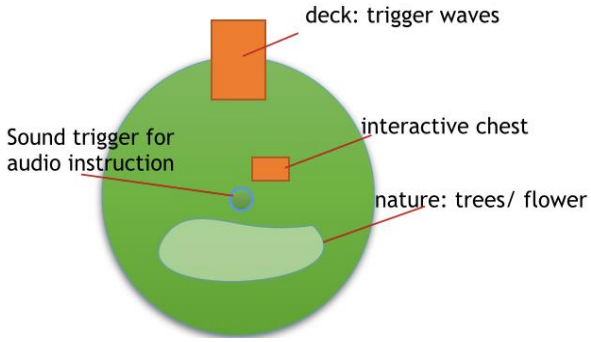

Figure 1. Visualization of the island environment

XR settings in Unity and imported Google VR (GVR) SDK functionalize the de-escalation environment in VR. Additional scripts in C# were incorporated to achieve an interactive environment. GVR reticle point provides a focus for the users. Since Google Cardboard does not offer a handheld controller for the user, a script was created and incorporated that allowed the user to move throughout the scene by changing his/her gaze. Figure 2 summarizes the code in a flowchart, where the project toggle between walk and stops depending on the Euler angle of the user's camera [19]. A border along the island was installed so that users could not enter the water in the scene; this measure simplified the scene and also aimed to reduce anxiety with any underwater experience. In addition to the gaze movement feature, the experience includes several interactive components. A trigger point is set up at the dock overlooking the water: as the player walks/stands on the dock, it will trigger the gentle sounds of ocean waves. On the island a treasure chest is centrally located; animations were created such that, upon approach, the treasure

chest lid will lift, allowing the user to see inside. Figure 1 details the components and their functionality in the environment.

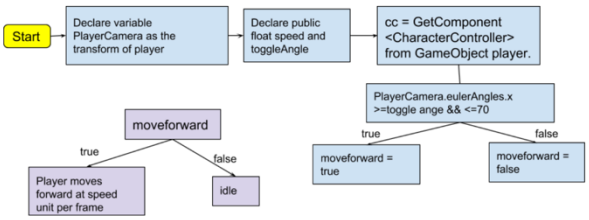

Figure 2. Gaze Walk Control

2.1.3. Calm Room Environment

The calm room environment replicates the main functions of a physical sensory room. Since virtual reality operates with the visual and auditory inputs, the room achieves calming effects through implementing calming designs to control external stimuli. The LookMovement Script is not active in the scene, instead being replaced by a GazeTeleport function to different sections. The default position, centered on a couch, allows the users to observe the room. On the left wall, different geometrical shapes are displayed as study shows emotional responses elicited by those visual inputs [4]. Simple auditory and visual instructions for calming down, and a sensory tent is placed in the corner of the room to offer the user a complete sensory deprivation experience. Figure 3 illustrates the 2-D design of the room.

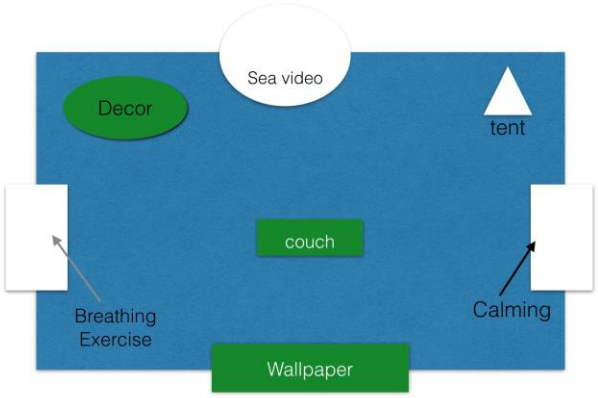

Figure 3. Visualization of the calm room environment

Compared to the island environment, all lighting in the calm room is achieved through point lights or area lightings. This is due to the nature of the room and the goal of a controlled sensory experience for the users. Current design also avoided windows to minimize external signals that may cause distraction or unexpected trigger from outside environment.

2.2. Active Anger Management Training

Aside from the two passive environments above, a CBT environment will be designed to train the users to identify anger stimuli and gain knowledge of self-soothing techniques in different situations.

2.2.1. CBT Environment

After the child has restored to a de-escalated condition, users can begin CBT accompanied by an adult supervisor. In the passive environment above, potential anger triggers are added to the scene. Aimed for emotion, mindfulness, and anger expression training, the goal of this environment is to alleviate users' dependence on the technology and increase the efficacy of the pediatric anger training.

2.3. Hardware Requirement

There are various VR head-mounted displays on the market with a relatively low cost. However, since the program serves as a pediatric therapy, consideration of comfort, graphic rendering quality, and price led the developers to suggest the following hardware specification for users:

Adjustable lenses are important to reduce the impact of cybersickness on the users while providing a clearer view of the environment rendered.

Portability of the hardware for parents and durability for the school must be considered. Foldable cardboard glasses for parents are useful for emergency situations outside of the classroom.

Comfort and stability of the hardware is also important. While the Google Cardboards provide great image quality at a fairly low price, the hard nose rest can make the users feel uncomfortable during the experience.

Headphones are useful in a classroom setting to eliminate distraction for others present in the same space.

3. RESULTS AND DISCUSSION

Through Unity Technologies, a de-escalation program is constructed support IOS and Android platforms.

3.1. Passive Calming Environment

The Menu Anteroom and the island environment is finished with all the functions described above implemented. Figure 4, 5, and 6 illustrate the environment that a user is in during the experience.

Figure 4. 2-D menu for input parameters (time, volume, movement options)

In Figure 5. The white circle represents user's gaze activated on the 3D mesh object textured with a thumbnail of the scene. After five seconds, the users will enter the selected calming environment.

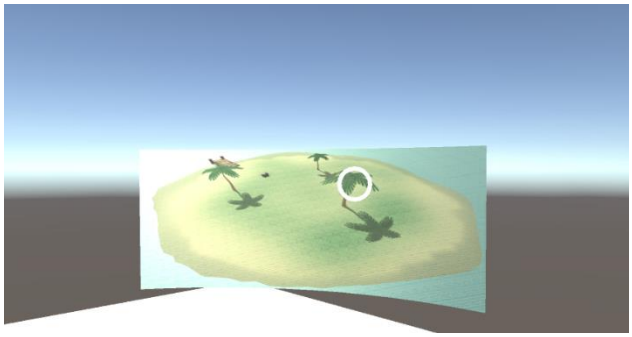

Figure 5. 3-D scene selection Anteroom for the users

Figure 6 displays the entire top-down view of the island calm room experience. The trees are colliders where the users can practice navigating around. The green outlines delineate the invisible borders to reduce potential aquaphobia with easy navigation.

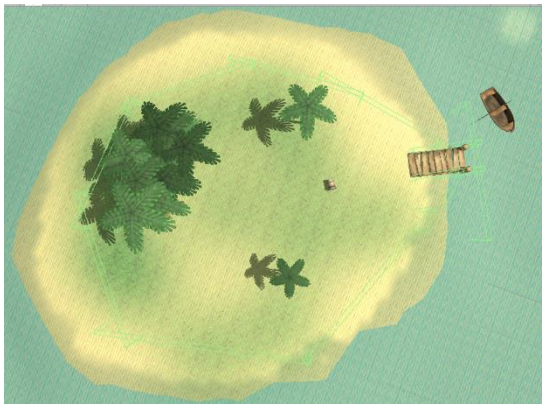

Figure 6. Passive Island Environment

Figure 7 presents the current model of the calm room. The user moves from one exercise to the next through teleport. There will be a radial countdown around the gaze pointer preceding teleport. The tent in the right corner offer deprivation of sensory stimulus and the breathing exercise on the left are the two areas in the room enabled for teleport. Indoor lighting is achieved through point light and area light in Unity to achieve different color in the room.

Figure 7. Passive Calm Room Environment

3.2. Future Direction

Future directions include finalizing the second passive calm room environment. While the first environment focuses on the amelioration of the terrain and the functionality of the GameObjects on the terrain, the calm room environment will emphasize the utilization of different lightings as visual input.

An investigation is also necessary for demonstrating the effectiveness of the application and testing the most appropriate hardware accompanying the program.

4. CONCLUSION

VR's application in anger management has potential to facilitate teenage de-escalation at a lower cost. However, the application requires intensive testing of effectiveness and is accessible to only the population with smartphones. Teenage anger management cannot be eliminated solely based on the passive calming environment. The implementation of an active learning environment is important to achieve the reduction of anger management issues.

5. ACKNOWLEDGEMENT

We would like to thank the Baylor School Research Program for the funding and resources. We would also like to thank the University of Tennessee, Chattanooga for their interest and cooperation in this research.

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