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College students are experiencing unprecedented levels of stress and anxiety. As a result, universities are seeing an increased need for ways to help students cope with pressures they face. One method could be through using multisensory environments (MSEs) as an opportunity for students to self-regulate.

This research was intended to expand on well-documented theories that environments with nature-based elements (ART and Biophilia), which were user controlled (Ulrich's Theory of Supportive Environments) and had artistic installations (Receptive Arts Engagement) could reduce stress and anxiety. Through collaboration with the Department of Community and Therapeutic Recreation and the Stantec Innovation Partnership grant from the Interior Design Educators Council, a permanent space for such an environment was identified and equipped with some of the popular sensory features being used. The room was designed using elements with researched beneficial properties and installed in the Ferguson Building at UNC-Greensboro. The grant went towards the design, furnishings, and finishing the space. A study was conducted with 19 students between the Summer and Fall semesters, and a digital questionnaire was administered, followed by a verbal interview.

Students identified their current coping strategies, their favorite and least favorite elements in the room, and many stated they enjoyed the space and felt better afterwards during the qualitative interview. However, the quantitative data showed no statistically relevant correlation. This could be due to multiple factors such as the timing of the study, the lack of availability of participants, and the scales used. There was enough qualitative evidence provided by participants to justify further investigation.

THE INFLUENCE OF MULTISENSORY ENVIRONMENTS ON COLLEGE  
STUDENTS' PERCEIVED ANXIETY AND STRESS

by

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## TABLE OF CONTENTS

LIST OF TABLES .....	v
LIST OF FIGURES .....	vi
CHAPTER I: INTRODUCTION .....	1
CHAPTER II: LITERATURE REVIEW .....	6
College Students and Stress, Anxiety, and Depression .....	6
Methods of Coping .....	8
Theories .....	10
Biophilia .....	12
Ulrich's Theory of Supportive Design .....	14
Receptive Arts Engagement .....	16
Research on the Senses .....	17
The Sense of Sight .....	19
The Sense of Touch .....	19
The Sense of Hearing .....	21
The Sense of Smell .....	22
Sensory Integration .....	22
Generalized Anxiety Disorder (GAD-7) .....	24
Perceived Stress Survey (PSS-10) .....	24
Conclusion .....	25
CHAPTER III: METHODOLOGY .....	26
Background Interviews .....	26
Participants .....	28
Study Location .....	28
Design of MSE .....	29
Procedure .....	39
CHAPTER IV: FINDINGS .....	40
Research Questions .....	40
Research Question 1 .....	40

Research Question 2 .....	42
Research Question 3 .....	44
Interview Questions.....	44
CHAPTER V: DISCUSSION AND CONCLUSIONS .....	47
Limitations.....	49
REFERENCES.....	52
APPENDIX A: PRE-TEST.....	59
APPENDIX B: POST-TEST.....	66
APPENDIX C: INTERVIEW QUESTIONS.....	71

## LIST OF TABLES

Table 1. ART, Biophilia, Receptive Arts and Ulrich's Theory Comparison .....	10
Table 2. Informational Interviews .....	27
Table 3. Room Elements by Theory .....	31
Table 4. Paired Samples Statistics.....	40

## LIST OF FIGURES

Figure 1. Ferguson 249 Original Space .....	29
Figure 2. Room Design by Sense .....	30
Figure 3. Window Covering Incorporating Nature Imagery .....	355
Figure 4. Abstract Floral Wall Mural .....	355
Figure 5. Tactile Pillows and Weighted Gorilla.....	355
Figure 6. Tactile Wall Hanging .....	356
Figure 7. View of Space from Hallway Entrance .....	37
Figure 8. View of Space from Classroom Entrance .....	37
Figure 9. View of Space with Lights On .....	38
Figure 10. Current Coping Strategies .....	43

## CHAPTER I: INTRODUCTION

Student stress and anxiety are at an all-time high (Wang et al., 2020). For many students, college can be a challenging time because many are overseeing their own lives for the first time. There are expectations from family, friends, and themselves, and they are in an unfamiliar environment surrounded by people who may not share a similar background (CNN, 2021). In addition, students recently have had to deal with several issues including the COVID pandemic, racial tensions, and a growing political chasm between right and left which may affect their personal relationships on a significant level (CNN, 2021). Even before the COVID pandemic, stress was a major issue with 65.7% of college students reporting having “overwhelming anxiety” (Hoyt et al., 2021). Prior to COVID, depression, anxiety, and stress were significant concerns for those who live or work with college students. After COVID hit, COVID-19 became even more alarming. According to a Boston University study, anxiety has reached the highest levels on record, with half of the students screening positive for depression or anxiety (McAlpine, 2021). A recent analysis suggests that depression and anxiety levels have doubled in young people compared to pre-pandemic levels (CNN, 2021). The most alarming statistic: suicide is the second leading cause of death among college students (College Students and Depression, 2021).

Unmanaged stress and anxiety can lead to several problematic issues such as poor academic achievement, substance abuse, sleep difficulties, burnout, dropping out, and even health and employment issues later in life (Pascoe et al., 2020). Teachers may notice students with stress and anxiety have decreased motivation and engagement (Turrell et al., 2006). Giving



students the tools and skills to manage stress and anxiety can have a lifelong benefit since most long-term health habits are established in adolescence and early adulthood (Sawyer et al., 2012).

Colleges and universities have seen the need to help students cope with the stressors that are affecting them. Programs addressing mental health, student wellness, and stress management have proliferated (Brown, 2018). Counseling centers have expanded options and introduced new ways for students to seek help. Some of these methods include online counseling, phone counseling, apps designed to help students relax, and bringing in companion animals to reduce anxiety, depression, and stress (Svrluga & Anderson, 2021). According to a survey conducted by the American College Health Association in 2022, 51.2% of college students reported moderate psychological distress, while 21.2% reported serious psychological distress. Psychological distress is defined as exhibiting symptoms of depression, anxiety, and psychological stress (Burnette et al., 2020). Anxiety and stress can affect students' ability to concentrate, their social interactions, and their desire to succeed (Son et al., 2020). According to the Center for Collegiate Mental Health (2022), anxiety continues to be the most common concern reported by students at college counseling centers. Stress was the second followed by depression.

The unprecedented levels of stress and anxiety and the lifestyle changes forced by COVID-19 have exacerbated an already eroding confidence in higher education (Fischer, 2022). Dramatic shifts in both the approach and environment of college instruction are necessary to address the needs of today's students. It has been well-documented that the built environment can significantly impact the well-being of inhabitants. In fact, according to a review of multiple studies conducted in 2010, "The built environment can be considered a foundation for health and wellness" (Renalds, et al. 2010 p.68). Interior designers have an obligation to improve built

environment conditions whenever possible – particularly when a specific population has been so significantly impacted by outside factors.

The purpose of this research project is to redesign an existing university space into a multisensory environment and to explore if such an environment could reduce students perceived stress and anxiety.

The target population for this study is traditional-aged full-time college students at UNC-Greensboro. Traditional-aged college students fall between the ages of 18 – 24 (Encyclopedia of Education Economics and Finance, 2014). Students in this age range fall into the generational cohort known as “Generation Z”. The pandemic has been especially stressful for this age group. Of Generation Z students surveyed, 35% said they frequently experience stress and 46% said they experience it sometimes (Associated Press, 2021). The cost of higher education, lower levels of life skills, being away from home for the first time, and returning to the classroom has added to anxiety and stress. A recent study revealed about 43% of four-year college students and close to half of community college students suffered from at least one mental health issue such as anxiety (Eisenberg et al., 2016). Anxiety and stress can affect students’ ability to concentrate, their social interactions, and their desire to succeed (Son et al., 2020).

Multisensory environments (MSEs) have been used since the 1970s to provide stimulation and interaction to individuals suffering from a variety of mental disorders (Grace, 2020). Some universities are now offering these rooms to help students relax. The trend appears to have been started by Adelphi University in New York (Weintraub, 2020). MSEs have also been installed in high-pressure office buildings, stadiums, schools, hospitals, long-term care centers, and therapist offices, among others (D. Troller, personal communication, February 25, 2022). A typical MSE might include twinkle lights, a bubble tube, a sound machine or music

with headphones, a projector, bean bag chairs, fidget toys, and books. There is usually a dimmable light source so that personal lighting preferences can be accommodated (Sensory Rooms in Mental Health, 2017). UNC-Greensboro received a grant of \$500 to create a sensory space for students. The space is located within Elliott University Center and was sponsored by the Office of Accessibility, Resources, and Services. A room that was being used for storage was converted into the space, but no changes were made in terms of layout, finishes, or lighting. The space includes a variety of seating and sensory activities. The overhead lighting is not used and lamps from storage that were dimmable were repurposed for the space. For ambiance, there are twinkle lights behind sheer panels, natural scenes, and nature sounds playing on a large flat-screen TV (T. Vires, personal communication, March 22, 2022).

An increasing number of colleges and universities are providing sensory spaces for student respite. Vendors of sensory elements revealed that they do not have any experience with mostly healthy adult populations (D. Troller, personal communication, February 25, 2022). In 2020 a study investigated the effect a multisensory environment might have on stressed college students in Australia. The environment featured natural sensory items and "passive" play elements. The main takeaway from the study was this: carefully curating a multisensory environment can not only increase the effectiveness of such a space in reducing stress and anxiety but also increase usage (Cavanagh et al., 2020).

Theories referenced in the design of the space for this thesis included Attention Restorative Theory, Biophilia, Ulrich's Theory of Supported Design, and Receptive Arts Engagement. Attention Restorative Theory (ART) was introduced by Stephen Kaplan in 1995 (Kaplan, 1995) and is strongly tied to elements found in the natural environment. He posits that ART provides ways to analyze how the brain can recover from attention fatigue (Kaplan, 1995).

Stressful situations with no relief cause attention fatigue which can have a negative impact on mental health. Biophilia is the inherent human inclination to affiliate with nature that even in the modern world continues to be critical to people's physical and mental health and well-being (Wilson 1986). It is connected to ART through the use of natural elements in the environment. Several factors play into the theory of biophilia, including light, water, plants, animals, weather, natural landscapes, and fire. Other things that fall under biophilia include the use of natural colors, air movement, natural shapes and forms (usually curvilinear), and imagined or abstract representations of nature (Kellert & Calabrese, 2015). While mainly referenced in hospital room design, Ulrich's Theory of Supported Design is useful in evaluating environments for mentally supportive elements. According to this theory, important aspects of design include perception of control, social support, and positive distraction (Andrade & Devlin, 2015) in addition to exposure to natural materials, views and shapes. Investigation into the role of the arts in promoting health and well-being has grown substantially in the last few years (Tymoszuk et al., 2021). Here too, images of or implying natural elements contribute to the ability of art to decrease stress and anxiety.

In order to provide the support students need to succeed in college, administrators must find ways to creatively help students deal with stress, depression, and anxiety. The multisensory environment has shown great promise in reducing perceived stress and anxiety in neurodiverse populations. The results of this study may help provide administrators with the data they need to support offering more of these environments on campus.

## CHAPTER II: LITERATURE REVIEW

This chapter is an overview of available literature on college students and stress, the theories used in this study, research into multisensory input, and the depression and anxiety scales used in this study.

### **College Students and Stress, Anxiety, and Depression**

Between the ages of 18 and 24, young people are still experiencing rapid brain development which puts them at increased risk of influence from outside stressors (Paus, 2008). College years can be one of the most stressful periods (Cress & Lampman, 2007) as students become adults. This can require self-reflection, evaluation of opportunities, a need for stability, and taking on levels of responsibility that are unfamiliar, and at times overwhelming (Arnett, 2004). The cost of higher education, lower levels of life skills, being away from home for the first time, and returning to the classroom after COVID have added to anxiety and depression. Anxiety and depression can lead to poor performance, lack of motivation, lack of interest in activities, and isolation, thus fueling a downward spiral (Druckenmiller, 2022).

Depression has long been a concern for college administrators (Sharkin, 2006). Depression is described as sadness and a lack of interest in activities (APA, 2021). It is important to note that sometimes people can “feel depressed” without having a mental illness (Tweten, 2017). In addition to the psychological damage stress and anxiety cause, depressed students are two times more likely to discontinue college enrollment (Arria et al., 2013). Anxiety is experienced as dread or fear of a future event (APA, 2021). Stress is how our bodies respond to external pressure – mental or physical (Yarp, 2021). In research, these terms are often grouped such as depression/stress, stress/anxiety, or depression/anxiety, and sometimes they are used interchangeably. This can cause confusion since these three terms are closely linked. Student

stress and anxiety are at an all-time high (Wang et al., 2020). Anxiety is the most common diagnosis given to students who seek support at college counseling centers (Son et al., 2020). Depression, anxiety, and stress can affect students' ability to concentrate, their social interactions, and their desire to succeed (Son et al., 2020). As a result, universities are providing more ways for students to destress and reduce anxiety.

A recent study revealed about 43% of four-year college students and close to half of community college students suffered from at least one mental health issue such as depression or anxiety (Eisenberg et al., 2016). According to a Boston University study, depression has reached the highest levels on record, with half of the students screening positive for depression or anxiety (McAlpine, 2021). Students who suffer from mental health conditions have an increased risk of attempting suicide or injuring themselves (Taliaferro & Muehlenkamp, 2015). Many universities are experiencing unprecedented levels of suicide. Among 18 -22-year-olds, about 25% had seriously considered suicide in 2020, according to the CDC (CNN, 2021). The University of North Carolina at Chapel Hill canceled classes on October 12, 2021, to provide a respite to grieving students. Two classmates had attempted suicide over the weekend, and university officials provided pop-up counseling centers for students to seek help. In addition, residents brought in baby goats and dogs, handed out motivational notes, and offered cookies and hugs to students (Svrluga and Anderson, 2021).

The pandemic has been especially difficult for students. A survey conducted by Active Minds in 2020 found that 80% of college students reported that COVID-19 negatively impacted their mental health (Active Minds' Student Mental Health Survey - Active Minds, 2020). According to Sheri Madigan, the author of a study on pandemic-related issues, Even after two years, Gen Z still points to the pandemic as a major stressor in their lives. Of Gen Z students

surveyed, 35% said they frequently experience stress and 46% said they experience it sometimes (APA, 2021). According to a survey conducted by the American College Health Association (ACHA) in 2020, 41.6% of college students reported feeling hopeless, while 38.2% reported feeling so depressed that it was difficult to function. The same survey found that 64.5% of students reported overwhelming anxiety in the past year and that 20.4% of students reported that depression negatively impacted their academic performance, while 21.5% reported the same for anxiety.

Campuses across the country have called for better mental health resources as students try to combat this epidemic. Despite the need for mental health support, several barriers exist for college students seeking treatment. These include limited access to mental health resources, the stigma surrounding mental health, and concerns about cost and confidentiality (Eisenberg et al., 2013).

Given the importance of the personal well-being of college students, higher education professionals have an opportunity to support and advocate for the mental and emotional health of students at an especially vulnerable point in their lives. Higher education professionals also have an opportunity to provide psychological and social resources to students, which can change their experiences with stress. Academic performance and the ability to complete tasks can be negatively affected by stress and depression, and an instructor might be the first to see this type of behavior (Boals & Banks, 2020).

### **Methods of Coping**

Students have developed a broad range of coping mechanisms to deal with the stress and anxiety they experience – some positive and some negative. Having a structured schedule for studying, sleeping, exercising, and engaging in enjoyable activities has been found to be a

beneficial method for managing stress and anxiety (Sibley et al., 2021). Students have turned to online platforms, virtual support groups, and mental health resources to seek guidance and connect with others who are experiencing similar challenges, which can provide a sense of belonging, and empathy (Lattie et al., 2020). Engaging in self-care activities such as hobbies, practicing mindfulness, taking breaks, and practicing self-compassion promotes relaxation, stress reduction, and improved well-being (Doré et al., 2020). Students have increasingly utilized teletherapy and remote counseling services to access professional mental health support (Lee et al., 2021). Maintaining social connections with friends, classmates, and family members through video calls, social media, and online platforms has also been a crucial coping mechanism. Virtual social interactions help combat feelings of isolation and promote a sense of community (Feinstein et al., 2021).

Negative coping mechanisms include alcohol and drug use, oversleeping, addiction to social media, emotional eating, procrastination, and ignoring the news and things going on around them (Son et al., 2020). Studies have shown a rise in substance use among college students since COVID-19, which can worsen mental health outcomes (Wang et al., 2020). While technology can be a valuable tool for connection, excessive use has been associated with increased anxiety, depression, and feelings of isolation (Banskota et al., 2020). Stress and anxiety have led some students to emotional eating and a shift towards unhealthy eating habits. Research suggests that emotional eating is associated with higher levels of depressive symptoms and poor mental health outcomes (Ogden et al., 2020). Some students may resort to avoidance and procrastination in response to the challenges posed by the pandemic. Delaying tasks and avoiding responsibilities can contribute to increased stress, anxiety, and a cycle of negative emotions (McCabe et al., 2020). One of the most alarming statistics reports that students



overwhelmingly opted to self-manage rather than see a professional for assistance managing their mental health issues (Son et al., 2020). In the academic year 2020 – 2021, there were significant declines in counseling center use (Center for Collegiate Mental Health, 2022).

While the pandemic episode of 2020 is now mostly resolved, the impact it had on student mental health is still evolving. While many studies show that students are more depressed, stressed, and anxious than ever before, researchers are still trying to identify substantiated ways to help reduce these negative influences in college students (Salimi et al., 2023).

### Theories

In design and psychology, there are several theories suggesting ways the built environment can have a positive impact on mental health and well-being. Studies referenced in this study included Attention Restoration Theory (ART), Biophilia, Ulrich’s Theory of Supportive Design, and Receptive Arts Engagement.

**Table 1. ART, Biophilia, Receptive Arts and Ulrich’s Theory Comparison**

	ART	Biophilia	Ulrich	Receptive Arts
Natural Patterns	Yes	Yes	Yes	Yes
Natural Materials	Yes	Yes	Yes	Yes
Natural Sounds	Yes	Yes	Yes	Yes
Natural Images	Yes	Yes	Yes	Yes
Nature	Yes	Yes	Yes	Yes
Sensory Stimulation	Yes	Yes	Yes	Yes
Attention	Yes	Yes	No	Yes
Familiarity	Yes	No	No	Yes
Control	Yes	No	Yes	Yes
Privacy	Yes	No	No	Yes

Shared Art				
Perform Arts				
Music				
Visual Arts				

Attention Restoration Theory (ART) was introduced by Stephen Kaplan in 1995 to provide ways to analyze how the brain can recover from Attention Fatigue (Kaplan, 1995). Stressful situations with no relief cause attention fatigue which can have a negative impact on mental health. ART has four stages and four key components. The first stage is characterized by a clearing of the mind. The concerns you are feeling begin to dissipate and fade away. The second stage is mental fatigue recovery which allows the mind to recharge and recover. The third stage provides a gentle distraction called soft fascination which quiets internal chatter and allows one to relax. In the final stage, the individual can relax, recover attention, and reflect (Han, 2003). The first component is to “be away” is to be detached from your present concerns, and to turn away from the things that are draining your attention and energy. The second component is fascination, which can be hard or soft. Hard fascination is when one’s attention is held by a highly stimulating activity. Soft fascination is when one’s attention is held by an activity that does not require mental exertion and allows for reflection. Extent, the third component, means the environment does not have any unusual or unexpected features, and you feel comfortable and at ease in the environment. Lastly, compatibility is about enjoying your environment. To be considered restorative, an environment must be one that the individual will choose to visit out of personal desire (Daniel, 2014).

Even with several stages involved, recent research has shown that micro-exposure can provide the ART benefit of boosting attention and mood (Lee et al., 2015). In this study, the

researchers found that even very brief exposures to nature could provide a cognitive break and aid in restoring attention. The study involved college psychology students who engaged in a demanding cognitive task. They were given intermittent breaks that involved either viewing a green roof scene for 40 seconds or looking at a concrete roof scene. The instruments used were the Perceived Restorativeness Scale and the Sustained Attention to Response Task. The results indicated that participants who viewed the green roof scene experienced better attention restoration and cognitive functioning compared to those who looked at the concrete roof scene. This aligns with the principles of Attention Restoration Theory and highlights the potential benefits of incorporating natural elements into built environments to enhance cognitive well-being. While ART has close associations with the natural environment, it is interesting to note that “perceived greenness” can also affect students’ self-evaluation of perceived restoration (Hipp et al., 2016).

### **Biophilia**

Biophilia is the inherent human inclination to gravitate towards nature that even in the modern world continues to be critical to people’s physical and mental health and well-being (Wilson, 1984). It is connected to ART, Ulrich’s Theory, and Receptive Arts Engagement through the use of natural elements in the environment. Incorporating biophilic elements in the built environment, such as natural light, greenery, water, plants, animals, weather, natural landscapes, fire, and natural materials has been shown to have positive effects on human well-being. Other design elements that fall under Biophilia include the use of natural colors, air movement, natural shapes, and forms (usually curvilinear), and imagined or abstract representations of nature (Kellert & Calabrese, 2015). Exposure to natural elements, such as views of nature or indoor plants, has been found to reduce physiological and psychological stress

responses. Studies have shown that biophilia in the built environment, such as green spaces or nature-inspired designs, can lead to decreased stress levels and improved well-being. Biophilia has also been associated with enhanced cognitive performance and attention restoration. It can improve concentration, memory, and overall cognitive function.

In a study conducted by Berman, Jonides, and Kaplan (2008), the researchers explored the cognitive benefits of engaging with nature. They aimed to investigate how interactions with natural environments could impact cognitive functioning. Using a combination of field experiments and cognitive assessments, the researchers examined how exposure to natural settings could affect cognitive processes such as attention and memory. They conducted experiments where participants were exposed to either natural or urban environments and then assessed their cognitive performance. The results of the study indicated that interacting with nature had positive effects on cognitive functioning. Participants who were exposed to natural environments showed improvements in attention and memory compared to those who were in urban environments. The findings suggested that spending time in nature could have a rejuvenating effect on cognitive abilities. A similar study examined the cognitive advantages of engaging with natural environments (source, year). The researchers aimed to understand how exposure to nature can impact cognitive performance and whether interacting with nature could lead to improvements in attention and memory. The study involved two experiments. In the first experiment, participants took a walk in either a natural setting or an urban environment and then completed a cognitive task. The results showed that individuals who walked in nature demonstrated improved performance on tasks requiring attention and short-term memory compared to those who walked in an urban environment. In the second experiment, participants engaged in a cognitive task that required directed attention, followed by a walk in either a natural

or an urban setting. Participants who walked in nature performed better on a subsequent task that demanded focused attention compared to those who walked in an urban environment. The findings of this study suggest that interacting with nature can have positive effects on cognitive function, particularly attention and working memory. Exposure to natural environments appears to provide a cognitive benefit, potentially due to the restorative qualities of nature that allow for a reprieve from directed attention fatigue (Lee et al., 2015).

Biophilic design elements can promote productivity and creativity in various settings and have been associated with higher productivity levels and increased creative thinking. In a study by Nieuwenhuis, Knight, Postmes, and Haslam (2014), the researchers conducted three field experiments to investigate the effects of office workspace environments on employees' well-being, productivity, and overall work experiences. They specifically compared "green" office spaces (those enriched with plants and natural elements) to "lean" office spaces (minimalistic and functional designs). The experiments were conducted in real office settings, and the participants were employees from various organizations. In each experiment, different aspects of employee experiences were measured, including well-being, perceived productivity, job satisfaction, and perceived air quality. The results of the study revealed that employees who worked in green office spaces reported higher levels of well-being, job satisfaction, and perceived air quality compared to those in lean office spaces. Additionally, participants in the green office environments also reported marginally higher levels of perceived productivity. People report higher levels of overall happiness and life satisfaction when exposed to natural elements and biophilic design (Joye, 2007).

### **Ulrich's Theory of Supportive Design**

Ulrich's Theory of Supportive Design, proposed by Roger Ulrich, suggests that the design of physical environments can have a significant impact on individuals' mental well-being and overall health (Ulrich, 1984). By incorporating elements such as nature, privacy and control, social support, psychological comfort, and sensory stimulation, designers can create environments that positively influence mental well-being. Like ART and Biophilia, Ulrich's theory emphasizes the importance of incorporating elements of nature into the built environment, such as views of nature, indoor plants, and natural materials (Ulrich, 1984). Supportive environments also offer individuals a sense of privacy and control over their surroundings. Design elements that allow for personalization, privacy screens, adjustable lighting, and temperature control can contribute to a sense of autonomy and well-being (Ulrich, 1991). Supportive environments also provide appropriate sensory stimulation including factors such as lighting quality, visual interest, textures, and aromas. Andrade and Devlin's study (2015) examined the impact of Ulrich's theory of supportive design on stress reduction in hospital rooms. The participants were 217 students from Portugal and the United States. The research demonstrated that incorporating design elements inspired by this theory, such as nature views and personalized items, can lead to decreased patient stress levels, supporting the idea that well-designed environments have the potential to positively influence patients' well-being. They conducted an experiment where patients were assigned to either a room with these supportive design elements or a room without them. The findings supported the hypothesis, showing that patients in rooms with supportive design elements experienced greater reductions in stress compared to those in rooms lacking these elements. The presence of natural views, artwork, and personal items seemed to create a more calming and positive environment for patients, aligning

with Ulrich's theory that thoughtful design can positively impact well-being (Andrade & Devlin, 2015).

### **Receptive Arts Engagement**

Receptive arts engagement refers to the act of actively experiencing various art forms, such as visual arts, music, dance, theater, literature, and film. Receptive arts engagement allows individuals to explore their emotions through art forms, leading to increased emotional well-being. It provides an outlet for self-expression and a means to process and understand complex emotions (Stuckey & Nobel, 2010). These experiences can encourage individuals to explore their own identities, values, and perspectives, and lead to personal insights and self-awareness (Stuckey & Nobel, 2010). Engaging with art can promote relaxation, reduce stress, and induce a sense of calm and tranquility. As well as, fostering social connections, empathy, and a sense of belonging (Clift & Camic, 2016). Immersion in art forms such as listening to soothing music, viewing nature paintings, or participating in mindful art activities has been found to have therapeutic benefits (Fancourt & Finn, 2019). Receptive arts engagement stimulates cognitive processes such as attention, perception, memory, and creativity. It can enhance cognitive functioning, problem-solving abilities, and critical thinking skills (Zatorre et al., 2007). Investigation into the role of the arts in promoting health and well-being has grown substantially in the last few years (Tymoszuk et al., 2021).

In 2020 a qualitative study applied the theory of receptive arts engagement and was conducted using 18 college students in Australia (Cavanagh et al., 2020). The environment featured natural sensory items (ART), artistic elements, and "passive" play elements. Participants spent 20 minutes in a curated sensory environment, then participated in structured interviews with the researcher. The objective of the study was to identify the design elements that increased

the participants' engagement and enhanced their experience of spending time in an artistically designed multisensory environment. Data was analyzed thematically and analysis was inductive and data-driven. Overriding themes noted by the students included: "Whole thing together"- meaning that all the elements worked with and complemented each other. "Immersive"- engaged multiple senses for maximum effect. "Balance"- no one element dominated the environment, and all the elements were balanced in importance. "Natural" - elements had the appearance or feel of nature. "Darkness"- testers indicated this feature gave the space a sense of calm and mystery. The darkness made the space seem larger because the actual distance to each boundary was unclear. "Variation"- each visitor could choose and control what aspects of the environment they experienced, and to what degree. "Different levels of experience"- there were multiple seating options at various heights, each giving a different perspective of the room. Lastly, "touch"- there was a variety of tactile elements that invited the testers to touch and appreciate the textures in the environment (Cavanagh et al., 2020).

### **Research on the Senses**

A sense is a physical characteristic that allows us to perceive data from external sources (Lou, 2015). Children learn that we have five senses: Sight (vision), hearing (audition), taste (gustation), smell (olfaction), and touch (somatosensation). We can interpret information outside these 5 senses, including temperature (thermoception), kinesthetic sense (proprioception), pain (nociception), balance (equilibrioception), and vibration (mechanoreception) (Spence, 2020). Regardless of the number of senses, each sense tends to operate in tandem with other senses rather than each operating independently of one another. We do not form an impression based on one sense at a time. Our brains assimilate information from all the senses before making a judgment. The senses work together and influence each other (Shukla, 2020).



Using this information, architecture has the potential to drastically increase (or decrease) our quality of life. Most people spend around 95% of their lives inside (Spence, 2020). Yet architects and interior designers have largely failed to incorporate all the senses (Spence, 2020). While sight and sound are largely addressed, touch is only beginning to be incorporated, and smell is often neglected. Charles Spence is a recognized expert on multisensory environments, and he believes that our interiors have the potential to elevate our existence:

Ultimately, the hope is that such a multisensory approach, in transitioning from the laboratory to the real-world application domain of architectural design practice, will lead to the development of buildings and urban spaces that do a better job of promoting our social, cognitive, and emotional development, rather than hindering it, as has too often been the case previously. (2020, p. 1)

While there has been talk about incorporating multisensory feedback into the design process of the built environment (Dal Palù et al., 2018), very little research exists. The research that does exist tends to focus on each sense individually, rather than multiple senses working together. Therefore, in some ways, we know that multisensory environments work. We just do not know how. Pairs of sensory effects such as tactile/visual, tactile/auditory, and visual/auditory signals are being examined (Jakesch et al., 2011). There is a lack of research into how our experiences, tastes, demo/psychographic data, etc. influence the way we process multisensory information. This is likely because the variables in that study would be astronomical and difficult to analyze.

It is commonly known that our environment affects the way we feel and behave. It is also well-documented that our bodies and our minds are inextricably linked. Engaging all the senses in an environment can improve cognitive engagement (Bosch, 2021).

## **The Sense of Sight**

Sight is regarded as the most dominant of the senses and it significantly influences our experiences and perceptions of the built environment, providing the most significant amount of sensory input and shaping our understanding of the world around us. We rely heavily on visual cues for navigation, spatial awareness, and gathering information about our environment (Pallasmaa, 2005). Visual elements are used to create ambiance, evoke emotions, communicate style, and enhance the overall visual appeal of a space (Hershberger, 2016). Visual cues, such as the size, scale, and arrangement of objects, help us navigate and comprehend the spatial layout of a built environment (Ching et al., 2014). Lighting design is a critical component of interior design and architecture, and it primarily focuses on the visual experience of a space. Proper lighting enhances visibility, accentuates architectural features, and creates a specific atmosphere or mood (Karlen et al., 2017). Dim lighting has been shown to increase creativity, while bright lighting has been shown to increase productivity but reduces the ability to create new ideas. While interior design and architecture also consider other senses such as touch, sound, and smell, these elements often serve to complement and enhance the visual experience.

## **The Sense of Touch**

“To touch can be to give life” Michelangelo (Keltner, 2010).

Touch is thought to be the first sense that humans develop (Fulkerson, 2020). It consists of several distinct feelings transmitted by nerves in the skin. Just as the eyes are the organ associated with sight and ears are associated with hearing, the skin is the primary organ concerned with touch. The sensations associated with touch include temperature (thermoception), kinesthetic sense- or the knowledge of the location of the body (proprioception), pain (nociception), vibration (mechanoreception), and haptic sense (the ability

to feel something using an object such as a stick or shovel) (Spence, 2020). In addition to being one of the primary ways humans interact with their environment, touch is critical for our socialization, interactions with others, and our general state of well-being. For example, touch has been found to convey compassion, build trust, signify safety, and even reduce pain (Keltner, 2010).

Touch has been studied across multidisciplinary fields, for a multitude of reasons. Marketers and engineers want to know what tactile design features will create a favorable brand impression. Neuroscientists want to know how our brain integrates touch with the other senses. Psychologists want to know how much of an impact our past experiences and demographic/psychographic characteristics factor on our preferences for one texture over another. Architects and interior architects want to know what features and materials can have a positive effect on the well-being of building inhabitants (Erwine, 2017). However, the materials being used for these studies are often generic and not specific to the built environment. For example, one study used different grits of sandpaper (Bergmann & Kappers, 2007), while one study used a plastic substance with various levels of roughness (Choi & Jun, 2007). This study involved participants who were asked to interact with surfaces of varying roughness. Participants were then asked to describe their tactile experiences and emotions associated with each surface. The researchers collected and analyzed the participants' responses to identify patterns and correlations between surface roughness, tactile perceptions, and emotional responses.

The findings of the study reveal relationships between the tactile sensations induced by different surface roughness levels and the emotional responses of participants. In summary, the research explored how different levels of roughness evoke emotional and sensory responses, contributing to a deeper understanding of the connections between touch, emotions, and material

qualities. What does seem clear is that most of us prefer smooth textures over rough, natural materials over synthetic, and softness over abrasiveness (Etzi et al., 2016). There is a caveat...positioning these textures juxtaposed against their opposites increases the amount of favor of the user (Erwine, 2017).

### **The Sense of Hearing**

Hearing plays a crucial role in affecting our comfort, cognitive functioning, and emotional state. Exposure to excessive noise levels in the built environment can lead to stress, annoyance, and negative health effects (Stansfeld & Matheson, 2003). Jahncke, Hygge, Halin, Green, and Dimberg (2011) investigated the impact of open-plan office noise on cognitive performance and restoration. The researchers focused on how noise in open-plan office environments affects individuals' cognitive abilities and their ability to mentally recover or restore their attention. They found that exposure to noise in such settings negatively influences cognitive performance, leading to decreased concentration, memory, and problem-solving abilities. In a study by Kang and Zhang (2010) regarding the restoration effects of natural environments on college students, the findings related to sound suggest that exposure to natural settings has a positive impact on students' mental restoration. Spending time in natural environments, which are characterized by natural sounds such as rustling leaves, birdsong, and flowing water, contributes to reducing stress and mental fatigue among college students. The soothing sounds of nature appear to promote relaxation and psychological rejuvenation, indicating that natural soundscapes play a role in enhancing students' overall well-being and mental state. Research has shown that exposure to certain sounds, such as natural or instrumental music, can positively impact mood and decrease stress levels. Kaplan's groundbreaking work (1995) highlights how natural environments, particularly those with water elements, can

facilitate stress reduction and recovery from mental fatigue. The soothing and predictable sounds of water are suggested to capture attention softly, allowing cognitive resources to replenish. Water features are theorized to induce a state of "soft fascination," promoting relaxation, stress recovery, and improved mood.

### **The Sense of Smell**

Scent can have a significant impact on our well-being by influencing our emotions, moods, and overall experiences (Damian & Damian, 1995). Pleasant scents can positively influence our mood, evoke positive emotions, and reduce stress and anxiety. Certain scents can trigger memory recall and improve cognitive performance, attention, and focus (Moss et al. 2008). Studies have demonstrated the stress-reducing effects of aromatherapy and the positive impact of certain scents on mood. A study by Gong, Dong, Tang, Huang, and Lu systematically reviewed multiple randomized controlled trials that investigated the effects of aromatherapy on anxiety. The study found that aromatherapy has a statistically significant positive effect in reducing anxiety levels. This suggests that the use of aromatherapy can contribute to lowering anxiety in individuals (Gong et al., 2020). Essential oils, such as lavender, chamomile, or citrus scents, have been shown to promote relaxation and decrease stress levels. Individual preferences for scents can vary, and some individuals may have sensitivities or allergies to certain fragrances. The preferences and potential sensitivities of the occupants should be considered when incorporating scents into the built environment.

### **Sensory Integration**

The sensory integration of the built environment plays a crucial role in contributing to overall well-being. A well-designed built environment offers a variety of sensory stimuli that engage and stimulate the senses, promoting cognitive engagement, curiosity, and interest. This

stimulation can enhance creativity, cognitive functioning, and overall satisfaction with the environment (Nasar & Julian, 1995) to reduce perceived levels of stress has been studied on pregnant women. In 2012, Staal, Shteyhfeld, Matheis, and Lopez explored the effects of multisensory behavior therapy through Snoezelen therapy sessions, on a pregnant woman experiencing depression and anxiety. The findings of the study suggest that Snoezelen therapy reduces levels of depression, stress and anxiety, potentially offered a complementary approach to addressing mental health concerns during pregnancy. Very little research exists using MSEs on college students. Some universities are now offering these rooms to help students relax. The trend appears to have been started by Adelphi University in New York in 2018. Stony Brook University, one of the State Universities of New York located on Staten Island implemented a MSE with the financial assistance of Adelphi University's "The Bridges to Adelphi Program"- an outreach program to bring multisensory environments to more campuses. Two rooms in the library at the University of Minnesota Duluth have been reassigned as multisensory environments (Weintraub, 2020).

A study done on the effects of a Snoezelen room on game-addicted college students showed that there is promise in this concept (Lim et al., 2021). In this study, the researchers focused on college students who were dealing with game addiction. The researchers utilized a pre-test and post-test design to evaluate the effects of Snoezelen therapy. Participants were divided into two groups, the study group and the control group. Sessions were 30 minutes two times a week for 18 sessions. The study group room included Snoezelen optical fibers, classical music, and a predetermined room temperature for visual, auditory, and temperature sensory input. The participants of the control group were assigned to the same room as the study group, but no sensory stimulation was provided. The study's findings indicates that the therapy

contributed to the reduction of stress, anxiety, and depression levels among college students struggling with game addiction.

### **Generalized Anxiety Disorder (GAD-7)**

The Generalized Anxiety Disorder 7 (GAD-7) is a self-report questionnaire developed by Spitzer et al. in 2006 that is commonly used by healthcare professionals to assess and screen for generalized anxiety disorder (GAD) in individuals. It consists of seven questions that ask about the frequency and severity of anxiety symptoms experienced over the past two weeks. The seven questions on the GAD-7 cover a range of symptoms associated with generalized anxiety disorder, including restlessness, excessive worry, difficulty controlling worry, irritability, muscle tension, sleep disturbances, and feeling on edge. Respondents rate each item on a scale from 0 to 3, with 0 representing "not at all" and 3 representing "nearly every day." The scores from these questions are then added together, with a total score ranging from 0 to 21.

Byrd-Bredbenner, Eck, and Quick (2021) aimed to assess the psychometric properties of three different versions of anxiety screening tools (GAD-7, GAD-2, and GAD-mini) among university students in the United States. The primary focus of the study was to evaluate the reliability and validity of three different anxiety assessment tools: the Generalized Anxiety Disorder 7 (GAD-7), the Generalized Anxiety Disorder 2 (GAD-2), and a shortened version called GAD-mini. A total of 823 students participated in the research. The findings suggest that these tools are effective for screening anxiety symptoms in this population and can assist healthcare professionals in assessing and monitoring anxiety levels among college students.

### **Perceived Stress Survey (PSS-10)**

The Perceived Stress Scale (PSS-10) is a self-report questionnaire designed to measure an individual's perception of stress. It was developed in 1983 by Cohen et al. and is one of the most

widely used tools for assessing perceived stress in research and clinical settings. The PSS-10 consists of 10 items that assess the extent to which a person finds their life situations unpredictable, uncontrollable, and overloaded during the past month. Respondents are asked to rate how often they have experienced specific thoughts and feelings related to stress on a 5-point Likert scale, ranging from 0 (never) to 4 (very often). The total score on the PSS-10 is calculated by summing the responses to all 10 items, with a higher score indicating a higher level of perceived stress.

A study conducted by Nielsen and Dammeyer in 2019 focused on evaluating the validity of the Perceived Stress Scale 10 (PSS-10) when applied to higher education students. The study involved 1,552 Danish university students. Results indicated that the PSS-10 is a reliable tool for measuring perceived stress among higher education students. Their use of Item Response Theory strengthened the evidence for the scale's suitability in assessing stress levels in this specific population, which can be valuable for research and interventions related to stress management in higher education settings.

### **Conclusion**

By designing multisensory environments that incorporate calming visual elements, relaxing sounds, aromatherapy, tactile experiences, and mindfulness aspects, colleges can provide students with supportive and stress-reducing environments that enhance their well-being and help manage stress and anxiety levels.



## CHAPTER III: METHODOLOGY

This chapter details the process by which this study was constructed to explore if sensory rooms have the potential to reduce perceived stress and anxiety in college students. The first section discusses the interviews with subject matter experts. The second section discusses the participants - why they were chosen and how they were recruited. The third section discusses the design of the MSE and implementation of sensory features. The final section discusses the instruments for data collection and study procedures.

The purpose of this project was to redesign an existing space into a MSE and to provide data supporting or detracting from research that suggests such an environment could reduce perceived stress and anxiety in otherwise healthy college students.

### **Background Interviews**

The research for this study began with informational interviews with experts from within and outside of UNCG (Table 2). Outside consultations included Sarah Alverson with the Durham Public Library, which currently has a sensory room for public use, Kaitlyn Phelps with Vines Architecture who has designed sensory spaces for higher education, and D. Troller a sales consultant for Flaghouse, the “official provider” of Snoezelen room furnishings. Inside UNC-G, discussions were initiated with Tina Vires, head of OARS, and the person responsible for the first sensory room on campus, Kristen Norden with the Counseling Center who works with students experiencing stress and anxiety, Joan Sutton with the Department of Community and Therapeutic Recreation, and Benjamin Hickerson, head of the CTR. Additionally, information was obtained from Facilities Design and Construction.

**Table 2. Informational Interviews**

Person Interviewed	Title, Affiliation	Conclusions and Results
Tina Vires	Director, UNC-G Office of Accessibility Resources & Services	There is a need for these spaces on campus. OARS used (limited) funding to create the current space in the Elliot University Center (EUC). Visitors have indicated the room has a calming effect, even though sensory elements are limited. Note – October 2022: The space will be moving to a larger space in the EUC – indicating success with the prototype.
Sarah Alverson	Community Engagement Administrator, Durham Public Library	Sarah trained with the original Snoezelen group. She provided information about the Durham Public Library sensory space and shared training manuals and videos for Snoezelen rooms.
Kaitlan Phelps	Designer, Vines Architecture	Kaitlan has worked on several projects that incorporated sensory spaces. She provided information on design considerations and offered to let us borrow a sensory deprivation chair.
Kristen Norden	Student Counselor and Outreach Coordinator, UNCG Student Health Services	Kristen provided information on current statistics about students and depression, stress, and anxiety. She shared that the university was overwhelmed and needed additional methods to help students cope. She discussed some of the workshops and methods currently recommended by Student Health Services, and offered to refer students to the study.
Joan Sutton	AP Assistant Professor- Clinical Fieldwork Supervisor, UNC-G Department of Community and Recreational Therapy	Joan has experience using sensory spaces. She indicated an interest in the study and said she believed that more could be done with sensory spaces. She gave great suggestions for incorporating scents into a sensory space that address the individual control aspect. She approached her department about my study, and we now have a space in their department for our sensory space that will be permanent.
Diana Troller	Sensory Sales Consultant with Flaghouse – official “Snoezelen” supplier.	Diana explained that most of the research done by Flaghouse was on neurodivergent populations. She indicated that there wasn’t much research done on each element – it was more of a trial-and-error process. She also shared that the market was expanding to include places that have high levels of stimulation and offices where high-stress jobs are located.
Benjamin Hickerson	Associate Professor, Interim Chair Community and Therapeutic Rec	Dr. Hickerson approved the project and offered support and advice during the installation of the room elements. He also posted study information on the department website which resulted in several student volunteers from the Departments of Community and Therapeutic Recreation, Psychology, and Nursing.

## **Participants**

Participants were current UNC-Greensboro students selected by a convenience method. There was no age limit, and participants included both undergraduates and graduate students. Methods of recruitment included a notice posted on the Department of Community and Therapeutic Recreation's Instagram page, emails sent to all Interior Architecture students and LinkedIn instant messages to some students in the Department of Interior Architecture, and word of mouth. Participants were told the purpose of the study, what they would experience, how long they would be needed, and what type of questions they would be asked. They signed up via a Google document link posted in the announcement and messages. The study was conducted at UNC-Greensboro. UNC-G is recognized as a culturally and racially diverse campus. Sixty-six and one-half percent of students are female and 33.5% are male. Sixty-nine percent of UNC-G students indicated some mental/ behavioral health diagnosis (Healthy Minds Survey, 2022). Nineteen students participated in the study.

## **Study Location**

Figure 2 shows Room 249 of the Ferguson Building, at UNC-Greensboro, which was selected for the study. The room is part of the Department of Community and Therapeutic Recreation.

After the study, the space will continue to be used by the Department of Community and Therapeutic Recreation to train students in the use of MSEs, for community outreach to underserved populations, and student respite.

**Figure 1. Ferguson 249 Original Space**



### **Design of MSE**







The design of the MSE was part of a grant, “Stantec Innovation Partnership” for \$3,000 through the Interior Design Educators Council. The funding supported the procurement of furniture, fixtures and equipment. Finishes were also donated, including carpet tiles by Interface Flooring, paint by PPG, and an acoustic suspended panel by Autex. The fabric was donated by

Greenhouse Fabrics, Kravet, and Furnitureland South to make pillows with contrasting and interesting textures which were used throughout the space. Figure 2 shows a furniture plan of the room that highlights each element and the sense it targets, and Table 3 shows the theory/theories it supports.



**Figure 2. Room Design by Sense**



**Table 3. Room Elements by Theory**

Element	Image	Sense	Theory
Torchiere with color changing bulb (x 2)		Sight	Ulrich (control over environment)
Fan		Touch	ART Biophilia (mimics breeze) Ulrich (control)
Swing		Touch	ART (soft fascination)
Fiber Optic Lights (x 2)		Sight, Touch	ART (soft fascination) Ulrich (control)
Wall Mural		Sight	ART Biophilia Receptive Arts
Carpet (Moss in Stone)		Sight, Touch	ART Biophilia
Echo Dot Speakers		Sound	ART Biophilia (if nature sounds selected) Ulrich (control) Receptive Arts



Essential Oil Diffuser		Smell	ART Biophilia (if natural scents selected) Ulrich (control)
Water Fountain		Sight, Sound	ART Biophilia Ulrich (control)
Acoustic Wall Panel		Sight, Sound	Receptive Arts
Light Curtain		Sight	ART (soft fascination) Ulrich (control)
Pillows		Sight, Touch	Receptive Arts
Weighted Gorilla		Sight, Touch	
Tree Window Panel		Sight	ART Biophilia Receptive Arts
Bubble Tube		Sight, Sound	ART Biophilia Ulrich (control)
Textile Wall Hanging		Sight, Touch	ART Biophilia Receptive Arts
Vibrating Beanbag Chair		Touch, Sound	Ulrich (control) Receptive Arts (Music)

Attention Restoration Theory was addressed by using natural images, natural patterns, and natural sounds (if chosen by participants). Natural images included a large floral mural (see Figure 4), a laser cut panel featuring tree silhouettes (see Figure 3), a tactile textile wall hanging featuring a mountain scene (see Figure 5), water sounds from the tabletop fountain (see Figure 6) and the carpet – Interface “Moss in Stone” (see Figure 7). In addition, participants could select nature sounds as the auditory input if desired.

Biophilia was addressed using the same elements as ART plus additional sensory stimulation such as aromatherapy (see Figure 8), tactile pillows and weighted gorilla (see Figure 9), thermoception (see Figure 10), and proprioception (see Figure 11).

Ulrich’s Theory of Supportive Design was addressed with all the elements from ART and Biophilia plus the ability to control the environment (via the remotes and iPads), and privacy (window coverings and single-user environment).

Receptive Arts Engagement was addressed by the inclusion of the handwoven tactile textile wall-hanging, the handmade pillows, the floral mural, and the laser-cut window cover.

To maximize the sensory stimulation, the design addressed four of the five commonly recognized senses - sight, sound, touch, and smell. To do this, furnishings, accessories, and equipment were selected that enhanced the user's sensory experience within the space. Visual effects were dramatized by keeping the background dark. To address user control over the environment the lighting, airflow (using a fan), and sounds (choice of music, silence, white noise, or nature sounds) were available to change through a tablet. Which activities (if any) the user used in the allotted time in the space were also open for the user to choose.

To address sight, iPad-controlled torchieres with color-changing lamps were used. Participants could select the color and intensity of light they preferred for all three light sources.



An iPad-operated programmable light curtain was used for which users could select a desired pattern and color. Some patterns were motion while others were static.. Window coverings were added to control light and view. Figure 4 shows one window cover which was cut on the CNC machine in the shape of tree branches, and a rainbow-colored fabric was placed behind the board. Figure 7 shows the Moss in Stone carpet by Interface which mimics the look of moss growing on stone, an additional nature-inspired element.

To address sight and touch, optic fibers were placed at each seating choice. Occupants could select the color, brightness, and pattern (if desired) of the light output. Also related to touch and sight was a pillow pile with a weighted stuffed gorilla shown in Figure 5 and the tactile wall hanging shown in Figure 6. Sound was addressed using Echo Dot speakers, and students had the option of using their playlist, a playlist from a streaming service, nature sounds, white noise, or any combination of these. The tabletop water fountain and a bubble tube also produced ambient sound. A fan was provided to allow users control over the airflow in the room. The fan was iPad-operated and had presets such as “breeze” and “high”. Aromatherapy was incorporated using a cool mist essential oil diffuser. This particular diffuser was cold mist and the scent dissipated quickly after the machine was turned off. It also had a “quick change” feature which allowed for rapid turnaround between participants. The scent options were “Bee Happy”, an essential oil blend incorporating citrus, vetiver, vanilla, and Lavender. “Bee Happy” is a combination of scents considered uplifting, while Lavender is considered relaxing.

**Figure 3. Window Covering Incorporating Nature Imagery**



**Figure 4. Abstract Floral Wall Mural**



**Figure 5. Tactile Pillows and Weighted Gorilla**





**Figure 6. Tactile Wall Hanging**

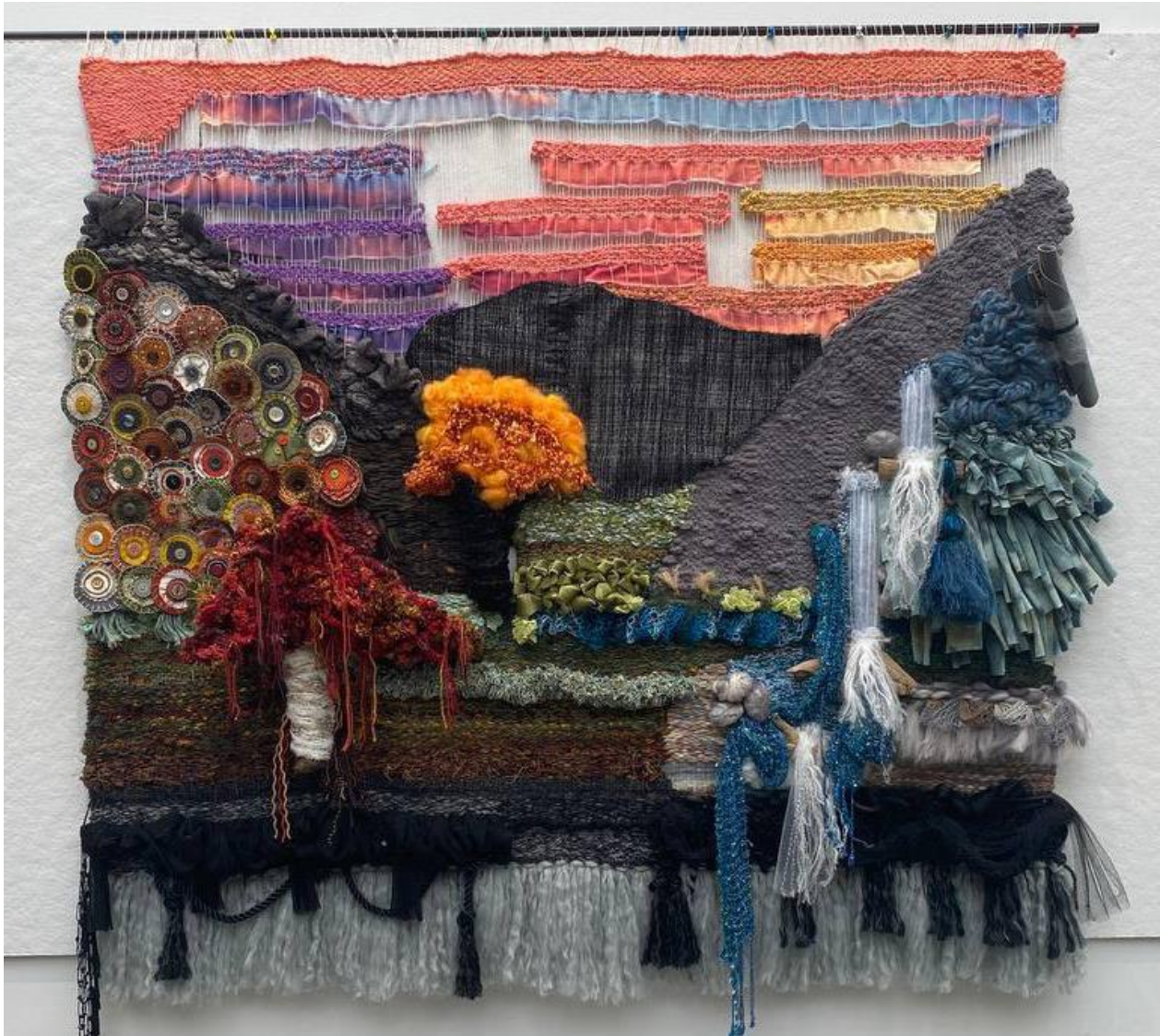


Figure 7 shows a view of the room from the hallway entrance with the overhead lights off. Figure 8 shows the room looking towards the hallway entrance from the side classroom entrance with the overhead lights off and Figure 9 shows a view of the space looking towards the hall entrance with the lights on.



**Figure 7. View of Space from Hallway Entrance**



**Figure 8. View of Space from Classroom Entrance**



**Figure 9. View of Space with Lights On**



There were three seating options in the room- a vibrating “Somatron” bean bag chair, a swing, and a pillow pile on the floor.

### **Instruments**

The pretest consisted of the Generalized Anxiety Disorder (GAD) -7 and the Perceived Stress Scale (PSS) – 10. Both instruments are self-reporting questionnaires using Likert scales. The Generalized Anxiety Disorder 7 (GAD-7) is commonly used by healthcare professionals to assess and screen for generalized anxiety disorder (GAD) in individuals (Byrd-Bredbenner et al., 2021). It consists of seven items that ask about the frequency and severity of anxiety symptoms experienced over the past two weeks. Respondents rate each item on a scale from 0 to 3, with 0 representing "not at all" and 3 representing "nearly every day." The Perceived Stress Scale (PSS-10) is designed to measure an individual's perception of stress. It is one of the most widely used tools for assessing perceived stress in research and clinical settings (Cohen et al., 1983). The

PSS-10 consists of 10 items and asks respondents to rate how often they have experienced specific thoughts and feelings related to stress on a 5-point Likert scale, ranging from 0 (never) to 4 (very often).

These scales were followed by three open-ended questions about the strategies students use to cope with stress and anxiety, and two demographic questions about age and gender. The post-test also contained the GAD-7 and PSS -10 scales, preceded by six open-ended questions related to what the participant liked and disliked about the MSE, how they used the space, and any additional comments (see appendices A and B. Lastly, the researcher conducted a semi-structured interview (see appendix C).

There were 14 questions included in the semi-structured interview. The interview was conducted in the classroom outside the study space and was recorded with a phone app which recorded words only, no audio (to protect the identity of the participant) was recorded. Questions were formatted as yes/no or open-ended with the opportunity for the participant to expand on questions on the yes/no questions and items in the post-test.

### **Procedure**

For the study, participants signed up for 20-minute periods. Before entering the space, they completed a pretest in Qualtrics administered via iPad. The participant was then guided to the room, shown how to control the lights, music, fan, and aromatherapy, and then left to experience the space. Participants were informed that they could stay the entire 20 minutes or leave the MSE whenever they were ready. After the participant left the space, the post-test was administered. Seventeen of the 19 participants spent the entire 20 minutes in the space, while one participant left after fifteen minutes and one left after seventeen minutes. The researcher then interviewed the participants to gather more detail.

## CHAPTER IV: FINDINGS

This chapter discusses the findings of the study. A section is provided for each research question detailing the statistical computation used and the results. The first section addresses the relationship between the sensory space and anxiety and stress. The second section identifies strategies college students currently use to deal with stress and anxiety. The last two sections identify which elements of the sensory space the students liked the best and the least.

### **Research Questions**

The research questions were:

1. What effect does visiting a multisensory environment have on the perceived anxiety and stress of college students?
2. What strategies do college students use to cope with anxiety and stress?
3. What multisensory elements do college students identify as the elements they like the best?
4. What multisensory elements do college students identify as the elements they like the least?

### **Research Question 1**

To determine the relationships between the variables, the results from the GAD-7 were analyzed in a paired t-Test using SPSS. To determine if the relationships between the dependent variable perceived anxiety and independent variable, spending time in the sensory room, had any statistical significance, a p-value lower than .05 ( $p < .05$ ) was needed. The results determine that there is no statistical significance. In this study, this means that the participants did not experience a significant reduction in perceived stress and anxiety after visiting the sensory space.

For the overall score of the GAD-7, the Sig. (2-tailed) value is 0.120. This represents the two-sided p-value that corresponds to a t-value of -1.632 with 18 degrees of freedom. Table 4.

**Table 4. Paired Samples Statistics**

Pair 8	V44	8.84	19	5.357	1.229
	V46	9.53	19	5.253	1.205

**Paired Samples Correlations**

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 8	V44 & V46	19	.941	<.001	<.001

**Paired Samples Test**

		Paired Differences				
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
					Lower	Upper
Pair 8	V44 - V46	-.684	1.827	.419	-1.565	.197

**Paired Samples Test**

		t	Df	Significance	
				One-Sided p	Two-Sided p
Pair 8	V44 - V46	-1.632	18	.060	.120

**Paired Samples Statistics**

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre	22.11	19	3.510	.805
	Post Test Total	21.05	19	5.005	1.148

**Paired Samples Correlations**

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	Pre & Post Test Total	19	.850	<.001	<.001



Pair 1	Pre & Post Test Total	19	.850	<.001	<.001
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**Paired Samples Test**

		Paired Differences			95% Confidenc Interval of th Difference
		Mean	Std. Deviation	Std. Error Mean	Lower
Pair 1	Pre - Post Test Total	1.053	2.738	.628	-.2

**Paired Samples Test**

		Paired Differences	Significance		
		95% Confidence Interval of the Difference	t	df	One-Sided p Two-S
Pair 1	Pre - Post Test Total	2.372	1.676	18	.056

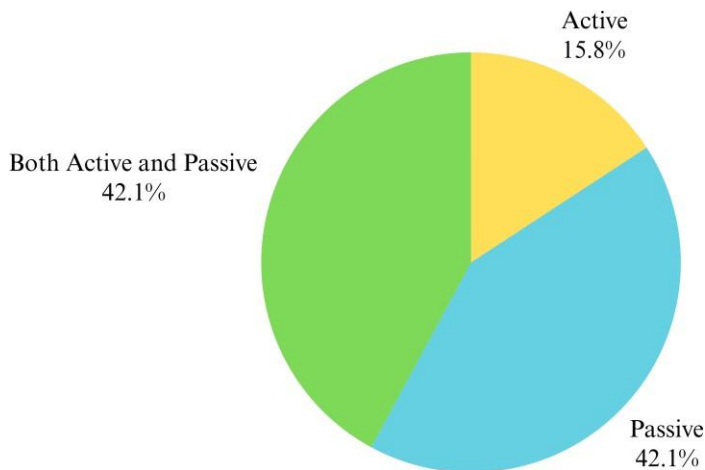
To determine the relationships between the variables, the results from the PSS-10 were analyzed in a paired t-Test using SPSS. To determine if the relationships between the dependent variable perceived stress and independent variable, spending time in the sensory room, had any statistical significance, a p-value lower than .05 ( $p < .05$ ) was needed. The results determine that there is no statistical significance. For the overall score of the PSS-10, the Sig. (2-tailed) value is 0.111. This represents the two-sided p-value that corresponds to a t-value of 1.676 with 18 degrees of freedom. Since the p-value of the test (.111) is not less than 0.05, there was no statistically significant relationship between the two variables.

**Research Question 2**

The second research question addressed how participants typically deal with stress and anxiety. Participant responses for stress varied greatly, however, passive coping strategies listed

outnumbered active strategies by two to one. Mindfulness/breathing/meditation were reported by half the participants, and music and exercise were reported by one-third of the participants. Other responses included talking to friends, video games, being in nature, yoga, therapy, eating, distractions, and religion. Many participants reported not being certain about the difference between stress and anxiety and were told that stress was related to a specific event or situation, while anxiety was an overall feeling of being under pressure. Coping strategies were very similar for stress with breathing/mindfulness/meditation reported by over half the participants. It is interesting to note that many participants listed both active and passive strategies as those they regularly used.

**Figure 10. Current Coping Strategies**



### Research Question 3

The third research question addressed participants' favorite element within the MSE. Eleven of the nineteen participants listed the lights as one of their favorite elements. Seven listed the hammock chair. Those two were followed by music, the fountain, nature sounds, the bubble

tube, and the bean bag chair. The gorilla, pillows, flooring, window cover, and aroma therapy each got one vote (participants could list more than one element).

#### **Research Question 4**

Finally, the last research question addressed with participants' least favorite element in the MSE. Four participants thought the fiber optic lights were too bright. Three participants indicated they had no interest in the pillows. Two listed the bubble tube as their least favorite, and two listed the hammock chair. The remaining listed elements (waterfall, wallpaper, gorilla, music, window cover, and fan) each got one mention.

#### **Interview Questions**

The interview was qualitative in nature and participants were asked to elaborate on some of the items in the post-test. The interview began with the researcher asking the participants how they felt. All participants responded positively, with one participant noting she felt relaxed and sleepy.

When asked "How do you feel?", nine participants responded "Good". Eight responded "less stressed, relaxed, or less anxious". One responded "Great, much better!" and one replied "sleepy and relaxed". When asked "Did you use your phone while in the room? For what purpose (messaging, gaming, social media, etc.)?", six replied no. The rest used their phones for social media (five), gaming (2) and to look up a song (1). Other participants did not elaborate. When asked "Did you change the music or the lights?", all respondents answered yes. Most changed both the music and the lights. One participant only changed the music, one turned off the music, and another only turned down the lights. When asked "Did you feel like you needed something to do?", ten replied "No", three replied "Yes", and the remainder replied "Maybe". All respondents except one believed that having control over the music and lights made the

experience more enjoyable. One respondent believed that there were too many choices and found it stressful to have to choose. One participant found the controls confusing, while one found them confusing at first, but figured them out quickly. The next question was a repetition of the question from the post-test questionnaire regarding what the participant liked most and least. When asked “What changes would you make changes to the room if it were up to you?” there were varied responses. Three would have more neutral colors. Other responses included rugs on the floor, something on the ceiling, better surround sound, more water features, more aroma, more stuffed animals, plants, a bigger hammock, floor mats, and making the art more visible. Several respondents said they wouldn’t change anything. All except one felt the seating options were adequate. That participant did not think the current options were accessible to students who might be mobility impaired. Seven people stayed in one seat while twelve tried different seats. Eleven participants preferred having the option to reserve the room for one person or a few people. Eight preferred experiencing the space alone. Most who preferred the option did not want the space to be open to everyone all the time, but only to those who they wanted to be with. Fifteen respondents said the light levels were adequate. Three said there was too much light, with one offering that the fiber optic lights were very bright. They were not aware they could modify the levels of light output from that element. One participant felt the light levels were too low. All participants noticed the tactile elements in the room, however, a few said they noticed them but did not explore them.

In summary, the quantitative data did not support the theory that sensory rooms could be used to reduce perceived stress and anxiety in college students. However, qualitative feedback indicated that participants felt better after spending time in the space. Also, coping strategies they are currently using, and their favorite and least favorite elements in the test room were identified.

In the next chapter, possible reasons for outcome will be discussed as well as potential uses for the information that was collected.

## CHAPTER V: DISCUSSION AND CONCLUSIONS

The initial section of this chapter will discuss the findings of the study. The next section will discuss the implications of the findings and address the limitations of the study and what could be done to overcome the limitations in future studies. The last section will discuss opportunities for future research.

The primary purpose of this research was to ascertain if a sensory room could reduce perceived anxiety and stress in a population of college students. Student stress is at an all time high, and colleges are struggling to provide the resources necessary to help students cope. According to research (Cavanagh et al., 2020), a sensory environment could be one way higher education facilities could help alleviate some of the issues facing students. Qualitative data obtained by open-ended questions and interviews supported this statement, however, the quantitative data was inconclusive.

Initial research indicated that the use of natural imagery identified in Biophilia (Wilson, 1984), soft fascination from Attention Restoration Theory or ART (Kaplan, 1995), the ability to control the environment cited in Ulrich's Theory of Supportive Environments (Andrade & Devlin, 2015), and the use of hand crafted artistic elements in Receptive Arts Engagement (Cavanagh et al., 2020) could reduce perceived stress and anxiety in an otherwise mentally health population. Unfortunately, the findings in this study did not reveal statistically significant evidence to support the theory that visiting a sensory room could reduce students perceived stress and anxiety. While the quantitative results did not support the previous literature, the qualitative evidence was promising. All the participants verbally indicated they enjoyed the space, and a majority of them (53%) volunteered they were more relaxed after coming out than before they went in. Several students (26%) mentioned that they would like to come back to use the room

when they were experiencing stress and anxiety when asked if there was anything else they would like to share.

REFER BACK TO THE FINDINGS TO EXPLAIN. (If I delete this the comment goes away)

Twenty-one percent of participants reported that they felt like they needed something to do which could have resulted in greater feelings of stress or anxiety. Almost 58% of respondents preferred a combination of active and passive (42.1%) or only active (15.8%) coping strategies. The MSE was designed with mostly passive elements, so this also could have contributed to the failure of the quantitative data to support that an MSE might help reduce stress in college students.

The lights were the element chosen by most participants as one of their favorite elements. This supports the belief that sight is the most dominant of the senses and can influence perception. The hammock swing was the second most popular element. The swing correlated with the sense of touch, but it could also be considered an “active element” if the participant was swinging – which could account for its popularity. Music was The remaining items listed (the music, the fountain, the bubble tube, the pillows and gorilla) included sight, sound, and touch. No one listed the aromatherapy as a favorite item. This could mean that scent is less important than the other senses, but it could also mean that participants were not as aware of it as they were the other elements. The fragrance was intended to be subtle so as not to overwhelm any student with sensitivities.

Participants indicated that they enjoyed using the space, that they felt better upon leaving, and provided insight into what elements they liked best and least. No one element stood out as negative, indicating that there were no widespread issues with any of the elements. There were

definitely some favorite elements such as the swing, lighting, and music. Many respondents indicated that the opportunity to experience the elements together as a whole environment made a positive impression. Based on this and other comments gleaned during the informational interview, suggestions were compiled that could be used by future users of the space.

An interesting thing to note is that responses did support previous studies. Respondents liked having control over the environment, they noticed the nature inspired elements, and they appreciated the artistic touches. In addition, participants mentioned that the elements distracted them from stressors that had been plaguing them, corresponding the concept of “soft fascination” in ART.

### **Limitations**

There are several factors that could have affected the findings, including the time of academic year the data was collected, the population that was available for testing, and the instrument for the study.

Due to delays in the installation of the room, the study was conducted between the Summer and Fall semesters and participants were difficult to find. Because of this, fewer participants were available, students were not experiencing the same academic pressures as they would during the Fall or Spring semesters.

In future studies, it would be helpful to run the test during the Spring or Fall Semesters when students are easier to find and facing more academic pressures. A larger sample size with greater diversity might provide different results.

A different instrument may also be more effective in evaluating a pre and post-treatment effect when the treatment is only 20 minutes, and the surveys are less than a half-hour apart. While the GAD=7 and PSS=19 have been proven effective tools to identify stress and anxiety in



college students, the instruments were designed to either identify the amount of stress and anxiety students felt, or the results of a treatment given over a period of days or weeks. They both asked about the participants state over the past two weeks or past month, which would be the same after only 20 minutes in the space.

Since the sales rep for the largest supplier of sensory room furnishings indicated that there had been no investigation into the effectiveness of each of the elements, it might also be helpful to analyze individual elements or senses by testing combinations of fewer elements.

Lastly, using a monitoring device that records indicators such as heart rate, perspiration, and blood pressure might provide more objective evidence for research purposes. Participants may feel obligated to report positive results if they know they are in a supervised study.

Regarding this design of the MSE, the following suggestions could improve the space based on participant responses provided in the qualitative interview:

- Move the console towards the center so that the music and aromatherapy fill more of the space.
- Use a music streaming service without commercials.
- Include blankets, and more stuffed animals.
- Include actual plants, not just images of nature in the environment.
- Use a music streaming service without ads.

In addition to the above, it might help streamline the experience to program “pre-set” environments for the students to select. For example, there could be a “Nature” theme, with green lights and nature sounds. Another example might be a “Water” theme with blue lights and ocean or rain sounds.

In conclusion, while this study failed to provide evidence to support the use of sensory rooms to reduce college students' perceived anxiety and stress, there is enough evidence to support further investigation. The limitations of this study provided enough reasonable interference that results could be very different under different circumstances. While there was little quantitative evidence to support the use of sensory rooms to reduce perceived student stress and anxiety, most students mentioned enjoying using the space and feeling relaxed in the post visit interview. Regardless of the lack of support provided to the initial concept, the study was responsible for the creation of a permanent space on campus for student respite that will also be used to train future therapists and for outreach to underserved neurodiverse populations in the area. The feedback provided useful suggestions for improving the space, and future research will be possible under better circumstances.

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## APPENDIX A: PRE-TEST

10/31/22, 2:40 PM

Qualtrics Survey Software

Gove Student Health Center 107 Gray Drive or call 336-334-5340. Benefits of being in the study: Benefits from participating in the study may include a reduction in perceived stress or anxiety from being in the multisensory space.

**Will I get paid for being in the study? Will it cost me anything?** There are no costs to you, or payments made for participating in this study.

**How will you keep my information confidential?** The surveys will not list participants names other than a given code. All questionnaires will be anonymous and only identified by a study code. All data will be stored on a password protected BOX file on a password protected computer. All information obtained in this study is strictly confidential unless disclosure is required by law. All information obtained in this study is strictly confidential unless disclosure is required by law. Your data will be destroyed after thesis is approved - estimated date Fall 2023.

De-identified data from this study may be shared with the research community at large to advance science and health. No personal identification information will be collected that could identify you before files are shared with other researchers. Despite these measures, we cannot guarantee anonymity of your personal data.

**What if I want to leave the study?** You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw after completing the survey the data remain with the study as there is no way to identify which survey was yours.

**Contacts and Questions:** You may ask any questions you have now by contacting the primary researcher Lisa Williams (lswilliams@uncg.edu) or Dr. Amanda Gale (ajgale@uncg.edu). If you have any questions about your rights, how you are being treated, concerned or complaints about this project or benefits or risks associated with being in the study please contact the Office of Research Integrity at UNCG toll-free at (855)-251-2351.

**Statement of Consent:** I have read the above information. I have asked any questions I needed answered and have received answers. I consent to participate in the study. By clicking "I Consent" on the first question, you are consenting to

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ing this survey. By clicking "I Do Not Consent" you will not have to answer any questions and will be directed away from this survey.

Do you consent to taking this survey? By clicking "Yes" below, you are consenting to taking this survey. By clicking "No" you will not have to answer any questions and will be directed away from this survey.

- Yes
- No

You were given a code on a piece of paper, type it here (feel free to ask the researcher if you need a reminder)\_

Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Sometimes	Over half the time	Nearly every day
Feeling nervous, jittery, or on edge	0	0	0	0

	Not at all	Several days	Over half the days	Nearly every day
Not being able to stop or control worrying	0	0	0	0
Worrying too much about different things	0	0	0	0
Trouble relaxing	0	0	0	0
Being so restless that it's hard to sit still	0	0	0	0
Becoming easily annoyed or irritable	0	0	0	0
Feeling afraid as if something awful might happen	0	0	0	0

The questions in this scale ask about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them, and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, do not try to count the number of times you felt a particular way; indicate the alternative that seems like a reasonable estimate. For each question choose from the following alternatives:

	Never	Almost never	sometimes	Fairly often	Very often
In the last month, how often have you been upset because of something that happened unexpectedly?	0	0	0	0	0
In the last month, how often have you felt you were unable to control the important things in your life?	0	0	0	0	0
In the last month, how often have you felt nervous and stressed?	0	0	0	0	0
In the last month, how often have you felt confident about your ability to handle your personal problems?	0	0	0	0	0
In the last month, how often have you felt that things were going your way?	0	0	0	0	0
In the last month, how often have you found that you could not cope with all the things that you had to do?	0	0	0	0	0
In the last month, how often have you been able to control irritations in your life?	0	0	0	0	0

	Never	Almost never	Sometimes	Fairly often	Very often
In the last month, how often have you felt you were on top of things?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you been angered because of things that happened that were outside of your control?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Block 1

Please complete the questions below as completely as possible.

What types of strategies do you use to cope with stress?

What types of strategies do you use to cope with anxiety?

Of these strategies, which are most effective?

What is your age?

- under 18 years
- 18-22 years
- 23-27 years
- 28-32 years
- 33 years or older

What gender do you identify with?

- Male

10/31/22, 2:40 PM

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- Female
- Non-binary / third gender
- Prefer not to say

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## APPENDIX B: POST-TEST

10/31/22, 3:50 PM

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Where did you spend the most time within the room

What, if anything, would like to see added to the space?

What elements in the space helped you feel less stressed?

What elements in the space helped you feel less anxious?

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How much control do you felt you had over the following features?

	Definitely not	Probably not	Might or might not	Probably yes	Definitely yes
lighting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
comfort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
sound	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
smell	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Several days	Over half the days	Nearly every day
Feeling nervous, anxious, or on edge	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Not being able to stop or control worrying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Worrying too much about different things	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Trouble relaxing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being so restless that it's hard to sit still	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Becoming easily annoyed or irritable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Not at all	Several days	Over half the days	Nearly every day
Feeling afraid as if something awful might happen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The questions in this scale ask about your feelings and thoughts during the last month. In each case, you will be asked to indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them, and you should treat each one as a separate question. The best approach is to answer fairly quickly. That is, do not try to count the number of times you felt a particular way; indicate the alternative that seems like a reasonable estimate. For each question choose from the following alternatives:

	Never	Almost never	Sometimes	Fairly often	Very often
In the last month, how often have you been upset because of something that happened unexpectedly?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you felt you were unable to control the important things in your life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Never	Almost never	Sometimes	Fairly often	Very often
In the last month, how often have you felt nervous and stressed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you felt confident about your ability to handle your personal problems?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you felt that things were going your way?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you found that you could not cope with all the things that you had to do?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you been able to control irritations in your life?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you felt you were on top of things?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
In the last month, how often have you been angered because of things that happened that were outside of your control?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

10/31/22, 3:50 PM

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Never      Almost never      Sometimes      Fairly often      Very often

In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

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## APPENDIX C: INTERVIEW QUESTIONS

### Questions for Sensory Room:

Some of these may already be on the questionnaire.

1. How do you feel?
2. Did you use your phone while in the room? For what purpose (messaging, gaming, social media, etc.)?
3. Did you change the music or the lights?
4. Did you feel like you needed something to do? 5. Did having control over the music and lights make the experience more or less enjoyable?
6. Did you find the controls confusing?
7. What did you like best? Least?
8. What changes would you make changes to the room if it were up to you?
9. Were the seating options adequate?
10. Did you stay in one seat or move around?
11. How would having more than one person in the room impact your feelings (use the word they said in response to question 1)?
12. Was there enough light? Too much light?
13. Did you notice the tactile/textural elements in the room? (weaving, pillows)
14. Any other thoughts you would like to share?