8-2020

# Efficacy of Creative Interventions in Virtual Reality

Matthew Thomas Richesin
mrichesi@vols.utk.edu

To the Graduate Council:

I am submitting herewith a thesis written by Matthew Thomas Richesin entitled "Efficacy of Creative Interventions in Virtual Reality." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Psychology.

Deborah R. Baldwin, Major Professor

We have read this thesis and recommend its acceptance:

Todd M. Moore, Ben Allen

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

# Efficacy of Creative Interventions in Virtual Reality

A Thesis Presented for the
Master of Arts
Degree
The University of Tennessee, Knoxville

Matthew Thomas Richesin
August 2020

# ABSTRACT

Engaging in creative activities is known to increase well-being by reducing levels of stress, anxiety, and improve life satisfaction. Interventions utilizing creative activities have proven to enhance therapeutic results in various mental disorders. Similarly, virtual reality has emerged as an effective method of decreasing negative aspects of mental disorders. While both creative interventions and virtual reality show promise in enhancing well-being, the efficacy of combining the two has not been explored. This study aimed to combine and compare 2-dimensional and 3-dimensional art-making on stress, anxiety, and mood in a non-clinical college student sample. To accomplish this, both physiological and self-report measures often used to measure levels of stress, anxiety, and mood were recorded before and after three interventions. A classic art-making intervention in 2-dimensions, a novel art-making intervention in 3-dimensional virtual reality, and a non-artistic control intervention in virtual reality were used to examine the beneficial outcomes of each method. It was hypothesized that the 3-dimensional art-making group would yield the greatest benefits compared to the other groups. Results show that all groups demonstrated a similar ability to reduce anxiety and enhance mood. Discussion on a common quality of these groups provides insight into these unexpected results and implicates a more fundamental level of examination when studying the benefits of creative intervention.

# TABLE OF CONTENTS

# CHAPTER ONE
# INTRODUCTION AND LITERATURE REVIEW

# Introduction

Mental illness is a serious problem in contemporary society and recent history has shown mental illness to be much more prevalent than historically assumed. The national institute of mental health (2019) (NIMH) has estimated that 46.6 million adults suffer from some mental illness. This equates to 18.9 percent of all adults in the United States. Women (22.3%) show a higher prevalence of mental illness than men (15.1%). The NIMH also shows that younger adults between the ages of 18 and 25 have the highest rates of mental illness (25.8%). The prevalence of mental illness is even higher in more vulnerable populations such as prison inmates (Diamond, Wang, Holzer, Thomas, & des Anges, 2001) and cancer patients (Singer, Das-Manshi, & Brahler 2009). Luckily, due to increased awareness, activism, and education, the negative stigma associated with mental health looks to be on the decline (Sampogna, Bakolis, Evans-Lacko, Robinson, Thornicroft, & Henderson, 2017; Silton, Flannelly, Milstein, & Vaaler, 2011). Nevertheless, we should explore every tool available to combat the current mental health crisis.

Art therapy utilizes many different psychotherapeutic methods in conjunction with creative activities. These activities often include making art (sculpture, drawing, coloring, and collage) but can also encompass other artistic endeavors such as interpretive dance and creative writing (Schouten, de Niet, Knipscheer, Kleber & Hutschemaekers, 2015). The goal of art therapy is to utilize methods from various therapeutic approaches and promote emotional expression in creative ways within a clinical population. This allows patients to express themselves and their emotions in non-

verbal ways. The hope is that the art-making process will help facilitate the integration of difficult to express emotions and lead to healing. Art therapy has proven beneficial in many aspects of mental health such as depression, anxiety, and overall well-being (Blomdahl, Gunnarsson, Guregård, & Björklund, 2013; Schouten et al., 2015; Wilkinson & Chilton 2013). The artistic intervention utilized in art therapy has been observed to provide benefits such as reduced stress and improved mood even in the absence of a psychotherapeutic program (Martin et al., 2015).

While the benefits of art therapy are clear, it is unclear what kinds of artistic interventions are best in achieving the desired benefits. Some studies have shown no difference in various art-making methods in terms of results (Ashlock, Miller-Perrin, & Krumrei-Mancuso, 2018; Duong, Stargell, & Mauk, 2018). While others have shown that small differences such as shape and dimension of the canvas can result in significantly different outcomes (Babouchkina & Robbins, 2015). More research is needed to identify and understand what various artistic mediums can affect positive outcomes for those engaging in art therapy.

Virtual reality (VR) is a 3-dimensional simulation, often using a head-mounted display, that works to mimic real-world situations and experiences. VR has emerged as a new way to provide therapeutic interventions to people suffering from mental disorders. A review by Maples-Keller, Bunnell, Kim, & Rothbaum, (2017) provides evidence that VR based therapies have produced positive results in depression, anxiety disorders, eating disorder, autism, pain management, addiction and even more severe disorders such as schizophrenia. Like art therapy, it is unclear what VR programs provide the best

results when treating patients with mental disorders. One of the main benefits of VR is the customizability of simulation. In theory, every patient could have a simulation tailored towards their specific needs. This makes VR a perfect method for the comparison of therapeutic methods to treat mental health disorders. It is also a wonderful tool in research as it provides enhanced control of experimental manipulation. VR can provide individuals with very similar experiences, unaffected by differences that may arise due to contrasts in researcher or therapist behavior.

In this study, I aim to combine the artistic intervention methods of art therapy with the promising possibilities of VR. This study compares a classic artistic intervention to a novel art-making intervention in VR. VR may provide a new medium in art therapy by moving the act of drawing from 2-dimensions into a 3-dimensional landscape. While this study can only provide foundational information on the efficacy of art-making in VR on healthy adults, this research will inform mental health practitioners using creative interventions about the efficacy of VR. If an artistic intervention in VR provides greater benefits than traditional artistic interventions, these interventions could be optimized to provide the best benefits for patients by utilizing the unique capabilities provided by VR technology.

## Art Therapy

Art therapy is the use of artistic creation, such as drawing, painting, sculpting, and collage making in conjunction with various psychotherapeutic methods (Schouten, de Niet, Knipscheer, Kleber & Hutschemaekers, 2015). Research has shown art therapy to be effective in the treatment of post-traumatic stress syndrome (Schouten et al., 2015),

depression (Blomdahl, Gunnarsson, Guregård & Björklund, 2013) and general improvements in well-being (Wilkinson & Chilton 2013).

### *Art Therapy and Depression*

Interestingly, the largest body of research examines the effects of art therapy on depression were conducted primarily on women diagnosed with breast cancer. Burgess et al. (2005) found 50% of a cohort of 222 patients had symptoms of depression in the first year after a breast cancer diagnosis. While not a clinically depressed sample, many of these authors cite this study as evidence of a higher rate of depression in those diagnosed with cancer.

Thyme, Sundin, Wiberg, Öster, Åström, & Lindh (2009) conducted a study that suggests art therapy may provide long term benefits for patients with breast cancer. Breast cancer patients were randomly assigned to either art therapy or a control group. The art therapy group underwent 5 art therapy sessions with a trained therapist. The first session focused on visualization of feelings, the second session expressed feeling by painting within a life-size silhouette of themselves, the third and fourth session consisted of free painting, and the last session was a reflection on the past sessions with a final painting to summarize the experience. The results showed no immediate changes in depression and anxiety post-therapy. However, there was a significant reduction in depression and anxiety at both 2 months and 6 months post-therapy.

Another randomized control trial using female cancer patients highlights the efficacy of mindfulness-based art therapy (MBAT) (Monte et al. 2006). This study took female patients diagnosed with various kinds of cancer and randomly assigned them to

either an 8-week MBAT program or waitlist control. Each of the eight weekly sessions consisted of mindfulness learning activities, mindfulness-based meditation, and various kinds of artistic interventions. The MBAT group reported significantly lower depression and anxiety scores compared to the waitlist control. They also found higher scores for the MBAT group on the quality of life questionnaire. They conclude that the MBAT program is useful in reducing distress and improving quality of life. However, it is difficult in this study to parse out which aspects of the program were responsible for these effects because there was no comparison group aside from a waitlist control. It is not clear if the art therapy portion of the program provides additional benefits beyond that of the mindfulness meditation and learning of mindfulness techniques. More research is needed to show how art therapy compares to other therapeutic methods.

The effects of art therapy on depression has also been studied in an elderly population. Im and Lee (2014) randomly assigned elderly participants to either an art therapy or music therapy group. Each group attended 12 weekly, 60-minute sessions of therapist-led art or music therapy. Pre and post-test measures were taken, and they found significantly decreased levels of depression for both the music and art therapy groups. Interestingly, they found art therapy led to greater decreases in depression than music therapy. While they show art therapy to be better at decreasing depressive symptoms, it is not clear what aspects of the art therapy generated these results due to the many methods used throughout the sessions. This study provides some evidence regarding the efficacy of art therapy in comparison to other creative therapies. However, more research is needed to understand what methods of art-making provide the best results.

### *Art Therapy and PTSD*

The American Psychiatric Association's (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5) considers PTSD to be past exposure to trauma and persistent symptoms of intrusion, avoidance, negative changes in mood and cognition and changes in arousal and reactivity. A recent study highlights how art therapy may provide a unique benefit to veterans with PTSD (Decker, Sarah, Deaver, Abbey, Campbell, & Turpin, 2018). In this study, veterans with PTSD were randomly assigned to an art therapy combined with cognitive processing therapy (CPT) or a comparison group consisting of CPT combined with supportive psychotherapy. Both groups underwent eight sessions of 1 hour for each therapy type, culminating in 16 hours of therapy for each participant. Results showed that participants in the art therapy/CBT group had significantly greater improvement in symptoms related to anxiety and depression than the participants in CPT/supportive psychotherapy. This study suggests the inclusion of art therapy may provide an advantage when combined with traditional therapeutic methods.

A pilot study conducted by Lyshak-Stelzer, Singer, St. John, & Chemtob (2007) examined the efficacy of art therapy for adolescents with chronic PTSD. Adolescent participants were selected from an inpatient psychiatric facility. Patients were screened before being admitted into the study for the severity of PTSD symptoms using the UCLA PTSD reaction index. Next patients were randomly assigned to either treatment as usual control (TAU) or trauma-focused art therapy group (TF-ART) for 16 weekly sessions. The TAU condition consisted of various arts and craft-making activities. The TF-ART group was a highly organized 16 session protocol where patients created at least 13

drawings/collages that culminate into a life story. They were also instructed to present their artwork to the therapist and other patients and explain its meaning as well as trauma-related experiences. The overall goal of TF-ART was to explore experiences related to safety and threat and garner appropriate recognition of safety and danger. They found both groups showed significant improvements in PTSD symptomatology, but TF-ART provided greater improvements than TAU. This study concluded that art therapy tailored towards patients with PTSD is superior to treatment as usual with general art-making. This suggests that art therapy can be optimized by gearing methods towards a target population.

Contrary to the other finding in this section, Chapman, Morabito, Ladakakos, Schreier, & Knudson (2001) did not find art therapy efficacious in the treatment of PTSD. In this study children admitted to a trauma center for traumatic injuries were randomly assigned to either a standard hospital treatment (SHT) or a group that participated in a Chapman Art Therapy Treatment Intervention (CATTI) designed to reduce PTSD symptoms in pediatric trauma patients. CATTI is a 1-hour session where patients conduct a verbal retelling of the traumatic event and render a drawing that represents the retelling. The authors found no difference between the SHT control group and the CATTI group in symptoms of PTSD immediately after the session or at a 6 month follow up. However, they did find a decrease in stress immediately following CATTI. It is important to note that these patients were not diagnosed with PTSD. The patients were only known to have a recent traumatic injury, and all scored < 12 on the

UCLA PTSD index, indicating “doubtful PTSD”. Since it is designed for PTSD, the CATTI intervention may not provide measurable benefit to those without PTSD.

### *Art Therapy and Well-being*

Well-being has been defined in many ways. One conception is subjective well-being (SWB), characterized by a culmination of overall life satisfaction including prolonged levels of positive affect and lack of negative affect (Deiner, 1994). It is the degree to which a person views themselves as happy and satisfied with life. An alternative view is psychological well-being (PWB), this includes autonomy, self-acceptance, positive relations with others, and meaning in life (Ryff, 1989). Both perspectives focus on the optimal levels of physical, mental, and societal health.

With regards to SWB, Puig, Lee, Goodman, & Sherrad (2006) found that art therapy promotes positive affect while decreasing negative affect in breast cancer patients. Female patients diagnosed with breast cancer were recruited and randomly assigned to either a waitlist control or an art therapy group. The art therapy group attended four sessions (1 hour in length). These sessions included semi-structured art-making in various mediums, poem writing, verbal expression, and meditation geared toward the emotional processing of the breast cancer diagnoses. They found patients in the art therapy condition experienced a significant increase in positive mood and a decrease in negative mood when compared to the waitlist control. In a final questionnaire, the patients were asked to convey the most important personal outcome they gained from the art therapy program. Answers included increased self -awareness,

less hopelessness, happier and more time for self-care. This study supports the idea that art therapy promotes SWB by influencing positive and negative affect.

Other work has provided evidence for art therapy's ability to increase PWB by increasing measures of life satisfaction (Kongkasuwan, Voraakhom, Pisolayabutra, Maneechai, Boonin, & Kuptniratsaikul, 2016). This study recruited recent stroke rehabilitation patients and examined the benefits of art therapy in their treatment. Patients were randomly assigned to either a control group who underwent usual physical therapy 5 days a week or an art therapy condition with 2 sessions of 1.5-2 hours per week for 4 weeks. The specifics of the art-making procedures are unclear in the article, but it was paired with meditation and songwriting. They discovered that the art therapy group showed significant decreases in depression as well as increased physical functioning and life satisfaction compared to the control group. The authors also note a few clinically significant findings, saying that most patients reported increased motivation, concentration, and self-confidence. Together these studies show art therapy can improve well-being in vulnerable populations. More research is needed to examine how art therapy can complement other therapies and what therapies pair best with art therapy.

## The Artistic Intervention in Healthy Populations

While the long-term psychotherapeutic methods employed in art therapy are the driving force in the positive results, there is something to be said for the artistic intervention itself. Research has shown the artistic intervention alone can reduce levels of anxiety/stress, increase positive mood, and elicit physiological responses associated with

stress reduction (Martin et al., 2015). This section will review art-making without therapeutic intervention.

### *The Artistic intervention on Stress and Anxiety*

A wealth of research has shown that various artistic interventions are suitable for lowering self-reported measures of stress and anxiety. In a recent study, Ashlock, Miller-Perrin, & Krumrei-Mancuso (2018) demonstrate that an activity as simple as coloring is effective in reducing anxiety in adults. In this study, undergraduate psychology students were randomly assigned to 1 of 4 groups: free drawing group, mandala coloring group, mandala creation group, or a coloring book group. Each group was given 20 minutes to complete their respective tasks. Results showed that all 4 groups significantly decreased anxiety in pre to post measurements. They also found no difference between the 4 groups in anxiety reduction. This suggests that a variety of creative interventions are equally suited to reducing anxiety. It is important to note the absence of a control group for this study. While the authors highlight the fact that other studies have shown that artistic interventions have proven significant decreases from control, they were unable to ensure the observed effect was due to the creative intervention.

Similarly, Duong, Stargell, & Mauk (2018) randomly assign graduate students to either color a mandala or color a blank sheet of paper. They found that 12 minutes of coloring lead to a significant decrease in situational anxiety in both groups with no difference between groups. They conclude that even an extremely short artistic intervention is effective in reducing anxiety. Once again, the lack of control must be mentioned as a limiting factor.

Sandmire, Gorham, Rankin, & Grimm (2012) allowed undergraduate participants to choose from a variety of creative interventions (painting, clay, still life drawing & collage-making), and they measured the changes in anxiety levels after a 30-minute session. They found the artistic group showed a significant decrease in both state (short term) and trait (long term) anxiety following the intervention. They found no such difference in a control group. They concluded that a short artistic intervention is effective in reducing anxiety and may help counseling professionals that aim to reduce stress in patients.

Curl (2008) highlights the importance of cognitive focus by showing that undergraduate participants focusing on a positive life event during a 25-minute creative intervention (drawing, collage making) lead to a decrease in stress. However, focusing on a stressful event during the creative intervention did not affect stress. The authors also mention a non-significant increase in stress from pre to post measures in those focusing on a stressful even. They suggested a larger sample size may lead to a significant finding in this domain. They conclude that focus is an important factor in the efficacy of artistic interventions. This is important for research using art therapy because participants that think negative thoughts during the artistic intervention may gain limited benefit from the activity. These findings suggest that participants should be encouraged to think of positive events while performing artistic interventions.

An interesting study by Abbott, Shanahan, & Neufeld (2013) shows that artistic tasks both active (drawing) or passive (looking at art) resulted in significantly greater stress reduction than matching active (puzzle) or passive (looking at a map) non-artistic

tasks. This study was comprised of undergraduate students who spent 12 minutes in their respective conditions. One interesting finding in this study is that all groups, including looking at a map, reduced stress levels from pre to post-test. This highlights the importance of a control group to ensure the observed reduction in stress levels from pre to post-test is not just a product of becoming more comfortable or relaxed in the research setting.

The stand-alone creative intervention has also been used in particularly stressed populations such as the family members of cancer patients (Walsh, Martin, & Schmidt 2004). In this study, the primary caretakers of cancer patients were given a creative intervention while the patients underwent chemotherapy. Participants attended a 2-hour long art-making class with a large variety of activities to choose from, such as water coloring, mandala creation, wall hanging creation, ribbon gems, and monoprinting. Measurements taken before and after the intervention showed a decrease in measures of both stress and anxiety as well as an increase in positive mood. They conclude that an artistic intervention is beneficial to families of cancer patients, but future studies should include control or other coping interventions to understand the extent of this benefit.

### *The Artistic Intervention and Mood*

The evidence that the standalone creative intervention can enhance mood has mixed results. Babouchkina & Robbins (2015) show that coloring within a blank circle leads to greater improvement in mood than coloring within a blank square. In this study, undergraduates were randomly assigned to either a circle group where they were instructed to color their feelings within the circle, a circle group where they were allowed

to draw freely within the circle, a square group where they colored their feelings in the square, or a square group where they were allowed to draw freely within the square. It was unclear how long the participants were engaged in the artistic intervention; the authors stated that it was a 30-minute session. However, this included both pre and post-test survey administration. They found that the circle groups yielded 77% more improvement in mood than the square conditions. They conclude that drawing within a circle provides a special benefit in mood improvement that requires further study to understand.

Drake, Coleman, & Winner (2011) found that drawing increases positive mood significantly more than creative writing. Undergraduate participants were randomly assigned to either a writing or drawing group where they were given 10 minutes to draw/write whatever they desired. Further, they found that using the intervention as a distraction, rather than a way to vent, led to a significant increase in positive mood in both the writing and drawing groups. They did this by asking if participants to choose if, "It helped me vent my feelings" (venting), "It helped me to think about things other than the movie clip" (distraction), and "Other—specify." This suggests that one of the main components of the efficacy of artistic intervention is a distraction from issues that may be causing negative mood.

Bell & Robbins (2007) compared the effect of art-making on negative mood states. Adult college student participants were randomly assigned to either a 20-minute free drawing task or a 20-minute art viewing and sorting condition. They found that art-making leads to a significantly more pronounced decrease in negative mood than simply

viewing art. They conclude that the creative process is an important aspect of art interventions above and beyond that of simply experiencing art.

De Petrill & Winner (2005) found that participants in a drawing group had significantly improved mood compared to those who copied shapes. The interesting finding in this study is that they found an improvement in mood regardless of if they drew a negative or non-negative image. This is somewhat conflicting with the findings of Curl (2008). However, this study only utilized negative and non-negative drawing, not specifically positive. Conversely, Smolarski, Leone & Robbins (2015) found a greater mood improvement in a positive drawing group when compared to a negative (venting) and line tracing group. There was a significant mood increase in all groups, but positive drawing yielded a mood improvement significantly higher than venting and tracing. Taken together, there is a rich history in contemporary literature showing improvements in both mood and stress/anxiety in response to a creative intervention.

## Virtual Reality

In the past decade, virtual reality (VR) has become widely available for consumers and researchers. VR is a simulated experience of a real-world phenomenon. VR gives researchers unparalleled control of specific situations that could not previously be replicated in a laboratory setting. Similar to art-making, VR in conjunction with therapy is effective in treating patients with anxiety and depression (Carl et al., 2019), posttraumatic stress syndrome (Kothgassner, 2019), pain management (Jerden, Grindle, Van Woerden, & Kamel Boulos, 2018). These findings show that VR could become a valuable tool for mental health and general wellness.

### *VR, Anxiety-Related Disorders, and PTSD*

Anxiety-related disorders encompass an array of disorders including but not limited to generalized anxiety disorder (GAD), specific phobias (SP), and social anxiety disorder (SAD). An increasingly common methodology for treating anxiety-related disorders is the implementation of virtual reality exposure therapy (VRET). VRET exposes the patient to anxiety invoking stimulus in a virtual environment as opposed to in vivo exposure. Utilizing VRET allows for an unprecedented amount of individualization in exposure, allowing clinicians to design programs for specific patient needs. Some exposure therapy such as driving, flying, and specific animal phobias take significant time and equipment while being potentially dangerous to the patient. Other exposures such as battlefield experience are impossible to recreate accurately in a therapeutic setting. VRET allows for patients to be exposed to similar stimuli in a safe therapeutic environment. While it has not been explicitly shown that VRET is superior to in vivo exposure, studies show that 79-89% of participants prefer VRET to in vivo exposure (García-Palacios, Botella, Hoffman, & Fabregat 2007; Garcia-Palacios, Hoffman, See, Tsai, & Botella, 2001).

GAD is characterized by persistent, intrusive, and excessive worry that causes significant negative effects on normal daily functioning according to the American Psychiatric Association's (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5). To my knowledge, only one study has examined VRET in the context of GAD. Guitard, Bouchard, Bélanger, & Berthiaume (2019) conducted a study that aimed to test if a standardized VR program could be used to elicit anxiety as well as a

standard personalized imagination task often used to elicit anxiety in patients with GAD. In the imagination task, patients imagine a personalized catastrophic scenario while those in the VR group were exposed to one of three standardized simulations. They found that both the imagination task and the standardized simulation resulted in a significant increase in anxiety when compared to a control group. They concluded that there is promise in future research using VR to treat GAD because the standardized simulation produced the same effect as the personalized imagination task.

The American Psychiatric Association's (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5) defines SP as a pronounced fear or anxiety regarding a specific object or situation. A meta-analysis conducted by Wechsler, Kümpers, & Mühlberger (2019) found no difference between VRET and in vivo exposure in the treatment of SP. They indicate a high potential for VRET in the treatment of SP. Fear of flying is one of the most obvious choices for VRET. Costa, Aline, & Nardi (2008) examined the effectiveness of VRET in patients with fear of flying along with two other methods of therapy. Patients were randomly assigned to undergo bibliotherapy (reading of texts with the purpose of healing), cognitive behavioral therapy (CBT), or VRET. They found that CBT and VRET were significantly more beneficial in reducing anxiety than bibliotherapy. They found no difference between CBT and VRET.

VRET has also shown promise in treating acrophobia (fear of heights). Meyerbroeker, Morina, Kerkhof & Emmelkamp (2013) gave acrophobic participants 4 sessions of CBT, after the sessions they were randomly assigned to VRET or in vivo exposure to heights. They found the efficacy of treatment to be the same on all but one

measure, the panic disorder severity scale. It appears that in vivo exposure was more beneficial. They suggest that the mechanisms of VRET and in vivo treatment for acrophobia may be the same. However, further research is needed to better understand the observed difference.

A recent study by Miloff, Lindner, Dafgård, Deak, Garke, Hamilton, et al. (2019) compared an automated (no therapist present) VRET against in vivo exposure for participants with arachnophobia (fear of spiders). They found that both groups significantly decreased spider phobia symptoms, but in vivo exposure was superior immediately after exposure. However, at 3 and 12 months after the session, VRET was shown to be just as beneficial as in vivo exposure. They conclude that VRET for arachnophobia should be considered as a viable option because it provides similar long-term effects even in the absence of a therapist.

SAD is defined by The American Psychiatric Association's (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5) as anxiety is social interactions where one might be judged or evaluated by others. One important benefit to VRET for SAD is the protection of the patient. In vivo exposure to social situations must expose the patient to other people effectively removing confidentiality. VRET does not expose patients to real social situations, thus keeping confidentiality intact. Robillard and colleges (2010) examined the effects of VRET and in vivo exposure to social interaction in patients diagnosed with severe SAD. In this study, patients were exposed to 16 sessions of CBT combined with either in vivo exposure or VRET. They found in vivo and VRET to provide significant improvements in anxiety when compared to a waitlist

control. However, no difference between the efficacy of VRET and in vivo exposure was noted.

Another study examining public speaking anxiety (PSA) randomly assigned participants to in vivo exposure combined with CBT, VRET combined with CBT, or waitlist control (Safir, Wallach, & Bar-Zvi. 2012). They found significant anxiety reduction from control for both VRET and in vivo exposure. There were no differences found between the VRET and in vivo exposure groups on anxiety levels. However, it was found that significantly more participants dropped out of the in vivo group (15) than the VRET group (6). A one year follow up found that decreases in anxiety were maintained on all measures regardless of treatment conditions. This study suggests that VRET is as effective as in vivo exposure for PSA and that VRET may increase retention or compliance to a therapeutic program.

The American Psychiatric Association's (2013) Diagnostic and Statistical Manual of Mental Disorders (5th ed.; DSM-5) considers PTSD to be past exposure to trauma and persistent symptoms of intrusion, avoidance, negative changes in mood and cognition and changes in arousal and reactivity. A recent metanalysis by Kothgassner (2019) surveyed 9 studies examining the effectiveness of VRET on PTSD and concluded that VRET may be as effective as comparable treatments. However, they note that most of the findings are isolated to male participants that are current or past members of the armed forces. They suggest that more diverse studies using females and civilian populations should be conducted before passing judgment on the efficacy of VRET for PTSD in for the general population.

In a study with a population of active service members, Mclay & colleges (2011) randomly assigned participants diagnosed with PTSD to one of two groups. A VRET group where participants were exposed to personalized simulations of their most salient trauma in Iraq or Afghanistan and a treatment as usual group (TAU) that had full access to all PTSD related mental health programs provided at the hospitals where the study took place. Results show that participants in the VRET condition saw significantly greater reductions in PTSD symptoms when compared to the TAU group after 10 weeks of treatment. Limitations in this study include a small sample (N=20) and an uncontrolled comparison group. The TAU group had a similar amount of sessions, but the authors did not have access to the specific method of treatment employed in each session. They conclude that VRET is a safe and effective method of treatment for PTSD for active-duty military personnel, but larger samples and better-controlled comparison groups are needed.

A more recent study used both a larger sample size (N = 162) and properly controlled comparison groups (Reger et al. 2016). This study randomly assigned active-duty personnel to receive VRET, prolonged exposure therapy (PE), or waitlist control. PE is described as a personalized treatment involving education on PTSD, imaginal exposure to the traumatic event, and the cognitive and emotional processing of traumatic material. The results showed that VRET and PE yield significantly greater reductions in PTSD symptoms than that of the waitlist control after 10 sessions. VRET and PE were found to have similar reductions in PTSD symptoms. However, PE produced significantly greater reductions in symptoms compared to VRET at both a 3 and 6 month follow up visit. They

conclude that VRET is an effective method for the treatment of PTSD, but PE may be more beneficial for long term results.

### *VR and Depression*

The literature examining the use of VR treatments to improve depressive symptoms is not nearly as robust as that for anxiety-related disorders. However, there have been some positive results. For example, Li, Chung, & Ho (2011) conducted a study on children hospitalized with cancer. Patients were assigned to either therapeutic play in VR (TPVR) or a control group. The researchers found a significant decrease in depressive symptoms in the children who participated in 30 minutes TPVR each day for 7 days. While depressive symptoms were reduced, they found no difference in measures of anxiety between TPVR and control. They conclude that TPVR is an effective way to reduce depressive symptoms in hospitalized children. It is also important to consider these findings for hospitalized children who are unable to play normally with others due to their illness. TPVR could prove to be an invaluable tool in the holistic care of children isolated by illness.

Another study examined the effects of a VR stress management program on participants diagnosed with mood disorders (Shah, Torres, Kannusamy, Chng, He, & Klainin-Yobas, 2015). Participants experienced 3, hour-long VR interventions. This stress management program consisted of education on stress management, mood disorders, relaxation techniques, and guided relaxation practice. The results showed significantly decreased levels of stress, depression, and anxiety after the 3 sessions.

Again, due to the lack of control, it is unclear if these results are caused by the VR program specifically or if the relaxation techniques alone would produce similar results.

An interesting study by Falconer et al. (2016) sought to decrease depressive symptoms in participants diagnosed with major depressive disorder by creating a unique embodiment program intended to decrease self-criticism and increase self-compassion. In this program participants first interacted and cared for a virtual infant. After caring for the infant, they were then embodied in the infant and experienced a recording of themselves caring for the infant. Essentially, they experienced being cared for by their past actions. Results showed a decrease in depressive symptoms, self-criticism, and an increase in self-compassion from baseline to a 4 week follow up. They also noted that 4 patients exhibited clinically significant improvement in depressive symptoms. While this study provides a novel treatment for depression, it succumbs to many of the limitations of other VR depression studies. Namely, a small population (N=15) and lack of a comparison group. The literature on depression highlights the need for larger studies with comparison groups. It also shows that innovative programs tailored to depression shop promise for the future of VR therapy in treating depression.

### *VR and Pain Management*

A wealth of research has shown the efficacy of VR interventions on the management of various causes of pain. Throughout the literature on VR therapy for pain management, distraction seems to be the driving force in pain reduction. Jeffs and colleges (2014) provide evidence that a VR intervention is beneficial for reducing pain in adolescent patients during burn wound care. Patients were randomly assigned to either a

standard care (SC) group where they underwent normal treatment by nurses and doctors, a passive distraction group (PD) where they watched a movie during wound care or a VR distraction program tailored towards burn pain management. They found the VR distraction group to have less pain during wound care than both the SC and PD groups. They also found the VR distraction group to have an estimated decrease in pain from pre-procedure to reported pain during the burn wound care procedure. It is important to note that these results were found without entirely immersive VR. The headset was mounted to a tripod device and patients moved their eyes to the headset in the same way one would look through a microscope. This study concludes that VR distraction is better than PD and SD even with a less immersive mounted VR setup.

Another series of studies tested the efficacy of VR interventions on both experienced pain and recollected pain during a cold pressor task (CPT) and dental treatment (Tanja-Dijkstra et al. 2017). In the first study, participants were assigned to a control group, a passive VR group where they watched a video of a coastal landscape with a VR headset, or an active VR group where they could navigate the coastal landscape. Pain experience was measured immediately after the CPT and pain recollection was measured one week after the study. They found both VR groups reported less pain immediately after the CPT and less recollected pain after one week. However, they did not find that any of the groups differed in the amount of time participants submerged their hands during the CPT.

In the second study, participants were dental patients that were scheduled for either a filling or extraction. Slightly different from the first study, they replaced the

passive VR condition with an active urban environment. The researchers also noted that the original coastal program was expanded to allow for up to 30 minutes of exploration with the environment. Like the first study, they found the coastal VR program to provide greater benefits in both pain experience and recollection than the standard care control. Interestingly they did not find this effect for the urban environment. This suggests that there may be more than simply distraction moderating these pain management effects. More research is needed to understand how the content of VR interventions can affect clinical outcomes.

## Flow and Immersion

We have seen that art-making and virtual reality can have similar effects on improving wellness. One reason for these similarities may lie in the concepts of flow and immersion. Flow and immersion are distinct but overlapping ideas that have been cited in both art and VR literature. Flow has been shown to improve wellness by reducing stress and improving life satisfaction (Lee, 2013; Reynolds & Prior, 2006). Moreover, one cannot achieve flow without experiencing immersion. This section will compare and contrast flow and immersion and discuss the ambiguity in measurement that may show these two concepts more similar in application than the definitions would suggest.

Coined by the psychologist Mihaly Csikszentmihalyi (1990), flow is a state of optimal performance characterized by being fully immersed in an activity that brings you joy. For example, historical accounts noted that Michelangelo was totally absorbed in painting the Sistine Chapel and would go days at a time without food, sleep, or changing his clothes (Getzels & Csikszentmihalyi, 1976). According to Csikszentmihalyi (1990),

flow occurs when a person's body and their mind are stretched to its limits in a voluntary effort to accomplish something difficult and worthwhile.

Flow has been widely studied in positive psychology and is often studied in the context of overall happiness and well-being. Flow states have been associated with quality of daily experience including feelings that life is more meaningful than those that have fewer states of flow. Csikszentmihalyi (1990) goes so far as to say that flow is necessary for happiness, and it allows an individual to perform at their best. However, throughout the literature flow exudes an almost mystical aura with a set of radical requirements before a flow state is said to be achieved.

The video game and VR literature note a similar, less stringent state simply called immersion. Immersion is at the least a precursor to the flow state in the sense that if one is in a flow state they must be immersed. Some researchers argue that attempts to separate the terms empirically have failed, and the terms can be used interchangeably (Michailidis, Balaguer-Ballester & He, 2018).

***Flow***

The concept of a flow state has been associated with art since the very inception of the term. Csikszentmihalyi has stated his interest in the phenomenon began while observing artists, noting the intense focus on the artistic endeavor (Getzels & Csikszentmihalyi, 1976). Reynolds & Prior (2006) conducted a qualitative study of women with breast cancer. They found that experiencing a flow state during art-making was associated with enhanced quality of everyday life. The authors specifically noted a refocusing of attention or distraction from problems associated with cancer as the driving

force behind life quality enhancement. Another study by Lee (2013) found Korean children that described a flow experience during art-making reported lower levels of anxiety during the activity.

It is not entirely clear what constitutes entering a flow state (Swann, Keegan, Piggott & Crust, 2012). Some researchers argue that you must meet all nine criteria to justify an experience as flow (Cairns, Cox, & Nordin, 2014). Others are less stringent and argue that all requirements do not need to be met but fail to give much more than an arbitrary explanation as to why the original dimensions are not all required (Cruz & Uresti, 2017). The nine dimensions that characterize a state of flow are as follows:

1. "Challenge-skills balance", being engaged but not overwhelmed by the task.
2. "Action-awareness merging", being so engaged that you are only aware of the task.
3. "Clear Goals", understanding what to do next and why you are doing it.
4. "Unambiguous Feedback", knowing how well you are performing.
5. "Concentration on the task at hand", concentration is only on the task.
6. "Sense of control", feeling of full autonomy while engaged in the task.
7. "Loss of self-consciousness", being too engaged in the task to worry what others think.
8. "Transformation of time", the experience of time either speeds or slows.
9. "Autotelic experience", the task is done for its own sake. (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2009).

These dimensions, especially the conclusion that flow must be derived from an autotelic experience, make flow extremely difficult to observe in an experimental setting. Randomly assigning participants to complete a task is not conducive to eliciting an

autotelic experience. However, the literature on video games and VR may help to show the benefits of flow can be achieved without such rigid prerequisites.

### *Immersion*

Immersion is characterized by concentration, absorption in an experience, lack of self-awareness, and altered perception of time (Michailidis, Balaguer-Ballester & He, 2018). Cheng, She & Annetta (2015) describe immersion as "suboptimal" and "less extreme" as compared to a flow state. Meeting all 9 criteria of flow will result in an "optimal experience". Immersion can be thought of as being absorbed in an experience without entering the optimal flow state. Unlike flow, immersion can be expected to occur in an experimental setting because it doesn't require clear goals, an optimal challenge, or doing the activity for its own sake.

While the two are distinct by definition, it is unclear if studies are accurately distinguishing between the two concepts. Many experiments on flow are phenomenological inquiries and often describe a flow-like experience without finding support for all dimensions (Lee, 2013; Reynolds & Prior 2006). Due to the considerable overlap in experiences, it is unknown if current survey data is capable of properly identifying flow rather than immersion (Nordin, Denisova, & Cairns, 2014). Flow experiences are not on a continuum, it is either reached or not. Studies relating levels of flow with well-being may really be relating immersion with well-being.

Much like flow, immersion has been linked with a feeling of detachment from the worries of everyday life (Frochot, Elliot, & Kreziak, 2017). The Reynolds & Prior (2006) article identified detachment from life stressors as the most important aspect of flow for

quality of life enhancement. This detachment from life's stressors is similar to the distraction from problems of everyday life or painful external stimuli noted as driving factors in the art-making and VR literature (Drake, Coleman, & Winter 2011; Jeffs et.al, 2014). This provides conceptual evidence that art-making, VR, flow, and immersion all share the ability to distract from external stressors.

The term immersion is frequently used in video game research (Angelides & Agius, 2014). VR has proven to be more immersive and leads to enhanced measures of flow than the same game on a computer screen (Pallavicini & Pepe, 2019). This study also shows that higher levels of immersion are related to higher levels of flow. As previously discussed, flow is known to be associated with increased life quality, decreased anxiety, and increased happiness (Lee, 2013; Reynolds & Prior, 2006; Tsaur, Yen, & Hsiao, 2013). In theory, VR should increase immersion in the art-making experience, resulting in increased flow, and lead to enhanced outcomes on wellbeing.

Research shows that flow and immersion are deeply intertwined concepts. Both art-making and VR are capable of eliciting immersive experiences. This immersive quality may play a part in the observed decreases in stress and anxiety covered in the art-making and VR sections of this manuscript. Virtual reality has been shown to be more immersive than the same experience in 2-dimensions. The use of virtual reality may enhance the immersive qualities of art-making and result in greater benefits to well-being.

## Physiological Measures as Indices of Stress

Various physiological measures are used to indirectly measure stress response. Physiological measures used as a measure of stress are generally associated with the autonomic nervous system (ANS). The ANS is comprised of two parts, the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). SNS arousal is often termed the "fight or flight response" and associated with threatening stimuli. SNS arousal is physiologically linked with increases in heart rate and redirection of blood flow to skeletal muscles to prepare for action (McCorry, 2007). The PNS is associated with times of rest or homeostatic conditions. The PNS is physiologically associated with lower levels of heart rate, increased salivary flow, digestive functioning, and energy storage (McCorry, 2007).

It is important to note that SNS activation is only indicative of a threat to homeostasis. The "fight or flight" label and the research focus of sympathetic activity during stress often lead to the conclusion that SNS arousal is only seen in negative stressful situations. However, studies have shown that measures of SNS activity increase during positive emotions such as happiness, joy, anticipation, amusement, and surprise while showing a decrease in emotions such as contentment, affection, and pride (Kreibig, 2010). This study will use physiological measures to determine autonomic activity and hopefully shed light on stress response.

### *Heart Rate (HR)*

HR is the frequency of heartbeat measured in beats per minute. Studies have shown HR as a reliable indicator of stress in situations where participants are exposed to

psychological and psychosocial stressors (Kirschbaum, Pirke, & Hellhammer 1993; Stein & Kleiger 1999). Higher HR is generally associated with higher levels of stress while lower HR is associated with less stress. A study conducted by Reinhardt, Schmahl, Wust, and Bohus, (2012) exposed adult participants to the Mannheim Multicomponent Stress Test (MMST) which involves cognitive, emotional, acoustic, and motivational stressors. They found increased significant increases in heart rate and SC in response to the MMST. Conversely, Venpati & Telles (2002) found that guided relaxation exercises significantly reduced HR.

**Skin Conductance (SC)**

SC is a measurement of the electrical conductance on the surface of the skin. Sympathetic arousal leads to increased activation of sweat glands and moisture on the surface of the skin. This increase in moisture leads to greater conductivity and higher measures of SC (Hall, 2015). SC is positively correlated with increases in levels of stress (Oliver, Datta, & Baldwin 2017; Perala & Sterling 2007; Sharma, Khera, Mohan, Gupta, & Ray 2006). For example, a study by Sharma et al. (2006) observed increases in SC with the introduction of a stressor. In this study, participants were asked to complete math problems or play a video game. They found both groups to have significant increases in SC response. The MMST mentioned in the previous section also resulted in increased levels of SC along with HR (Reinhardt, Schmahl, Wust, & Bohus, 2012). The study by Venpati & Telles (2002) also indicates guided relaxation as a method of reducing measures of SC as well as HR.

***Salivary Alpha Amylase (sAA)***

sAA is a known biomarker for ANS activity (Van Stegeren, Rohleder, Everaerd, & Wolf, 2006**).** sAA is one of the most plentiful enzymes found in human saliva. According to Scannapieco, Torres & Levine (1993), sAA is also known to be used in carbohydrate digestion and the clearance and nutrition of certain bacteria found in the mouth. One of the first studies to examine sAA as a correlate of the ANS submerged participants up to their waist in near-freezing water or gave them propranolol, a beta-blocker with known anti-anxiety effects (Speirs, Herring, Cooper, Hardy & Hind 1974). They found the cold-water submersion led to significant increases in sAA while those who were given propranolol saw a significant reduction in sAA. This study demonstrates sAA is sensitive to both the induction and reduction of stress.

Another study conducted by Schoofs, Preuss, and Wolf (2008) found that sAA is also sensitive to psychosocial stress. In this task, participants were either given the Trier Social Stress Test (TSST), a test that induces stress via a social evaluation task, or a non (TSST) control. Both groups were given an n-back task to assess working memory. They found significant increases in sAA in the TSST group and no significant increase in the control condition. A review by Nater and Rohleder (2009) further shows that sAA has been shown to increase in response to mental math, the cold pressor task, oral exams, driving simulations, loud noises, and interpersonal stress. The review concludes that sAA is a sensitive measure of stress due to a large amount of confirming evidence using many different methods of stress induction.

### *Physiological Measures and Artistic intervention*

The inclusion of physiological measures in the literature surrounding creative interventions is sparse, but there have been a few studies conducted. For example, Kamal, Ray & Muniz (2016) demonstrated a decrease in salivary cortisol, a well-known marker for stress, following 45 minutes of art-making. Another study found that coloring mandalas significantly decreases systolic and diastolic blood pressure but found no such decreases in a free drawing or control condition (Schrade, Tronsky, & Kaiser, 2011). Evidence is building regarding the association between creativity and the release of dopamine. For example, Bloem and colleagues (2018) noted that when Parkinson's patients receive medication which increases their dopamine levels, there is an improvement in mobility, curiosity, and artistic expressions. Thus, the inclusion of physiological measures in the study of artistic interventions may provide compelling and promising results.

There is a need to incorporate physiological data to add to the current literature on creative interventions. Research shows a clear effect of artistic interventions on self-report measures of stress, anxiety, and mood. However, we are not sure of the biological correlates associated with these observed phenomena in conjunction with art therapy or VR use.

## Purpose and Hypothesis

To my knowledge, no studies have examined the efficacy of art-making through the medium of VR. Current art interventions mainly focus on coloring, drawing, painting,

and collage making which are two dimensional in space (Martin et al. 2018). VR gives rise to a world where creativity can be expressed in 3-dimensional space. The current study explores this medium of expression with an experimental study that: 1) compares the process of art-making in 3-dimensional vs 2-dimensional space, and 2) examines aspects of the autonomic nervous system (ANS) in the context of art-making. The proposed study examines the efficacy of a novel creative intervention in virtual reality on the reduction of stress, anxiety, and mood. Stress, anxiety, and mood will be measured using both physiological (HR, SC, sAA) and self-report surveys. In accordance with past literature, it is hypothesized:

A) That there will be significant differences pre to post-test in both the 2-dimensional and 3-dimensional art-making groups with no difference in the control group. Specifically, we expect to see a decrease in measures of stress and anxiety with an increase in positive mood.

B) That the 3-dimensional group will have a greater decrease pre to post-test in stress and anxiety as well as an increased positive mood than those in the 2-dimensional group.

C) That the physiological measures will be significantly correlated with self-report measures. We expect a positive correlation between physiological measures (HR, SC, sAA) and self-report measures of stress and anxiety. We expect a negative correlation between physiological measures and measures of positive mood.

# CHAPTER TWO
# MATERIALS AND METHODS

## Participants

Forty-four undergraduate students (8 males and 36 females) with a mean age of 21.20 (SD = 2.26) were recruited from undergraduate courses in psychology at the University of Tennessee Knoxville campus using the departmental SONA system. Participants were randomly assigned to one of the 3 groups: *2-dimensional (2D), 3-dimensional (3D), or control.* Participants were all at least 18 years of age and did not have any of the following: History of epilepsy or seizures, fainting spells, cardiac pacemaker, or other implanted medical devices with electronic signaling. Each participant read and signed an informed consent form prior to data collection. This study was approved by the university's institutional review board.

## Measures

Self-report data were collected using Questionpro software on a 22-inch Dell desktop computer. HR and SC data were recorded in an adjacent room equipped with two Dell 22-inch monitors. HR and SC data were collected via the multichannel Procomp InfinitiTM and Biograph software system (Thought Technology Ltd., Montreal, Canada). The control simulation is a part of "The experience machine" an open-source package with various simulations created by Eric Ramirez, Scott LaBarge, Miles Elliott & Carl Maggio at Santa Clara University. The simulation used is called the "training room". It was intended to familiarize users with VR controls. This simulation was run on an HTC Vive (Vive and Valve Corporation) headset connected to a Gigabyte Aero 15 (Gigabyte Technology) laptop computer. The 3D group entered the Google Tilt Brush (Google) application, a popular VR program used for art and design. This simulation was run on an

Oculus Quest (Oculus) headset. The Oculus Quest is a standalone VR headset and does not require a connection to a computer. The 2D group was given Crayola brand washable markers, colored pencils, and crayons as well as Sharpie brand permanent markers and Ticonderoga brand # 2 pencils. The drawing surface was a 25" x 30" Post It easel pad placed on a 64" tall easel.

***Demographic Survey***

A self-report survey used to obtain information on age, race, gender, and other demographic information. The following health items were also included: a history epilepsy/seizures, fainting spells or cardiac pacemaker or other implanted medical devices with electronic signaling. The health items were used as a screening procedure for participation in the current study. Individuals who indicate the above were not allowed to participate in the study.

***Positive and Negative Affect Schedule (PANAS)***

Developed by Watson, Clark, & Tellegen (1988), this survey is a set of 2 mood scales consisting of 10-items each. These scales measure positive and negative affect. The authors describe positive affect as high energy, engagement, and concentration while negative affect is characterized by many negative mood states such as anger, fear, and contempt. Participants are asked to report how much they feel a given feeling (positive or negative) right now on a 5-point scale ranging from not at all to extremely. The scores are added separately for positive or negative feelings and a higher score represents higher levels of positive or negative affect while a lower score represents lower levels. Watson,

Clark, & Tellegen (1988) report internal reliability coefficients to be between 0.84 and 0.90 for both positive and negative affect over six large samples.

***State-Trait Anxiety Inventory (STAI)***

A regularly used survey to measure anxiety in adults (Spielberger, 1983), it measures both state (temporary) and trait (long term) anxiety. State measures generally increase in the response to danger and psychological stress and decrease after relaxation. Trait measures examine longstanding and general anxiety, usually higher in those diagnosed with anxiety and/or depression. The survey consists of 40-items (20 for each subscale), which are measured using a 4-point Likert scale. Scores range from 20 to 80; higher scores represent higher levels of anxiety and lower scores represent lower levels. A review by Barnes, Harp, & Jung (2002) reports the mean internal reliability across 52 studies as 0.91 (state) and 0.89 (trait).

***Perceived Stress Scale (PSS)***

A 14-item (7 positive, 7 negative) scale developed by Cohen, Kamarck, and Mermelstein (1983) was used to measure general stress over the past month. This measure is widely used in research with higher scores being associated with higher levels of stress (Lee, 2012). Lee (2012) also found the average internal reliability of the PSS across 12 studies to be 0.83.

***HR***

HR was collected using a Thought Technology (Montreal, Canada) Blood Volume Pulse (BVP) Sensor - SA9308M. The sensor was connected to multichannel

Procomp Infiniti hardware and Biograph software from Thought Technology (Montreal, Canada) and collected at 2048 Hz.

***SC***

SC was measured using a Though Technology (Montreal, Canada) SC-Flex/Pro Skin Conductance sensor. The sensor was connected to multichannel Procomp Infiniti hardware and Biograph software from Thought Technology (Montreal, Canada) and collected at 256 Hz.

***Saliva Collection and Analysis***

A saliva sample to obtain measurements of sAA was administered to all participants. Participants were first asked to wash their mouth out with water to ensure the absence of foreign particles that may decrease the quality of analysis. Next, participants were asked to let saliva collect in their mouth for 1 minute. After 1-minute participants drooled the collected saliva into a 50 ml test tube. This pooling and drooling protocol was repeated a total of 3 times. The saliva sample was labeled by participant number only, centrifuged, and stored in an ultra-freezer at -70 degrees Celsius until analysis. sAA concentrations were determined via an assay kit (Salimetrics, State College, PA) and expressed in U/mL. Higher levels of sAA are indicative of higher levels of SNS activity. Samples were analyzed using a Multiskan™ FC Microplate Photometer using a wavelength of 405 nm. Raw data were converted to U/ml by taking the difference in Optical density x total sample volume. This calculation was made using SkanIt™ Software for Microplate Readers.

## Procedures

Participants reported to the Wellness and Autonomic Nervous System Laboratory (Mossman 337 A-B). First, everyone was presented with the informed consent document to read and sign prior to participation. After signing the informed consent participants were directed to the computer to fill out demographic information and self-report measures (STAI, PANAS, PSS).

Next, the participants were escorted into a separate examination room. In this room, the participant was asked to sit and relax in a comfortable chair with armrest while the SC and BVP sensors are attached. SC electrodes were attached to the index and ring fingers of the non-dominant hand. The BVP sensor attached to the thumb of the non-dominant hand. After the attachment of sensors, participants were asked to sit quietly for five minutes to record baseline physiological measures. Next, participants were asked to deliver the first saliva sample to obtain a baseline measurement of sAA. After the completion of baseline measures, participants underwent a 15-minute intervention depending on the group.

Participants in the control group entered a VR simulation of an office room. Within the room were various items such as a stapler, drawers, a ball, and a dartboard that they could able to interact with. Participants were told they could move freely within the simulation and interact with anything of their choosing except for a door leading out of the office room. Interacting with this door would end the simulation.

The 2D group was given an array of drawing utensils to choose from such as crayons, colored pencils, markers, and pens. They were instructed to draw freely on a 25 x 30 pad of paper attached to an easel using any combination of the utensils.

The 3D group was fitted with an Oculus Quest virtual reality headset and enter the Google Tilt Brush drawing application. Like the 2D group, participants were instructed to draw freely utilizing all available tools in the Google Tilt Brush application.

After the creative intervention, participants were once again asked to sit for 5 minutes while the final HR and SC measures were recorded. Following the post-intervention HR and SC reading, participants were asked to submit the second and final saliva sample to measure sAA post-intervention. After the final saliva sample, participants were escorted back to the computer to complete the self-report questionnaires (PANAS, STAI, PSS). After the completion of the self-report measures, participants were thanked for their participation and given the appropriate SONA credits.

# CHAPTER THREE

# RESULTS

All data were analyzed using SPSS version 25 with alpha level set at 0.05. To address hypothesis one, paired-sample T-tests were used to identify differences pre to post-intervention. To test hypothesis 2, a one-way ANOVA was conducted on the change scores between groups for each measured variable (STAI, PANAS, PSS, HR, SC & sAA). To test hypothesis 3, a Pearson correlation was conducted to test for associations between self-report measures (STAI, PANAS & PSS) and physiological data (HR, SC & sAA). A one-way ANOVA on the baseline scores indicated there were no significant differences between groups on baseline measures.

***Hypothesis 1***

Paired sample T-tests were computed to identify differences between baseline and post intervention for physiological measures. See Table 1 (in appendix) for means and standard deviations for pre-test and post-test measures within each group. As expected, there was no significant change in HR from pre-test to post-test $t(15) = .473$ , $p = .643$ among control participants. However, a significant decrease in HR was found for both the 2D, $t(.12) = -2.594$ , $p = .023$ and 3D, $t(14) = -3.967$, $p = .001$, groups. There were no significant differences in SC between baseline and post intervention in the Control $t(15) = -.006$, $p = 0.995$, 2D $t(12) = 1.037$, $p = 0.320$, or 3D $t(14) = .585$, $p = 0.568$ groups. Similarly, there were no significant differences in baseline and post intervention measures of sAA for the Control $t(15) = 1.92$, $p = 0.074$, 2D $t(12) = 1.046$, $p = 0.316$, or 3D $t(14) = -.036$, $p = 0.972$ groups. Partial support for the study hypotheses were found.

Paired sample T-tests were also used to examine the pre-test to post-test changes for self-report measures. Regarding the PANAS, there was no significant changes in

positive affect found in any group: Control $t(15) = .865$, $p = 0.400$, 2D $t(12) = .855$, $p = 0.403$, or 3D $t(14) = 1.871$, $p = 0.082$. However, there was a significant decrease in negative affect from pre-test to post-test for all groups: Control $t(15) = -3.365$, $p = 0.004$, 2D $t(12) = -3.010$, $p = 0.011$, and 3D $t(14) = -4.961$, $p < 0.001$. The analysis revealed a significant reduction from baseline to post intervention on state anxiety for all groups: Control $t(15) = -6.850$, $p < 0.001$, 2D $t(12) = -3.369$, $p = 0.006$, and 3D $t(14) = -5.349$, $p < 0.000$. Significant reductions in trait anxiety were also found in all groups: Control $t(15) = -5.337$, $p < 0.001$, 2D $t(12) = -2.557$, $p = 0.025$, and 3D $t(14) = -3.973$, $p = 0.001$. Finally, there was an arguably significant decrease on the PSS measures for the control group, $t(15) = -2.174$, $p = 0.046$. However, there were no significant changes in the 2D, $t(12) = -1.731$, $p = 0.109$, or 3D, $t(14) = -.178$, $p = 0.861$ groups on this measure. Again, partial support for the study hypotheses were found.

***Hypothesis 2***

To examine the differences between groups on the dependent variables, a one-way ANOVA was conducted on the change scores. See Table 2 (in appendix) for means and standard deviations of change scores for each group. Only HR was found to have a significant main effect, $F(2, 41) = 5.070$, $p = 0.011$. A post hoc Tukey test was conducted and found the 3D group displayed significantly greater decreases in HR than the control group ($p = 0.009$). No significant differences were found for the other groups. No other significant main effects were detected between groups: SC $F(2, 41) = 0.231$, $p = 0.795$, Positive affect $F(2, 41) = 0.214$, $p = 0.816$, Negative affect $F(2, 41) = 1.031$, $p = 0.366$,

State anxiety $F(2, 41) = 0.042$, $p = 0.959$, Trait anxiety $F(2, 41) = 0.562$, $p = 0.575$, PSS $F(2, 41) = 1.005$, $p = 0.375$, or sAA $F(2, 41) = 1.326$, $p = 0.277$].

***Hypothesis 3***

Pearson correlation analyses were used to examine relationships between variables via change scores. See Table 3 (in appendix) for correlation matrix. Surprisingly, both HR and SC showed no correlation with any other study variables. A significant positive correlation was found between sAA and negative affect ($r = 0.319$, $p = 0.035$), indicating that lower measures of negative affect lead to lower levels of sAA. State anxiety change was also found to be positively correlated with sAA change ($r = 0.336$, $p = 0.026$). Thus, sAA levels would be expected to decrease as state anxiety decreases. The correlation analysis also uncovered associations between self-report measures. Negative affect was found to be positively correlated with both state ($r = 0.678$, $p < 0.001$) and trait ($r = 0.509$, $p < 0.001$) anxiety levels, while state anxiety was also positively correlated with both trait anxiety ($r = 0.683$, $p < 0.001$) and PSS ($r = 0.354$, $p = 0.018$). Thus, increases in negative affect are associated with increases in anxiety levels. Likewise, increases in stress tend to lead to increases in anxiety.

# CHAPTER FIVE
# DISCUSSION AND CONCLUSION

The purpose of the current study was to compare the outcome of a novel method of art-making (3D) with well-studied methods (2D) known to reduce both physiological and self-report measures of stress and anxiety. Using a pre-test post-test experimental design, a 3D control group was incorporated to ensure the act of art-making was responsible for significant changes in the study measures (heart rate, skin conductance, alpha-amylase, affect, anxiety, & stress).

It was hypothesized that the art-making groups (2D & 3D) would show significant within-group decreases on all variables except positive affect. It was hypothesized that the control group would not show any changes from pre-test to post-test on the measures. Partial support for both hypotheses was found. Results showed significant pre to post-intervention decreases in negative affect and anxiety (state & trait) measures for all groups. HR was found to have a significant decrease in the 2D and 3D groups, but no change in control. Contrary to the hypotheses, PSS decreased in the control group but showed no change in the 2D and 3D groups. Regarding the between-group differences, it was hypothesized that both art-making groups would display significant decreases in physiological and self-report measures compared to the control group. More specifically, the 3D group would yield the greatest significance on well-being measures. Only HR was found to have a significant main effect between groups with the 3D group showing a significantly greater decrease than control. Finally, there was a significant positive correlation between sAA and both state anxiety and negative affect. Neither HR nor SC were associated with any self-report measures.

It was hypothesized that the 2D and 3D groups would decrease from pre to post on all measures except for positive affect, which would show an increase. Partial support for this hypothesis was found on measures of HR, negative affect, state anxiety and trait anxiety but was not found for measures of SC, sAA, positive affect, or PSS. A decrease in heart rate was expected for the art-making groups, and this finding is consistent with past art intervention research (e.g., DeLue, 1999). Anxiety levels are the most regularly sampled measure in the art-making literature. Researchers consistently report decreased anxiety levels in relation to art-making (Ashlock, Miller-Perrin & Krumrei-Mancuso, 2018; Duong, Stargell & Mauk, 2018; Sandmire, Gorham, Rankin & Grimm, 2012). The decrease in negative affect was expected in the current study, and these findings are partially aligned with past art interventions research demonstrating both a decrease in negative affect and an increase in positive affect (Kamal & Ray, 2017) However, this study provides more support to another study reporting decreased negative affect but no change in positive affect in grieving children after individual art-making but not collaborative art-making (Hill & Lineweaver, 2016).

The lack of change in skin conductance may be attributable to a limitation in the study design. Because participants were active with both hands during the interventions, we could not take a continuous measurement throughout the intervention process. Most research on SC is focused on arousal and increases in levels of skin conductance. Increases in SC due to minor acute stressors tend to return to baseline in < 30 seconds if no other arousing stimuli are presented and individuals have no underlying conditions capable of affecting autonomic arousal (Schwarz, 2017). One study examining SC levels

before, during, and after guided relaxation found SC to only decrease significantly during the session (Vempati, & Telles, 2002). Future studies should aim to measure SC continuously throughout interventions if possible. Few studies have measured SC in conjunction with art-making. One example shows an increase in SC in professional artists during art-making. They posit that both the physical movement and the challenging nature of the work lead to an increase in arousal (Van Heerden & Munro, 2012). Our findings may indicate that free art-making used in the current study was not challenging enough to elicit an increase in skin conductance.

To our knowledge, this is the first study to incorporate sAA, a known salivary marker of stress and anxiety in conjunction with art-making. The null result for sAA may be explained in a variety of ways. It is plausible that art-making was not sensitive enough to influence sAA levels. However, upon a closer examination of the descriptives, we see high variance between individuals. This is not unusual for sAA measures, individual levels are consistently variable across many studies (Rohelder & Nater, 2009). This high variance data combined with small sample size is unlikely to produce any significant results. While participants were asked not to eat or drink anything for at least an hour prior to the study, it is unlikely this rule was followed by all participants. Eating and drinking (particularly carbohydrates), nicotine, caffeine, and exercise have all been shown to affect levels of sAA (Rohelder & Nater, 2009).

We also neglected to control for the diurnal increase of sAA throughout the day. There is disagreement in the literature about diurnal levels of sAA. Some researchers argue for control of the time of day with studies that show a stable increase throughout

the day that are resistant to momentary changes (Nater, Rohleder, Schlotz, Ehlert, & Kirschbaum, 2007; Out, Granger, Sephton, & Segerstrom, 2013). Others argue that the increase is negligible and environmental stimuli result in greater changes (Hunter, Gillespie, & Chen, 2019; Yamaguchi, Deguchi, & Miyazaki, 2006). These authors also note that the time of waking, not the time of day, is the most important aspect. These studies control the time of waking (morning only) to be around the same time while speculating about the importance of time of day. It is unclear if the cycle is determined by time of day or by the time of waking. Regardless, the current study collected data between the hours of 9:00 am and 5:00 pm, neither time of day nor the time of wake was controlled for.

We hypothesized that measures of positive affect would increase while measures of negative affect would decrease with respect to the art-making groups. However, the findings only support the decrease of negative affect. This is contrary to other studies showing both increases in positive affect and decreases in negative affect in response to art-making interventions (Drake & Winner, 2012; Kaimal & Ray, 2017). While studies have found drawing to increase positive affect, there is precedence for negative findings in the literature. Drake and Winner (2012) noted that while there was an effect on positive affect, drawing was much more effective in decreasing negative affect. However, this effect may have been tied to a mood induction task. They found that those who watched a video had less of an increase in positive affect than those who imagined “the saddest thing” that had ever happened to them. Even though negative affect and positive affect often correlate, it has long been said that they are independent of each other.

Deiner and Emmons (1984) argue that the negative correlation between the two is fleeting and only occurs for a brief time demonstrating that the correlation disappears with long term measurements and only appears during times of higher emotion. Our findings also support other studies that showed only negative affect to be associated with measures of anxiety (Deiner and Emmons, 1984; Watson, Clark & Carey, 1988). While we had no measures of depression in this study, we did find levels of anxiety and negative affect to decrease significantly.

The within-group hypothesis also stated that the control group would show no significant difference for any measures. The results from the current study indicated that the control group showed significant decreases in measures of negative affect, state anxiety, and trait anxiety; just like the 2D and 3D groups. The control group additionally showed a significant decrease in PSS measures, while the 2D and 3D groups showed no such difference. The findings from VR research demonstrate that VR is capable of reducing stress and anxiety (Carl et al., 2019; Kothgassner, 2019). However, these findings were in conjunction with therapeutic techniques and various simulations were used. The lack of control and comparison groups was often noted throughout the literature review. This finding highlights the need to explore the effects of different simulations on well-being and account for the novelty of the VR experience.

The literature on novelty is mixed. Researchers have found evidence of a novelty effect by observing a negative correlation between learning outcomes and the number of times exposed to a VR learning simulation (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014). While others have found no evidence of a novelty effect

when using neutral virtual experiences, much like the waiting room used in the current study (Busscher, de Vliegher, Ling, & Brinkman, 2011). Other research has shown no decline in benefits provided by VR during a painful stressor over repeated exposures (Rutter, Dahlquist, & Weiss, 2009). However, the findings from the current study support the idea of a novelty effect.

The takeaway from within-group findings is that all three groups are similarly capable of reducing measures of stress and anxiety. The novelty of VR may result in stress and anxiety reduction comparable to creative interventions. However, the art-making groups seem to have an increased ability to reduce HR which has meaningful implications from a therapeutic perspective.

It was further hypothesized that there would be between-group differences on the study variables and that the 3D group would show the greatest improvements. The only hypothesis confirmed was that HR is significantly reduced in the 3D group when compared with control. It is possible that the small sample sized is not powerful enough to yield significant results without striking differences between groups. However, it could also be that art-making is not the underlying cause of the observed changes in the current study. The comparison group in this study was the VR control group, and there was not a true control group incorporated in the study. The idea of immersion discussed in chapter two is prominent in both VR and art-making. Although the VR control group was incorporated as a measure for examining the effect of art-making, the design failed to eliminate the phenomenon of immersion. All groups, one could argue, incorporated elements of immersion. Art-making may have no special benefits beyond being a vehicle

for a peaceful immersive experience. It may be more useful to compare artistic activities to other immersive activities known to decrease stress and anxiety. Other non-artistic immersive activities that have a track record for stress and anxiety reduction include things like meditation, sports, or reading (Goyal, Singh & Sibinga, et al, 2013; Judge, 2018; Rizzolo, Zipp, Stiskal, & Simpkins, 2009).

It was also hypothesized that the physiological data would be correlated with self-report measures. This hypothesis was partially confirmed with sAA change being positively correlated with negative affect and STAI change. This result supports past research linking sAA and anxiety levels (Lim, 2016; Rashkova, Ribagin & Toneva, 2012). We expected the correlation between sAA and anxiety due to sAA's known association with SNS activation. One study showed a surgical block of SNS activation reduces anxiety levels in those with social phobia (Pohjavaara, Telaranta, & Väisänen, 2003). Negative affect is known to be associated with anxiety (Watson, Clark & Carey, 1988). Altogether the results from the current study strongly suggest that anxiety levels, sAA, and negative affect change in concert with environmental provoking stimuli. Unfortunately, there were no other correlations between physiological and psychological measures.

***Limitations***

There are several limitations, and the most notable is that of a pandemic. One reason for this inconsistency may be the small sample size due to the abrupt conclusion of data analysis during the COVID-19 shutdown. This small sample has likely led to low power and a higher risk of type-2 error. We may find significant results in these areas

with the completion of data collection to 120 participants. Another limitation is that residual change was not incorporated during data analysis. While there were no significant differences between groups on baseline measures, it may be beneficial to account for residual change to best understand the change over time. The pre to post-test design, while necessary for this study, was not ideal for measuring HR and SC. The ability to measure continuously throughout the intervention would lead to a more accurate understanding of the physiological response to the intervention. As mentioned previously, the lack of daytime control regarding sAA may have led to a less reliable result. The sample itself is also a limitation. Using the SONA system, our sample consists of an overwhelmingly white female demographic, all of which attend a large public university. This is not representative of the larger population. Due to the consistent results in the literature, a true control was excluded in favor of a VR control to test the possibility of a novelty effect. With the observed outcome, a control group was needed to ensure that these groups did share a common variable and the findings couldn't be explained by the experimental setting or procedures.

### *Conclusions*

Working under the assumption that the sample size has not resulted in any type-II errors, the implication for these results is quite interesting. While the majority of hypotheses were not confirmed, the study has given further support to past findings. Art making, whether in 2 or 3 dimensions can reduce levels of stress and anxiety in a non-clinical population. The study also indicates that basic interactions in a VR office room can reduce measures of stress and anxiety. This study shows that wellness can be

improved through a variety of activities, and you do not need to be skilled at the endeavor. While the 2D and 3D groups have art-making in common the control condition must possess a common variable to produce such similar results. I believe all groups share an immersive quality. Simply being in virtual reality is immersive enough to elicit the stress and anxiety-reducing benefits associated with art-making. However, this may be the result of a novelty effect. Repeated sessions in the VR waiting room may become boring over time and fail to produce the level of immersion needed for the currently observed effect. Future research should address this possible novelty effect by repeated exposure to various VR interventions and observing what interventions retain anxiety-reducing and mood-enhancing effects following habituation.

Conceptually, we tend to associate a salient action with observed results. However, this study shows similar results with various interventions. Other studies have found a similar trend, Rizzolo, and colleges (2009) found that yoga, reading, and humor sessions all lead to significant decreases in measures of stress and no difference between groups. Instead of focusing on a particular intervention, researchers should focus on what produces the state of immersion found in these various activities. Focusing on the underlying factors of anxiety reduction and mood enhancement in creative interventions may lead to improved methods of achieving the psychological states associated with health benefits.

# REFERENCES

Abbott, K., Shanahan, M.J., Neufeld, R.W.J. (2013) Artistic tasks outperform nonartistic tasks for stress reduction. Art Therapy.30:71–78. doi: 10.1080/07421656.2013.787214

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

Ashlock, L. E., Miller-Perrin, C., & Krumrei-Mancuso, E., (2018). The Effectiveness of Structured Coloring Activities for Anxiety Reduction, *Art Therapy*, 35:4, 195-201, DOI: 10.1080/07421656.2018.1540823

Babouchkina, A., & Robbins, S. J. (2015). Reducing negative mood through mandala creation: A randomized controlled trial. *Art Therapy: Journal of the American Art Therapy Association*, *32*, 34–39. doi:10.1080/07421656.2015.994428

Bell, C. E., & Robbins S. J. (2007) Effect of Art Production on Negative Mood: A Randomized, Controlled Trial, *Art Therapy*, 24:2, 71-75, DOI: 10.1080/07421656.2007.10129589

Bloem, B.R., Pfeijffer, I.L., & Krack, P. (2018). Art for better health and wellbeing. The British Medical Journal, 363, 1-6.

Blomdahl, C., Gunnarsson, A. B., Guregård, S., & Björklund, A. (2013). A realist review of art therapy for clients with depression. *The Arts in Psychotherapy, 40*(3), 322-330. http://dx.doi.org/10.1016/j.aip.2013.05.009

Burgess, C., Cornelius, V., Love, S., et al. (2005). Depression and anxiety in women with early breast cancer; five year observational cohort study. *British Medical Journal*, 330, 702.

Busscher, B., de Vliegher, D., Ling, Y., & Brinkman, W. P. (2011). Physiological measures and self-report to evaluate neutral virtual reality worlds. *Journal of CyberTherapy and Rehabilitation*, *4*(1), 15-25.

Cairns, P., Cox, A., & Nordin, A. I. (2014). Immersion in digital games: review of gaming experience research. *Handbook of digital games*, *1*, 767.

Carl, E., Stein, A.T., Levihn-Coon, A., Pogue, J.R., Rothbaum, B.O., Emmelkamp, P.M., Asmundson, G.J., Carlbring, P., & Powers, M.B. (2019). Virtual reality exposure therapy for anxiety and related disorders: A meta-analysis of randomized controlled trials. *Journal of anxiety disorders*, *61*, 27-36.

Chapman, L., Morabito, D., Ladakakos, C., Schreier, H., & Knudson, M. (2001). The effectiveness of art therapy interventions in reducing post-traumatic stress disorder symptoms in paediatric trauma patients. *Art Therapy: Journal of the American Art Therapy Association*, 18(2), 100–104. doi:10.1080/07421656.2001.10129750

Cheng, M. T., She, H. C., & Annetta, L. A. (2015). Game immersion experience: its hierarchical structure and impact on game-based science learning. *Journal of Computer Assisted Learning*, *31*(3), 232-253.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385-396. http://dx.doi.org/10.2307/2136404

Costa R. T. D., Aline S., Nardi A. E. (2008). Virtual reality exposure in the treatment of fear of flying. *Aviation Space Environ. Med*. 79 899–903. 10.3357/ASEM.2277.2008

Cross, G., & Brown P., (2019) A Comparison of the Positive Effects of Structured and Nonstructured Art Activities, *Art Therapy*, 36:1, 22-29, DOI: 10.1080/07421656.2019.1564642

Cruz, C. A., & Uresti, J. A. R. (2017). Player-centered game AI from a flow perspective: Towards a better understanding of past trends and future directions. *Entertainment Computing*, *20*, 11-24.

Curl, K. (2008) Assessing Stress Reduction as a Function of Artistic Creation and Cognitive Focus, *Art Therapy*, 25:4, 164 169, DOI: 10.1080/07421656.2008.10129550

Csikszentmihalyi, M., & Csikzentmihaly, M. (1990). Flow: The psychology of optimal experience (Vol. 1990). New York: Harper & Row.

Decker, K., Sarah, P., Deaver, S., Abbey V., Campbell, M & Turpin, C. (2018) Quantitatively Improved Treatment Outcomes for Combat-Associated PTSD With Adjunctive Art Therapy: Randomized Controlled Trial, *Art Therapy*, 35:4, 184-194, DOI: 10.1080/07421656.2018.1540822

Diamond, P. M., Wang, E. W., Holzer, C. E., & Thomas, C. (2001). The prevalence of mental illness in prison. *Administration and Policy in Mental Health and Mental Health Services Research*, *29*(1), 21-40.

Diener, E. (1994) Assessing subjective well-being: Progress and opportunities. *Social Indicators Research* 31(2): 103–157. doi:10.1007/BF01207052

Diener, E., & Emmons, R. A. (1984). The independence of positive and negative affect. *Journal of personality and social psychology*, *47*(5), 1105.

De Petrill, L., & Winner, E. (2005) Does Art Improve Mood? A Test of a Key Assumption Underlying Art Therapy, *Art Therapy*, 22:4, 205-212, DOI: 10.1080/07421656.2005.10129521

DeLue, C. (1999) Physiological effects of creating mandalas. In Medical art therapy with children, Edited by: Malchiodi, C. 33–49. Philadelphia, PA: Jessica Kingsley.

Drake, J. E., Coleman, K., & Winner, E. (2011). Short-term mood repair through art: Effects of medium and strategy. *Art Therapy: Journal of the American Art Therapy Association*, *28*, 26–30. doi:10.1080/07421656.2011.557032

Duong, K., Stargell, N., & Mauk, G., (2018) Effectiveness of Coloring Mandala Designs to Reduce Anxiety in Graduate Counseling Students, *Journal of Creativity in Mental Health*, 13:3, 318-330, DOI: 10.1080/15401383.2018.1437001

Falconer, C., Rovira, A., King, J., Gilbert, P., Antley, A., Fearon, P., . . . Brewin, C. (2016). Embodying self-compassion within virtual reality and its effects on patients with depression. BJPsych Open, 2(1), 74-80. doi:10.1192/bjpo.bp.115.002147

Frochot, I., Elliot, S. and Kreziak, D. (2017), "Digging deep into the experience – flow and immersion patterns in a mountain holiday", *International Journal of Culture,*

*Tourism and Hospitality Research*, Vol. 11 No. 1, pp. 81-91. https://doi.org/10.1108/IJCTHR-09-2015-0115

Garcia-Palacios, A., Hoffman, H. G., Kwong See, S., Tsai, A. M. Y., & Botella, C. (2001). Redefining therapeutic success with virtual reality exposure therapy. *CyberPsychology & Behavior*, *4*(3), 341-348.

Garcia-Palacios, A., Botella, C., Hoffman, H., & Fabregat, S. (2007). Comparing acceptance and refusal rates of virtual reality exposure vs. in vivo exposure by patients with specific phobias. *Cyberpsychology & behavior*, *10*(5), 722-724.

Getzels, J. W., & Cs´ıkszentmihalyi, M. (1976). ´ The creative vision: A longitudinal study of problem finding in art. New York, NY: Wiley.

Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., ... & Ranasinghe, P. D. (2014). Meditation programs for psychological stress and well-being: a systematic review and meta-analysis. *JAMA internal medicine*, *174*(3), 357-368.

Guitard, T., Bouchard, S., Bélanger, C., & Berthiaume, M. (2019). Exposure to a Standardized Catastrophic Scenario in Virtual Reality or a Personalized Scenario in Imagination for Generalized Anxiety Disorder. *Journal of Clinical Medicine*, *8*(3), 309. MDPI AG. Retrieved from http://dx.doi.org/10.3390/jcm8030309

Hall, J. E. (2015). *Guyton and Hall textbook of medical physiology e-Book*. Elsevier Health Sciences.

Hektner, J. M. (1997). Exploring optimal personality development: A longitudinal study of adolescents. *Dissertation Abstracts International: Section B: The Sciences and Engineering, 57*(11-B), 7249.

Hill, K. E., & Lineweaver, T. T. (2016). Improving the short-term affect of grieving children through art. *Art Therapy*, *33*(2), 91-98.

Hunter, M. R., Gillespie, B. W., & Chen, S. Y. P. (2019). Urban nature experiences reduce stress in the context of daily life based on salivary biomarkers. *Frontiers in psychology*, *10*, 722.

Im, M. L., and Lee, J. I. (2014). Effects of art and music therapy on depression and cognitive function of the elderly. *Technol. Health Care* 22, 453–458. doi: 10.3233/THC-140803

Jeffs, D., Dorman, D., Brown, S., Files, A., Graves, T., Kirk, E., … Swearingen, C. J. (2014). Effect of Virtual Reality on Adolescent Pain During Burn Wound Care. *Journal of Burn Care & Research, 35(5), 395–408.* doi:10.1097/bcr.0000000000000019

Jerdan, SW., Grindle, M., van Woerden, H. C., Kamel Boulos, M.N. (2018). Head-Mounted Virtual Reality and Mental Health: Critical Review of Current Research. *JMIR Serious Games* ;6(3):e14. DOI: 10.2196/games.9226

Judge, J. (2018). Stress, happiness and psychological well-being among college students: Role of sports in mental health. *International journal of physical education, sports and health, 5,* 22-25.

Kaimal, G., & Ray, K. (2017) Free art-making in an art therapy open studio: changes in affect and self-efficacy, *Arts & Health*, 9:2, 154-166, DOI: 10.1080/17533015.2016.1217248

Kaimal, G., Ray, K., & Muniz, J. (2016). Reduction of Cortisol Levels and Participants' Responses Following Art Making. *Art Therapy*, *33*(2), 74–80. https://doi.org/10.1080/07421656.2016.1166832

Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test'–a tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, 28(1-2), 76-81.

Kongkasuwan, R., Voraakhom, K., Pisolayabutra, P., Maneechai, P., Boonin, J., & Kuptniratsaikul, V. (2016). Creative art therapy to enhance rehabilitation for stroke patients: a randomized controlled trial. *Clinical rehabilitation*, *30*(10), 1016-1023.

Kothgassner, O. D., Goreis A., Kafka J. X., Van Eickels R. L., Plener P. L., & Felnhofer A. (2019) Virtual reality exposure therapy for posttraumatic stress disorder (PTSD): a meta-analysis, *European Journal of Psychotraumatology*, 10:1, DOI: 10.1080/20008198.2019.1654782

Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological psychology*, *84*(3), 394-421.

Lee, E. H. (2012). Review of the psychometric evidence of the perceived stress scale. *Asian nursing research*, *6*(4), 121-127.

Lee, S. Y. (2013). “Flow” in art therapy: Empowering immigrant children with adjustment difficulties. *Art Therapy: Journal of the American Art Therapy Association*, 30(2), 56–63.

Li, W. H., Chung, J. O. and Ho, E. K. (2011), The effectiveness of therapeutic play, using virtual reality computer games, in promoting the psychological well-being of children hospitalised with cancer. *Journal of Clinical Nursing*, 20: 2135-2143. doi:10.1111/j.1365-2702.2011.03733.x

Lim, I. S. (2016). Correlation between salivary alpha-amylase, anxiety, and game records in the archery competition. *Journal of exercise nutrition & biochemistry*, *20*(4), 44.

Lyshak-Stelzer, F., Singer, P., St. John, P., & Chemtob, C. M. (2007). Art therapy for adolescents with posttraumatic stress disorder symptoms: A pilot study. *Art Therapy, 24*(4), 163-169. http://dx.doi.org/10.1080/07421656.2007.10129474

Maples-Keller, J. L., Bunnell, B. E., Kim, S. J., & Rothbaum, B. O. (2017). The Use of Virtual Reality Technology in the Treatment of Anxiety and Other Psychiatric Disorders. *Harvard review of psychiatry*, *25*(3), 103–113. doi:10.1097/HRP.0000000000000138

Martin, L., Oepen, R., Bauer, K., Nottensteiner, A., Mergheim, K., Gruber, H., & Koch, S. C. (2018). Creative Arts Interventions for Stress Management and Prevention-A Systematic Review. *Behavioral sciences (Basel, Switzerland)*, *8*(2), 28. doi:10.3390/bs8020028

McCorry L. K. (2007). Physiology of the autonomic nervous system. *American journal of pharmaceutical education*, *71*(4), 78. https://doi.org/10.5688/aj710478

McLay, R. N., Wood, D. P., Webb-Murphy, J. A., Spira, J. L., Wiederhold, M. D., Pyne, J. M., & Wiederhold, B. K. (2011). A Randomized, Controlled Trial of Virtual Reality-Graded Exposure Therapy for Post-Traumatic Stress Disorder in Active Duty Service Members with Combat-Related Post-Traumatic Stress Disorder. *CyberPsychology, Behavior & Social Networking*, *14*(4), 223–229. https://doi-org.proxy.lib.utk.edu/10.1089/cyber.2011.0003

Merchant, Z., Goetz, E. T., Cifuentes, L., Keeney-Kennicutt, W., & Davis, T. J. (2014). Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A meta-analysis. *Computers & Education*, *70*, 29-40.

Meyerbroeker, K., Morina, N., Kerkhof, G. A., & Emmelkamp, P. M. G. (2013). Virtual reality exposure therapy does not provide any additional value in agoraphobic patients: a randomized controlled trial. *Psychotherapy and psychosomatics*, *82*(3), 170-176.

Michailidis, L., Balaguer-Ballester, E., & He, X. (2018). Flow and immersion in video games: The aftermath of a conceptual challenge. *Frontiers in psychology*, *9*, 1682.

Miloff, A., Lindner, P., Dafgård, P., Deak, S., Garke, M., Hamilton, W., ... & Sjölund, J. (2019). Automated virtual reality exposure therapy for spider phobia vs. in-vivo one-session treatment: A randomized non-inferiority trial. *Behaviour research and therapy*, *118*, 130-140.

Monti, D. A., Peterson, C., Kunkel, E. J. S., Hauck, W. W., Pequignot, E., Rhodes, L., & Brainard, G. C. (2006). A randomized, controlled trial of mindfulness-based art therapy (MBAT) for women with cancer. *Psycho-Oncology, 15(5), 363–373.* doi:10.1002/pon.988

Nakamura, J., & Csikszentmihalyi, M. (2009). Flow theory and research. *Handbook of positive psychology*, 195-206.

Nater, U. M., and Rohleder, N. (2009). Salivary alpha-amylase as a non-invasive biomarker for the sympathetic nervous system: current state of research. *Psychoneuroendocrinology* 34, 486–496. doi: 10.1016/j.psyneuen.2009.01.014

Nater, U. M., Rohleder, N., Schlotz, W., Ehlert, U., and Kirschbaum, C. (2007). Determinants of the diurnal course of salivary alpha-amylase. *Psychoneuroendocrinology* 32, 392–401. doi: 10.1016/j.psyneuen.2007.02.007

National Institute of Mental Health (2019). *Mental illness*. Retrieved November 8, 2019, from https://www.nimh.nih.gov/health/statistics/mental-illness.shtml.

Nordin, A. I., Denisova, A. and Cairns, P. (2014). Too Many Questionnaires: Measuring Player Experience Whilst Playing Digital Games. Paper presented at the The Seventh York Doctoral Symposium on Computer Science and Electronics, 30 Oct 2014, York, UK.

Oliver, M. D., Datta, S., & Baldwin, D. R. (2017). A sympathetic nervous system evaluation of obesity stigma. *PloS one*, *12*(10), e0185703.

Out, D., Granger, D. A., Sephton, S. E., & Segerstrom, S. C. (2013). Disentangling sources of individual differences in diurnal salivary α-amylase: Reliability, stability and sensitivity to context. *Psychoneuroendocrinology*, *38*(3), 367-375.

Pallavicini, F., & Pepe, A. (2019, October). Comparing Player Experience in Video Games Played in Virtual Reality or on Desktop Displays: Immersion, Flow, and Positive Emotions. In *Extended Abstracts of the Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts* (pp. 195-210).

Perala, C. H., & Sterling, B. S. (2007). *Galvanic skin response as a measure of soldier stress* (No.ARL-TR-4114). Army Research Lab Aberdeen Proving Ground MD Human Research and Engineering Directorate.

Pohjavaara, P., Telaranta, T., & Väisänen, E. (2003). The role of the sympathetic nervous system in anxiety: is it possible to relieve anxiety with endoscopic sympathetic block?. *Nordic journal of psychiatry*, *57*(1), 55-60.

Puig, A., Min Lee, S., Goodwin, L., & Sherrad, P. A. D. (2006). The efficacy of creative arts therapies to enhance emotional expression, spirituality, and psychological well-being of newly diagnosed Stage I and Stage II breast cancer patients: A preliminary study. *The Arts in Psychotherapy*, *33*, 218–228. doi: 10.1016/j.aip.2006.02.004.

Rashkova, M. R., Ribagin, L. S., & Toneva, N. G. (2012). Correlation between salivary α-amylase and stress-related anxiety, *Folia Medica*, *54*(2), 46-51. doi: https://doi.org/10.2478/v10153-011-0088-4

Ramirez, E., LaBarge, S., Elliott, M., & Maggio, C. Virtual Reality Thought Experiments Module Package (includes VR Training Room).

Reger, G. M., Koenen-Woods, P., Zetocha, K., Smolenski, D. J., Holloway, K. M., Rothbaum, B. O., . . . Gahm, G. A. (2016). Randomized controlled trial of prolonged exposure using imaginal exposure vs. virtual reality exposure in active duty soldiers with deployment-related posttraumatic stress disorder (PTSD). *Journal of Consulting and Clinical Psychology, 84*(11), 946-959. doi:http://dx.doi.org.proxy.lib.utk.edu:90/10.1037/ccp0000134

Reinhardt, T., Schmahl, C., Wüst, S., & Bohus, M. (2012). Salivary cortisol, heart rate, electrodermal activity and subjective stress responses to the Mannheim Multicomponent Stress Test (MMST). *Psychiatry research*, *198*(1), 106-111.

Reynolds, F., & Prior, S. (2006). Creative Adventures and Flow in Art-Making: A Qualitative Study of Women Living with Cancer. *British Journal of Occupational Therapy*, *69*(6), 255–262. https://doi.org/10.1177/030802260606900603

Rizzolo, D., Zipp, G. P., Stiskal, D., & Simpkins, S. (2009). Stress Management Strategies For Students: The Immediate Effects Of Yoga, Humor, And Reading On Stress. *Journal of College Teaching & Learning (TLC)*, *6*(8). https://doi.org/10.19030/tlc.v6i8.1117

Robillard, G., Bouchard, S., Dumoulin, S., Guitard, T., & Klinger, E. (2010). Using virtual humans to alleviate social anxiety: preliminary report from a comparative outcome study. *Stud Health Technol Inform*, *154*, 57-60.

Rohleder, N., & Nater, U. M. (2009). Determinants of salivary α-amylase in humans and methodological considerations. *Psychoneuroendocrinology*, *34*(4), 469-485.

Rutter, C. E., Dahlquist, L. M., & Weiss, K. E. (2009). Sustained efficacy of virtual reality distraction. *The journal of pain: official journal of the American Pain Society*, *10*(4), 391–397. https://doi.org/10.1016/j.jpain.2008.09.016

Ryff, C. D. (1989) Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, 57(6): 1069–1081. doi:10.1037/0022–3514.57.6.1069

Sampogna, G., Bakolis, I., Evans-Lacko, S., Robinson, E., Thornicroft, G., & Henderson, C. (2017). The impact of social marketing campaigns on reducing mental health stigma: results from the 2009–2014 Time to Change programme. *European Psychiatry*, *40*, 116-122.

Sandmire D. A., Gorham S. R., Rankin N. E. &. Grimm D. R (2012) The Influence of Art Making on Anxiety: A Pilot Study, *Art Therapy*, 29:2, 68-73, DOI: 10.1080/07421656.2012.683748

Safir, M. P., Wallach, H. S., & Bar-Zvi, M. (2012). Virtual reality cognitive-behavior therapy for public speaking anxiety: one-year follow-up. *Behavior modification*, *36*(2), 235-246.

Scannapieco, F.A., Torres, G., & Levine M.J. (1993) Salivary α-amylase: role in dental plaque and caries formation. *Critical Review of Oral Biology* M 4: 301–307.

Schoofs, D., Preuss, D., & Wolf, O. T. (2008). Psychosocial stress induces working memory impairments in an n-back paradigm. *Psychoneuroendocrinology* 33, 643–653. doi: 10.1016/j.psyneuen.2008.02.004

Schouten, K. A., de Niet, G. J., Knipscheer, J. W., Kleber, R. J., & Hutschemaekers, G. J. M. (2015). The Effectiveness of Art Therapy in the Treatment of Traumatized Adults: A Systematic Review on Art Therapy and Trauma. *Trauma, Violence, & Abuse, 16*(2), 220 228. https://doi.org/10.1177/1524838014555032

Schrade, C., Tronsky, L. N., & Kaiser, D. H. (2011). Physiological effects of mandala making in adults with intellectual disability. *The Arts in Psychotherapy, 38,* 109–113. doi:10.1016/j.aip.2011.01.002

Schwartz, M.S. (2017) Biofeedback: A Practitioner's Guide 4th ed. Guilford Press, New York.

Shah, L. B. I., Torres, S., Kannusamy, P., Chng, C. M. L., He, H. G., & Klainin-Yobas, P. (2015). Efficacy of the virtual reality-based stress management program on stress-related variables in people with mood disorders: the feasibility study. *Archives of psychiatric nursing*, *29*(1), 6-13.

Sharma, R., Khera, S. H. V. E. T. A., Mohan, A. M. I. T., Gupta, N., & Ray, R. B. (2006). Assessment of computer game as a psychological stressor. *Indian journal of physiology and pharmacology*, *50*(4), 367.

Silton, N. R., Flannelly, K. J., Milstein, G., & Vaaler, M. L. (2011). Stigma in America: Has anything changed? Impact of perceptions of mental illness and dangerousness

on the desire for social distance: 1996 and 2006. *Journal of Nervous and Mental Disease, 199*(6), 361–366.

Singer, S., Das-Munshi, J., & Brähler, E. (2010). Prevalence of mental health conditions in cancer patients in acute care—a meta-analysis. *Annals of Oncology*, *21*(5), 925-930.

Smolarski, K., Leone, K., & Robbins, S. J. (2015). Reducing negative mood through drawing: Comparing venting, positive expression, and tracing. *Art Therapy*, *32*(4), 197-201.

Speirs, R. L., Herring, J., Cooper, W. D., Hardy, C. C., & Hind, C. R. K. (1974). The influence of sympathetic activity and isoprenaline on the secretion of amylase from the human parotid gland. *Archives of Oral Biology*, *19*(9), 747-752.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Stein, PhD, P. K., & Kleiger, MD, R. E. (1999). Insights from the study of heart rate variability. *Annual review of medicine*, *50*(1), 249-261.

Stuckey, H. L., & Nobel, J. (2010). The connection between art, healing, and public health: a review of current literature. *American journal of public health*, *100*(2), 254–263. doi:10.2105/AJPH.2008.156497

Swann, C., Keegan, R. J., Piggott, D., & Crust, L. (2012). A systematic review of the experience, occurrence, and controllability of flow states in elite sport. *Psychology of sport and exercise*, *13*(6), 807-819.

Tanja-Dijkstra, K., Pahl, S., White, M. P., Auvray, M., Stone, R. J., Andrade, J., … Moles, D. R. (2017). The Soothing Sea: A Virtual Coastal Walk Can Reduce Experienced and Recollected Pain. *Environment and Behavior, 50(6), 599–625.* doi:10.1177/0013916517710077

Thyme, K. E., Sundin, E. C., Wiberg, B., Öster, I., Åström, S., & Lindh, J. (2009). Individual brief art therapy can be helpful for women with breast cancer: A randomized controlled clinical study. *Palliative and Supportive Care, 7(01), 87.* doi:10.1017/s147895150900011x

Tsaur, S. H., Yen, C. H., & Hsiao, S. L. (2013). Transcendent experience, flow and happiness for mountain climbers. *International Journal of Tourism Research*, *15*(4), 360-374.

Van Heerden, A., & Munro, M. (2012). Reflecting on the art making process. *South African Journal of Art History*, *27*(2), 295-309.

Van Lith, T. (2016). Art therapy in mental health: A systematic review of approaches and practices. *The Arts in Psychotherapy, 47*, 9-22. http://dx.doi.org/10.1016/j.aip.2015.09.003

Van Stegeren, A., Rohleder, N., Everaerd, W., Wolf, O.T. (2006). Salivary alpha amylase as marker for adrenergic activity during stress: Effect of betablockade. *Psychoneuroendocrinology*, 31 (1), pp. 137-141. Doi:10.1016/j.psyneuen.2005.05.012

Vempati, R. P., & Telles, S. (2002). Yoga-Based Guided Relaxation Reduces Sympathetic Activity Judged from Baseline Levels. *Psychological Reports*, *90*(2), 487–494.

Walsh, S. M., Martin, S. C. and Schmidt, L. A. (2004), Testing the Efficacy of a Creative-Arts Intervention With Family Caregivers of Patients With Cancer. Journal of Nursing Scholarship, 36: 214-219. doi:10.1111/j.1547-5069.2004.04040.x

Watson, D., & Clark, L. A. (1994). *The PANAS-X: Manual for the Positive and Negative Affect Schedule-Expanded Form.* Ames: The University of Iowa.

Watson, D., Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to anxiety and depressive disorders. Journal of Abnormal Psychology, 97, 346–353.

Wechsler, T. F., Kümpers, F., & Mühlberger, A. (2019). Inferiority or Even Superiority of Virtual Reality Exposure Therapy in Phobias?-A Systematic Review and Quantitative Meta-Analysis on Randomized Controlled Trials Specifically Comparing the Efficacy of Virtual Reality Exposure to Gold Standard *in vivo* Exposure in Agoraphobia, Specific Phobia, and Social Phobia. *Frontiers in psychology*, *10*, 1758. doi:10.3389/fpsyg.2019.01758

Wilkinson, R., & Chilton. G (2013) Positive Art Therapy: Linking Positive Psychology to Art Therapy Theory, Practice, and Research, *Art Therapy*, 30:1, 4-11, DOI: 10.1080/07421656.2013.757513

Yamaguchi, M., Deguchi, M., & Miyazaki, Y. (2006). The Effects of Exercise in Forest and Urban Environments on Sympathetic Nervous Activity of Normal Young Adults. *Journal of International Medical Research*, 152–159.

# APPENDIX

**Table 2**

*Means and standard deviations for the change from baseline to post-intervention.*

| Group | | HR Δ | SC Δ | PA Δ | NA Δ | STAIS Δ | STAIT Δ | PSS Δ | sAA Δ |
|---|---|---|---|---|---|---|---|---|---|
| **Control (*n*=16)** | Mean | .669 | -.001 | .938 | -2.438* | -8.313* | -7.500* | -1.313* | 12.563 |
| | Std. Deviation | 5.658 | .823 | 4.328 | 2.898 | 4.854 | 5.621 | 2.414 | 26.172 |
| **2D (*n*=13)** | Mean | -2.915* | .178 | .769 | -4.385* | -8.154* | -5.000* | -1.462 | -10.236 |
| | Std. Deviation | 4.052 | .620 | 3.244 | 5.253 | 8.726 | 7.071 | 3.045 | 35.272 |
| **3D (*n*=15)** | Mean | -4.885* | .101 | 1.600 | -3.733* | -7.667* | -6.600* | -.133 | -.449 |
| | Std. Deviation | 4.769 | .666 | 3.312 | 2.915 | 5.551 | 6.434 | 2.900 | 49.002 |

*Note.* HR Δ = Average change from pre to post heart rate. SC Δ = Average pre to post change in skin conductance. PA Δ = Average pre to post change in positive affect. NA Δ = Average pre to post change in negative affect. STAIS Δ = Average pre to post change in state measures of anxiety. STAIT Δ = Average pre to post change in trait measures of anxiety. PSS Δ = Average pre to post change for scores on the perceived stress scale. sAA Δ = Average pre to post change of salivary alpha-amylase levels.

## Informed Consent Form

**Title of Project**: Methods of Art Making and Wellness.

**Principal Investigator**: Matthew Richesin

**Purpose**: This study is designed to examine the effects of art making through different mediums and its effect on stress and mood.

Upon participation in this study, you will be asked to complete a few surveys (stress, mood, sleep), sit quietly while physiological measures are taken (heart rate, and skin conductance) using a small physio-graph with sensors attached the fingers of the non-dominant hand and complete a virtual reality task. We will also collect a saliva sample to determine levels of salivary alpha amylase before and after the experiment. Participation is strictly voluntary, and only the PI, CO-PI and faculty advisor will have access to the data. The total time to complete this experiment is approximately 45 minutes.

**Risks**: Risks to participate in this study are minimal, although breach of confidentiality is possible. Although rare, there is a risk of seizure or loss of consciousness due to the visual effects produced by the virtual reality headset. Do not participate in this research if you have a history of epilepsy or seizures. Radio waves omitted by the virtual reality headset can interfere with the operation of nearby electrical devices. Do not participate in this research if you have a cardiac pacemaker or other implanted medical devices that use electronic signaling. Inform the researchers immediately if you experience any odd sensations, dizziness, nausea or see "auras."

**Benefits:**
Participation in this study could provide a decrease in stress and improved mood. This research will also inform other researchers regarding therapeutic methods and could be applied in therapeutic programs for better results. We hope this research will also shed light into beneficial uses of virtual reality for society.

**Compensation**: You will be awarded one SONA credit for complete participation in this study.

**Confidentiality**: The information you provide is strictly confidential. No names or other identifying items will be present on any of the surveys or data analyses. Your data will be coded, and all identifiers will be removed. All data will be kept in a secure password protected computer file, and all data will be discarded after the required minimum of 3 years. Only the PI (Matthew Richesin), CO-PI (Lahai A.M. Wicks) and faculty advisor (Dr. Baldwin) will have access to this data. No reference will be made in oral or written reports which could link you to this study.

**Informed Consent Form Continued:**

**Future Research:** We will not keep your information to use for future research. Your name and other information that can directly identify you will be deleted from your research data collected as part of the study.

**Participation**: You can withdraw from the study at any time without penalty and your participation is completely voluntary. Refusal to participate or withdrawal will involve no loss of benefits to which you are otherwise entitled. Upon completion of this study, the PI will provide you with an opportunity to ask questions during the de-briefing session.

**Contact Information**: Matthew Richesin can be contacted at mrichesi@vols.utk.edu. Dr. Debora Baldwin's contact information is dbaldwin@utk.edu or 974-3357. Lahai Wicks can be contacted at lwicks@vols.utk.edu. In addition, if you have any questions about your rights as a participant, you may contact the University of Tennessee IRB Compliance Officer at utkirb@utk.edu or (865) 974-7697.

**Statement of Consent:**

I have read this form and the research study has been explained to me. I have been given the chance to ask questions and my questions have been answered. If I have more questions, I have been told who to contact. By signing this document, I am agreeing to be in this study. I will receive a copy of this document after I sign it.

| | | |
|---|---|---|
| Name of Adult Participant | Signature of Adult Participant | Date |

**State-Trait Anxiety Inventory**

**DIRECTIONS:** A number of statements which people have used to describe themselves are given below. Read each statement and then write the number in the blank at the end of the statement that indicates how you feel right now, that is, at this moment. There is no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1=Not at all 2=Some What 3=Moderately so 4=Very much so

1. I feel calm 1 2 3 4
2. I feel secure 1 2 3 4
3. I am tense 1 2 3 4
4. I feel Strained 1 2 3 4
5. I feel at ease 1 2 3 4
6. I feel upset 1 2 3 4
7. I am presently worrying over possible misfortunes 1 2 3 4
8. I feel satisfied 1 2 3 4
9. I feel frightened 1 2 3 4
10. I feel comfortable 1 2 3 4
11. I feel self confident 1 2 3 4
12. I feel nervous 1 2 3 4
13. I am Jittery 1 2 3 4
14. I feel indecisive 1 2 3 4
15. I am relaxed 1 2 3 4
16. I feel content 1 2 3 4
17. I am worried 1 2 3 4
18. I feel confused 1 2 3 4
19. I feel steady 1 2 3 4
20. I feel pleasant 1 2 3 4

A number of statements which people have used to describe themselves are given below. Read each statement and then write the number in the blank at the end of the statement that indicates how you feel in general. There is no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

1=Not at all 2=Some What 3=Moderately so 4=Very much so

21. I feel pleasant 1 2 3 4
22. I feel nervous and restless 1 2 3 4
23. I feel satisfied with myself 1 2 3 4
24. I wish I could be as happy as others seem to be 1 2 3 4

**State-Trait Anxiety Inventory Continued:**

25. I feel like a failure 1 2 3 4
26. I feel rested 1 2 3 4
27. I am calm, cool, and collected 1 2 3 4
28. I feel that difficulties are piling up so that I cannot overcome them 1 2 3 4
29. I worry too much over something that really doesn't matter 1 2 3 4
30. I am happy 1 2 3 4
31. I have disturbing thoughts 1 2 3 4
32. I lack self confidence 1 2 3 4
33. I feel secure 1 2 3 4
34. I make decision easily 1 2 3 4
35. I feel inadequate 1 2 3 4
36. I am content 1 2 3 4
37. Some unimportant thoughts runs through my mind and bothers me 1 2 3 4
38. I take disappointments so keenly that I can't put them out of my mind 1 2 3 4
39. I am a steady person 1 2 3 4
40. I get in a state of tension or turmoil as I think over my recent concerns and interests 1 2 3 4

**PANAS**

**This scale consists of a number of words that describe different feelings and emotions. Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way generally, that is, how you feel right now:**

| **1** | **2** | **3** | **4** | **5** |
|---|---|---|---|---|
| very slightly or not at all | a little | moderately | quite a bit | extremely |

_____ interested

_____ distressed

_____ excited

_____ upset

_____ strong

_____ guilty

_____ scared

_____ hostile

_____ enthusiastic

_____ proud

_____ irritable

_____ alert

_____ ashamed

_____ inspired

_____ nervous

_____ determined

_____ attentive

_____ jittery

_____ active

_____ afraid

## PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly? 0 1 2 3 4

2. In the last month, how often have you felt that you were unable to control the important things in your life? 0 1 2 3 4

3. In the last month, how often have you felt nervous and "stressed"? 0 1 2 3 4

4. In the last month, how often have you felt confident about your ability to handle your personal problems? 0 1 2 3 4

5. In the last month, how often have you felt that things were going your way? 0 1 2 3 4

6. In the last month, how often have you found that you could not cope with all the things that you had to do? 0 1 2 3 4

7. In the last month, how often have you been able to control irritations

in your life? 0 1 2 3 4

8. In the last month, how often have you felt that you were on top of things? 0 1 2 3 4

9. In the last month, how often have you been angered because of things that were outside of your control? 0 1 2 3 4

10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? 0 1 2 3 4

# VITA

Matthew Thomas Richesin was born in Johnson City, Tennessee but moved to Knoxville at an early age. He was raised by his parents Jill Broaddus and Bruce Richesin and is the eldest of three children. Matthew attended elementary school at Ridgedale Elementary School. Prior to middle school Matthew moved to Alcoa, Tennessee and was educated through the Alcoa School System through middle and high school. Upon graduation he decided to attend Pellissippi State Community College where he received an Associate of Arts degree. Matthew then transferred to The University of Tennessee Knoxville where he graduated with a Bachelor of Arts degree in Psychology with a minor in Philosophy. Matthew decided to continue his education and entered the Master of Arts program in Experimental Psychology under the tutelage of Dr. Deborah Baldwin.