

**A Virtual Reality Framework to support Rheumatoid Arthritis Education: The Impact of Different Immersion Levels on the Empathy and Engagement of College Students**

by

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A dissertation submitted to the Graduate Faculty of  
Auburn University  
in partial fulfillment of the  
requirements for the Degree of  
Doctor of Philosophy

Auburn, Alabama  
May 6, 2023

Keywords: human-computer interaction, virtual reality, immersion

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## Abstract

The use of Virtual reality (VR) has increased within the medical field. Its uses include assisting physicians and patients through medical education, medical training, patient rehabilitation, surgery simulations, and many more activities. In this research, the work is done in a participatory design process with Rheumatoid Arthritis (RA) and Virtual Reality experts to create a VR framework to assist in understanding the effects of Rheumatoid arthritis on the daily life of an RA patient once the disease progresses. Rheumatoid arthritis (RA) is a disease that affects the joints and potentially internal organs. RA causes stiffness, pain, and swelling in an individual's joints. By providing users a better understanding of disease progression and its effect on future mobility, the goal is to increase their empathy for others.

From reviews of the literature, it has been found that highly immersive experiences can have a significant impact on users. In this research, a RA patient journey is created and will be experienced in multiple levels of immersion for this framework to support clinical disorder education. Next, the users are presented with various levels of immersion (i.e., traditional low-fidelity experiments versus the virtual treatment, which includes multiple virtual simulation experiences). This research aims to observe the effect multiple levels of immersion have on the empathy, user engagement, and user experiences of students.

## Acknowledgments

First, I would like to thank God for this opportunity and for being my guide every step of the way. Completing my Ph.D. has had a ton of ups and downs, and without my faith, I know there is no way I would be at the finish line.

Next, I want to thank my friends and family who were there for me whenever I needed them during this academic journey, whether it be for comfort, support, or new adventures. A lot of who I have grown to be professionally and personally has stemmed from the encouragement of my friends whom I love so dearly. I am genuinely grateful to have such a wonderful group of people in my life that I know I'll have forever.

I want to thank the entire Auburn Human-Computer Interaction lab and the faculty from the Library Administration for all their help and support throughout this process. It has been an honor working alongside you throughout my time on this research team, and I genuinely appreciate all of the support and help along the way.

I sincerely thank my research advisors, Dr. Cheryl Seals and Dr. Richard Chapman, for taking a chance on me and guiding me through this educational journey. I would also like to thank my committee, Dr. Jakita Thomas and Dr. Kimberly Garza, for their encouragement, assistance, and time regarding my work and life. Another committee member I want to thank is Dr. Cordelia Brown, a mentor, for her guidance, patience, and constant encouragement and motivation for me to be great. Each of these professors has had a significant impact on not only my academic and professional life but also my personal growth. I hope to be as motivating, supportive, and helpful as my committee regarding all aspects of life. They have been there for me at my lowest academically and at my highest, and I am eternally thankful that I had the privilege to have them guide me through this journey.

Last and certainly not least, I want to thank my parents. Their support and love throughout this journey have been nothing short of amazing. In every phase of my life, they have done nothing but support my dreams and aspirations and encourage me to be the best version of

myself that I can be. I would not be the person I am today without the love and care they have given me. Words will never be enough to express how blessed I am to have them. This entire work is dedicated to my parents, who I love with all of my heart. Thank you for all you do; you'll never know how much it truly means to me.

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## List of Abbreviations

CDC Centers for Disease Control and Prevention

HMD Headmounted Display

I&RC Innovation & Research Commons

RA Rheumatoid Arthritis

RBD Ralph Brown Draughon Library

VR Virtual Reality

## Chapter 1

### Introduction

#### 1.1 Virtual Reality

Virtual Reality can be defined as a simulated experience typically through a headset (HMD) or the web. Some popular HMDs are the Oculus Quest and Oculus Rift [20], and the Vive Pro [21]. Virtual Reality has different immersion levels. Three levels of immersion are non-immersive, semi-immersive, and fully immersive. In a non-immersive setting, a computer is used to display the virtual environment for the user to interact with, giving the user a two-dimensional experience. The environment is only partially virtual in a semi-immersive setting while in a real physical environment. Fully immersive VR is when the user is fully immersed in a virtual environment, typically through an HMD. Virtual Reality's use is present in various applications like education [22, 23], entertainment [24, 25], training [23, 26], medicine [3, 14, 27, 28, 29, 30], and more. This research focuses on the potential benefits of VR when used for medical-related purposes in an educational setting. In this research, we aim to compare the difference in empathy, user engagement, and user experience of students in a non-immersive and immersive setting when presented with a medical-related experiment.

#### 1.2 Empathy, Self-Efficacy, User Experience & User Engagement

According to [34], there are three forms of empathy in healthcare and social care: cognitive, emotional, and behavioral. Cognitive empathy is the ability to relate and understand someone else's feelings [5]. Emotional empathy is the ability to feel what the other person is feeling [35]. Behavioral empathy is what you do after experiencing cognitive or emotional empathy [35]. In this research, the focus is on the empathy that students have for others. This research

investigates how non-immersive and immersive experiences impact the participant's empathy, user experience, and engagement. The goal is once they are done experiencing what it is like daily for others, specifically patients with Rheumatoid Arthritis, that they would be a bit more understanding and considerate of people whose lives are a bit different from theirs.

Self-Efficacy is one's belief in their ability to accomplish a goal, complete a task, or perform at a certain level [36]. According to [36], there are four sources of self-efficacy: mastery experiences, vicarious experiences, social persuasions, and physiological and emotional states. In this research, we are focused on the mastery experiences source. Mastery experiences revolve around the success and failure of completing a task.

User experience is the understanding of what a user is going through while interacting with an application or technology. By understanding the enjoyment, difficulties, and emotions that a user has about the product, the developer can take that information and use it for improvement. Keeping the user in mind throughout the development process will hopefully lead to a positive user experience. Products should be created efficiently, effectively, and satisfy their users. An important aspect that can be considered a part of the user experience is user engagement. User engagement is often used to measure how engaging a product is for its users. As a developer, the objective should be to create an optimal user experience and keep the user engaged with the application they are experiencing.

### 1.3 Rheumatoid Arthritis

One of the leading causes of work disability among adults ages 18 to 64 is arthritis [37]. Rheumatoid arthritis is a common disease that affects the joints, and when severe, it also affects the internal organs [38]. This disease can cause stiffness, pain, and swelling for an individual, leading to difficulties while doing their typical day-to-day activities. According to [39], from 2013 to 2015, about 23.7 million US adults had limitations to what they could do because of their disease, which accounts for about 43.5% of those with arthritis. Some of the daily activities that the Centers for Disease Control and Prevention mentions arthritis patients struggle with are grasping small objects, carrying anything that weighs at least ten pounds, bending down, and pushing or pulling heavy objects [41]. The CDC also shares that RA can make

working difficult, and things that someone could typically do with no problem seem to get more challenging as the disease progresses.

CDC shares that there is no cure for arthritis, but it can be treated using medications, physical therapy, patient education, and surgery. Managing the disease can mitigate the progression and make the patient's ability to complete their daily activities as usual as possible.

#### 1.4 Research Problem & Motivation

The research problem addressed in this work focuses on cyberpsychology, user experience, and user engagement and beginning a framework that will allow for multiple diseases and disorders to be experienced virtually. From the cyberpsychology perspective, the objective is to compare the different effects on one's empathy when engaged in a non-immersive vs. an immersive experience. Along with observing their empathy changes, our research investigates the difference in the user's engagement and user experience when completing activities in a non-immersive vs. an immersive experience.

The motivation behind these tasks is first to show participants what it is like for someone with severe RA to complete tasks that typically would not present a challenge. The motivation for this research is also to observe if virtual reality enhances their experience enough to significantly impact their empathy, user engagement, or user experience. Empathy is an essential aspect of this research because the goal is to increase a student's empathy after experiencing tasks as someone with RA. By measuring the differences in empathy between the pre-experiment and post each immersive level, the comparisons will show whether this experience impacts the student's empathy. If any impact is observed, this research will investigate which immersive level has the greater impact. The user engagement and experience comparisons will only occur after the non-immersive and immersive experiences. These two factors and empathy will motivate future iterations of the application. Another motivating factor behind these choices is to observe if user engagement and user experience directly impact the students' empathy results. By piloting it in students, not in the medical field, we hope to learn from their responses how to better update the application in the future. In the future, the application will be deployed within

a pharmacy class to increase their empathy for their patients and educate them on what it is like in their daily life.

## 1.5 Research Questions

The research questions that this study is set to answer are as follows:

1. Is an application centered around a patient's journey with RA more effective than the traditional method (i.e. normal routines while wearing gloves) to bring awareness to how RA can impact a patient's life?
2. Does the immersive application enhance the user experience more than the non-immersive approach?
3. Does each of the levels of immersion increase empathy, create better engagement or both in users?
4. Does the strength of association between empathy improvement, UX, and engagement differ for each level of immersion?

## 1.6 Research Hypotheses

1. An application centered around a patient's journey has more impact than the traditional method in bringing awareness to RA's impact on a patient's life.

H1<sub>0</sub>. There is no difference in awareness in the methods of demonstrating how RA can impact a patient's life.

2. The immersive application enhances the user experience more than the traditional approach.

H2<sub>0</sub>. There is no difference between the impact of the immersive and non-immersive approach on the user's experience.

3. Each immersion level impacts the student's empathy and user engagement.

H3<sub>0</sub>. Neither level of immersion impacts the student's empathy and user engagement.

4. The strength of association differs between empathy improvement, UX, and user engagement.

H<sub>4</sub><sub>0</sub>. There is no difference in the strength of association between empathy improvement, UX, and user engagement.

## Chapter 2

### Literature Review

#### 2.1 Virtual Reality in Medicine

The use of virtual reality in the medical field has become more prominent over time and is multi-purposeful in that area. In this research, the focus is on how VR can assist in the area of Rheumatoid Arthritis and the impact that it can have on the participants who use the application. Like in [1], Venuturupalli et al. are focused on the reduction of pain and anxiety in patients who are suffering from some form of rheumatic autoimmune disorders. Typically, the pain is experienced in certain body areas with these disorders. Their study used patients who were consistently taking medication and scored at least five on the Visual Analog Scale (VAS). The VAS is used to measure the amount of pain someone is in. Also, to be qualified for the study, the patients had to not be at risk for motion sickness and not suffer from epilepsy. The authors used AppliedVR's EaseVR chronic pain platform as the basis of their experiment. Two virtual environments were used: one focused on guided meditation and the other on biofeedback. Patients participated in both environments sequentially. Which environment each patient completed first was assigned at random. While the pain was measured using VAS, the anxiety was measured with the Facial Anxiety Scale (FAS). Their final findings showed that this experience significantly reduced the pain and anxiety felt by patients with rheumatic autoimmune disorders. This is a prime example of one of the many ways VR can positively impact a patient's experience with their disorder.

In [2], the authors develop a game that promotes physical activity in older patients. According to the CDC [33], patients who are older tend to be less active. To create a safe and encouraging environment to promote physical activity in older patients with Rheumatoid Arthritis, the authors created LumaPath. Lumapath aims to create a space for the user to be as active as possible without overdoing it while increasing their range of motion. The game allows users to explore different places using a ship and discover new plants and life. In their study, the authors focused on three things: the impact of the game on the patient's physical activity, the patients' user experience, and the performance gap between older and younger people. The study consisted of 28 people, with 8 participants being 50 and older. Of those 8, 5 of them were arthritis patients. The hardware used was an HTC VIVE with controllers to play the game. The patients also wore Scosche's Rhythm + Heart Rate Monitor Armband to monitor their heart rates. The authors collected the users' heart rates, and the users took the Borg Rating of Perceived Exertion Scale questionnaire. Based on their mapping of heart rates to Borg score, they could measure how intense the user's physical activity was. The authors were successful in having users increase their heart rate to reach an aerobic state. The LumaPath game allowed participants to increase their physical activity and provided a sense of enjoyment.

As the two previous articles have shown, VR can impact in different ways in the medical field, from reducing pain and anxiety to increasing physical activity in older patients. VR also has had an impact on medical training and patient rehabilitation. In [3], Mishra completes their thesis on how VR can help patients be self-sufficient in their rehabilitation practices within the comfort of their own home and the use of VR to train medical professionals on social determinants of health. In their first case study, the objective focused on patient rehabilitation for those who have recently had hand surgery. Using exercises that the professional surgeons suggested, the author created a VR application to assist in completing post-surgery rehab at home. For their second case study, they created an application to train medical professionals on the social determinants of health. This method will give the medical professionals a better idea of what different patients are experiencing in their lives and will lead to them identifying how to be most effective when treating the patients. This work demonstrates the variety of ways that VR can be used in the medical field to help patients and medical professionals.

## 2.2 Virtual Reality's Impact on Empathy and Efficacy

Along with the training and rehabilitation successes that VR has found in the medical field, VR has also found some success in effectively impacting the empathy and efficacy of people. The following works are examples of how VR has been used in an effort to increase empathy and efficacy.

In [4], Li et al. conducted an experiment to train medical professionals and students to have more empathy for patients with Parkinson's Disease. In this study, the authors developed a virtual reality experience that simulates what it is like to participate in the typical daily activities of someone who has been diagnosed with Parkinson's disease. The objective is to have the medical professionals and medical students see what it is like a day in the life of someone with Parkinson's to increase their empathy for those patients. The application begins with a tutorial to give instructions on how the experience will go. Each of the activities the user needs to complete is timed. If an activity is not complete within the time frame, it is deemed incomplete and moves on to the next activity. Once complete, the user's final score from their performance is shared with them. There were two groups of participants in this study: the controlled and the intervention groups. The intervention group was assigned to the VR application, while the control group watched videos of patients who have Parkinson's Disease. This research is currently still in development and has plans to be included in the curriculum. However, an experiment that has already shown some success in increasing empathy for others comes from Schutte and Stilinović.

In [5], the authors conducted an experiment to explore how virtual reality influences empathy and engagement. Another critical observation was whether an empathy increase is a direct result of the increase in engagement of users. Schutte and Stilinović investigated their theories using a group of 24 college students in Australia. The students were broken up to form two groups: VR and controlled groups, each with 12 students. Both groups were required to watch a video narrated by a little girl who is a Syrian refugee. The VR group watched the video using an HMD, with the video displayed in a 360 format. The controlled group used the same HMD, but their view was restricted to a two-dimensional (2D) format. The authors used a 5-point

scale of 15 items to measure engagement and empathy and assessed using Chronbach's alpha. The survey results show that when it came to engagement, those in the VR group's levels of engagement and empathy were significantly higher than those who experienced the video in 2D. Their results also showed that the more engaged the users are, the more empathy the users tend to have.

In terms of the success that VR applications have had with efficacy, the authors in [6] created a VR application to assist in the rehabilitation of stroke patients. Their application aims to assist patients in rehabbing from a stroke with precision grasps such as pinch movements. Yeh et al. used 16 participants in the experiment that involved two different tasks. The first task required users to use two fingers, their thumb and each of their other fingers, to pinch a box. The second task required them to pinch and lift the weighted box to a certain level using two fingers, the thumb and index and the thumb and middle fingers. The participants completed 24 sessions throughout 8 weeks while being monitored by an occupational therapist. Based on the clinical measures in this experiment, the application has been shown to help assist with the rehabilitation of precision grasps for stroke patients. Another success story for the use of VR for stroke patients comes from [7].

In [7], the authors investigate the impact that VR training has on the occupational performance and self-efficacy of patients who have had a stroke. The VR application created included five tasks: bilateral upper limb flexion, abduction activity, gold coins picking game, shoulder circle, and cross and mixed training. The study's final results were based on 52 participants, 25 from the VR group and 27 in the controlled group. Each group participated in their usual rehabilitation routines while the VR group had additional training sessions using the VR system. All of the sessions were over the span of 3 weeks, 5 times a week for 45 minutes. Based on their final results, the authors concluded that the regular rehabilitation regimen and the bonus VR training sessions results could increase patients' self-efficacy and daily living activities but had no major impact when it came to occupational therapy performance.

### 2.3 The Effects of Different Levels of Immersion in Virtual Reality

With the progress made by VR, there are some interesting questions to be answered regarding the effect that the different levels of immersion bring. Although VR is impactful in many ways, is the fully-immersive experience always best to lead to optimal results? Is there a cheaper, more effective method to achieve the goal? In [8], Bowman and McMahan discuss the benefits of immersion and explain that the benefits do not always stem from the experience being highly immersive. In a study conducted with civil engineers, the authors wanted to demonstrate the benefits of immersion in VR. The immersive factors they focused on are the field of regard, stereoscopy, and head tracking. Using the CAVE hardware, they implement a low and high-level version of their experiment based on the civil engineer's AMADEUS system. At the high-level, all of the CAVE hardware's abilities are in play. At the same time, for low immersion, they use one screen to mimic a desktop-type experience, which does not include any stereoscopy or head-tracking features. Their final results discovered that each feature has its own benefits depending on the situation. In certain situations, it is just as effective to use a less-immersive experience as it is to use a highly immersive one which could lead to less expensive VR equipment.

In [9], the researchers conducted a study to examine the effects that different levels of immersion have on the knowledge of medical students. Their study consisted of 25 students split into two groups: a fully immersed group of 13 students and a partially immersed group of 12. The fully immersed group experienced the application using an HMD, while the partially immersed group completed the experience via a computer screen. The VR experience was centered around treating a patient who had just been in a bad accident. The patient was suffering from a head injury, and the students needed to examine the patient to decide how they should treat them. The final results showed an improvement in the knowledge of both groups after the experiment. However, the increase of knowledge from the fully immersed group was higher than that of the partially immersed group.

In [10], Sinatra et al. investigated the impact that immersion levels and previous VR experience have on users in a VE that are tasked with recognition and recalling information.

Recognition was determining if an item was a part of the VE or not and identifying which were. The recall was tested by having participants list everything they recalled seeing in the VE. The recall was broken down into two categories: target recall (items that they were supposed to identify) and incidental recall (items that were not targets). To gain participants for their study, they recruited college students. Sixty-one total participants completed all sessions of the experiment. Of the 61 participants, 28 had some form of VR experience in the past. Their experiment was experienced in three different levels of immersion. Their low-level experience used a desktop, while medium-level used an NVIS HMD and high-level used an Oculus Rift. An Xbox controller was used to navigate through all three immersion levels. The experiment was broken up into three sessions so that each participant who participated could complete the tasks from each immersion level. The participants began with an introductory task to prepare them for the main tasks. After their practice experiment, they went on to complete the main experiment.

The authors consistently checked in with the participants during the process to make sure none of them were getting motion sickness. Once finished, the participants then began to answer questions to test their recall and recognition. In terms of recognition and immersion levels, there was only a significant difference between high and low immersion and high and medium immersion. Regarding target recall and immersion levels, there was only a significant difference in high and medium immersion. There was no significant difference in immersion levels for incidental recall, but there was in VR experience. Those with VR experience performed better than those who had no experience. This study shows that in some situations, depending on the objective of the experiment, some immersion levels can be more effective than others.

#### 2.4 Virtual Reality in Medical Education

Virtual reality has also been successful in medical education, whether it is teaching medical students or patients. In [18], they attempt to increase the understanding and decrease the anxiety of cancer patients who need to undergo radiotherapy. The authors create a VR experience using Unity to show the patients getting radiotherapy. The study consisted of 43 participants. The patients went through a 30-minute session simulating their radiotherapy experience in the coming

days. To evaluate the success of their application, the authors presented the participants with a survey before their VR experience. Once they completed their experience, they were asked to retake the same survey. The survey was used to test the knowledge and anxiety of the patients pre and post-experiment. The survey consisted of 10 questions, seven main questions (asked before and after), and three bonus questions (only asked after). The first five questions were about understanding, and each question had an increase in their average response, meaning that the participants had an increase in understanding after their VR experience. The final two questions were about anxiety, and each average decreased after the VR experience meaning that anxiety levels decreased. This experiment shows the potential that VR has in educating patients about an experience that they will need to go through to help their health and reduce some of the anxiety they feel.

In [19], the objective of this study is to test their VR application that is used to investigate the decision-making of the participants in regard to trauma patients. The VR experience required the participants to go through the process of making decisions to help the patients survive. There were two participant groups: instructors and candidates. They were scored based on the amount of correct and incorrect choices, correct and incorrect diagnoses, patient deaths, and the amount of time it took to complete the task. There were seven instructors and 15 patients who had completion scores. Of those scores, the candidates averaged significantly more deaths than the instructors. In terms of correct decisions, the instructors, on average, had more correct decisions. On average, the instructors made fewer incorrect decisions than the candidates. Although the instructors performed better on average, there was no significant difference in correct and incorrect decisions. However, the percentage of incorrect decision-making was significantly higher for candidates. Although the instructors, on average, made more correct diagnoses, fewer incorrect diagnoses, and took less time, there was no significant difference in their performance and that of the candidates. After the experiment, the participants completed a survey about their experience. The participants felt that the VR experience was enjoyable and cost-effective.

## Chapter 3

### Methodology

This chapter is designated to describe the steps taken to answer the research questions of this dissertation. The main objective of this dissertation is to design and develop a VR application that can be experienced at different levels of immersion. The application will be based on the daily struggles of RA patients. There are four key end goals of this application. Those end goals are:

1. begin a framework for patient journey experiences,
2. simulate what it is like to have RA,
3. improve the empathy of users, and
4. observe the difference in empathy, user engagement, and user experience between non-immersive and immersive experiences.

#### 3.1 Subjects

The subjects of this experiment are university students and experts. The students will be recruited from Auburn University, majoring in non-medical-related fields. The goal is to have anywhere between 20 to 50 students participate in the study. There will be an incentive of a \$20 gift card for their voluntary participation. For the experts, we will have between 6 to 8 to participate in the study. The experts will be colleagues around the area who are knowledgeable in VR or RA. The experts will assist in the application's design.

### 3.2 Experimental Design Plan

The Oculus Quest 2, simulation gloves, and real-world objects will be used for this research to simulate the experiences. As previously mentioned, haptic gloves were unavailable during this current phase of the application, leading to simulation gloves' use. The gloves used in this research are the Cambridge simulation gloves [53]. The simulation gloves alone cannot be recognized by the VR headset, which results in the participants also needing to wear a nude pair of gloves on top of the simulation gloves, as seen in Figure 3.1. The gloves can likely not be recognized due to the simulation gloves not looking exactly like a hand.



Figure 3.1: Glove Visualization

The experiment is planned to be carried out as follows. A recruitment email will be sent out to different departments on campus. That email will introduce the students briefly to the project and offer a link to the pre-survey if they are interested. Those who are interested can complete the pre-survey that asks them demographic information, questions about their knowledge of RA and VR, and an empathy scale. Participants are notified that they only qualify for the \$20 gift card if they complete all stages of the study. Once the survey is complete, the students will be redirected to a SignUp Genius that will prompt them to sign up for one 45-minute session to come to The Innovation& Research Commons (I&RC) on the first floor of Auburn University's

Ralph Brown Draughon Library (RBD) Library to participate in the study. The participants will first be screened for their participation eligibility in this session. To be eligible to participate, students must be clear of COVID symptoms and not be susceptible to motion sickness or any hand ailments that can be impacted in the experiment. If the students are deemed eligible, they will be presented with a consent form acknowledging their participation in this research study. During that time, students will be allowed to ask questions if they have any concerns about the experiment. Students will then sign the consent form and be asked to wash their hands before proceeding. After, they will be informed on how the experiment will take place, allowing for more questions if needed. A researcher will put the gloves on the students properly and frequently verify that they are okay and not in any pain. These gloves were designed to demonstrate how difficult it would be to use certain products for people who have joint mobility issues, like those with RA. The participants will be asked to participate in the patient journey experience from different levels of immersion, non-immersive and immersive. Some of the users will begin with the non-immersive experience first while others will start with the immersive. Each level of immersion will simulate what it is like to have RA, specifically joint mobility limitations. Each of these experiences will range from 3 to 5 minutes involving the participants completing the daily activities of the experiment. If a participant feels discomfort or distress at any point in the experience, they will be removed from the experience and not allowed to proceed. They will be given a list of places to get assistance if they feel distressed after their experience.

### 3.2.1 Non-Immersive Set Up

For the non-immersive experience, the participants will have three tasks to complete. The three tasks are a hygiene task (teeth brush preparation and simulation), a pill sorting task, and making a cup of coffee. These three activities were chosen based on [39] that mentions the limitations that RA patients have throughout their daily activities. The focus of this research surrounded the hands of RA patients which meant that the limitation that the application centered around was grasping. These three activities were specifically chosen using the ADL from [43]. Basic ADL includes hygiene (brushing teeth), instrumental ADL includes managing medications (pill

sorting), and making a cup of coffee can be considered basic (feeding oneself) or instrumental (preparing a meal). There are not only activities of daily living but also include grasping objects in order to complete those activities. The participants will be given one minute and thirty seconds to experience those tasks from the perspective of an RA patient. The participants will then begin their first activity. Once the activity is completed or time is up, the participants will stop and move on to activity two. This process will continue until all three activities are complete. Once complete, the participant will be removed from the gloves and asked to complete the post-non-immersive survey consisting of questions to measure their empathy, user engagement, user experience, and awareness.

### 3.2.2 Immersive Set Up

When entering the immersive experience station, the participants will be sat down and assisted in putting on the headset because they have the simulation and beige gloves on. The participants are seated for this experiment due to an effort to limit motion sickness. The participant also is not allowed to move around in the virtual environment because of the attempts to limit motion sickness. Once the headset is on, the user is not only tasked with completing the activities from the perspective of an RA patient but also navigating through the application that was as well. In the immersive experience, the participants will be asked to complete the same tasks as the non-immersive experience, but virtually. The participants will still have only one minute and thirty seconds in each activity. At the end of the immersive experience, the users will receive feedback on their performance in each activity. At the completion of their immersive experience, the gloves will be removed, and they can take off their headset. Following the completion of the VR experience, the participant will be asked to complete a post-VR experience survey. This survey consists of empathy, user engagement, user experience, and awareness questions. Each post-survey questionnaire should take approximately 10 minutes to complete and includes questions on empathy, user experience, user engagement, and awareness.

## Chapter 4

### Design

#### 4.1 Original Design Plan

The design of this project went through various iterations. The original plan was to create a VR application to simulate RA progression as a patient age. The idea was to show RA patients how advanced RA can affect their daily activities with age progression under different conditions. By showing the patients how it can progress and how the disease can impact their lives, the original objective was to increase their empathy and self-efficacy for their future selves and alter their attitudes toward treatment. During this phase, our goals were to use Unity, Oculus Quest 2 [20], the TESLASUIT [49], and the TESLAGLOVE [48].

In Figure 4.1 is the first empathy map we created just based on our perception of what it would be like for a patient to experience the application with all the haptic and VR technology to address their possible concerns and feelings. Shown in Figure 4.2 was our very first wireframe of how we felt the application would be presented to the users. In this wireframe, there is a menu with various daily activities that the user would have ideally been able to choose from, along with three precaution levels. The users would have experienced the application differently with each precaution level chosen. Low precaution would have shown them how hard daily activities can be compared to high precautions, where the RA may not have as significant of an impact on their daily life.



Figure 4.1: Hypothetical Empathy Map

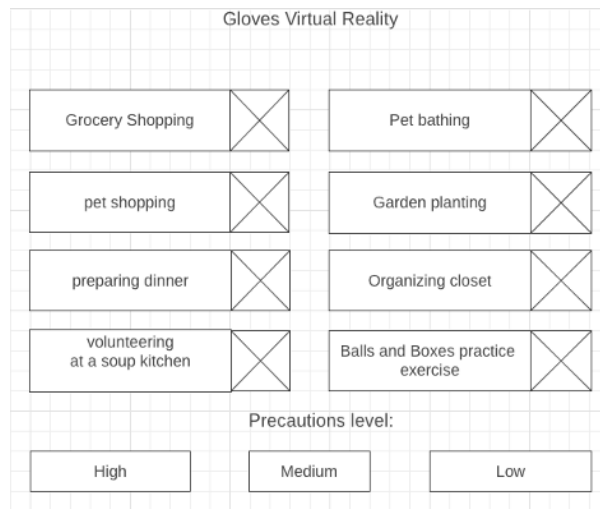


Figure 4.2: Menu Wireframe

Due to the lack of technology during the time of this current phase of this project, the focus shifted to increasing empathy in students after experiencing tasks through the lens of patients with RA, along with observing their differences in empathy, user engagement, and user experience in a non-immersive vs. immersive setting. Although the subjects were changed, feedback obtained in surveys of patients [44, 50] still influenced the application's overall design.

## 4.2 A Preliminary User Interface Design for a Rheumatoid Arthritis Virtual Reality Experience

This work, published in [54], focused on the preliminary design for the VR Rheumatoid Arthritis experience. During this process, RA and VR experts assisted in the application's design. RA patients were also surveyed to learn more about how RA impacts their day-to-day lives. Based on survey results, about 55.1% of the participants believe that VR would help them learn about their health conditions [44, 50]. Patients were also asked whether they would use VR to help manage their RA, and 93.5% of the patients felt that they would [44, 50].

For the initial stages of the design, we began with creating a persona and an empathy map. Each of these gives insight into the group we are creating an experience based on. Figure 4.3 shows a persona we created of a woman who is starting to be impacted by the progression of her RA. The remedies she has been trying are not as helpful as they once were, and it is likely in her best interest to see a doctor. A doctor would be able to inform her on what she can do to help slow down the progression of her disease. The empathy map in Figure 4.4 displays some feedback from the patients surveyed in [44, 50]. RA patients expressed some feelings: exhaustion, fear, disappointment, pain, a sense of contentment or satisfaction with the current treatment, discouragement, and being overwhelmed. Patients tend to think about whether today will be a good day for them, how to accommodate their RA, whether they should switch their treatment regimens, and how long before a task leads to them feeling discomfort. Some participants say they wish they had started treatment sooner and can't enjoy activities they once could do. Some of those activities they cannot do anymore or struggle to do include hobbies like hiking, walking their pets, and going to the gym. Some struggle to do daily activities like carrying groceries or vacuuming. In Figure 4.5, this chart allows the visualization of how the application should flow and demonstrates all the entities needed in the grand scheme.

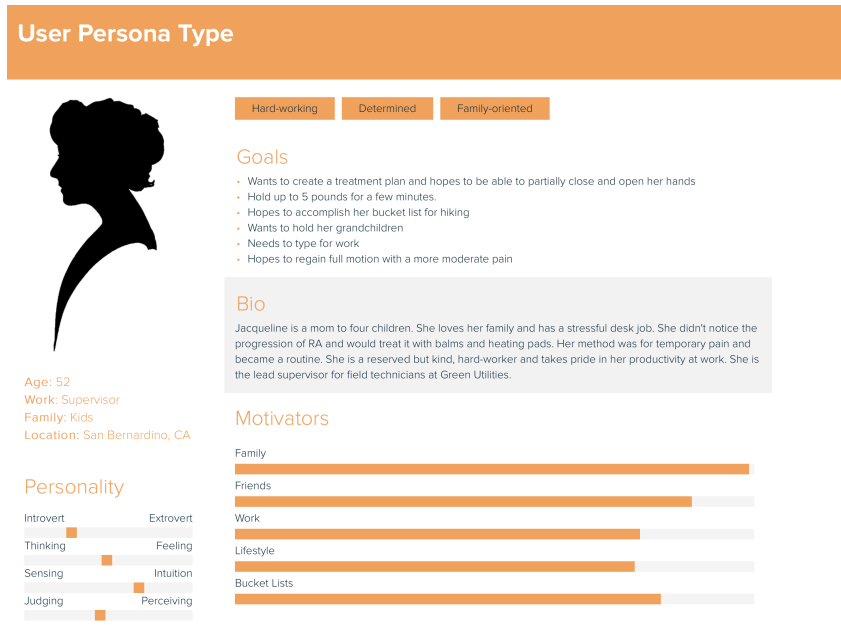


Figure 4.3: Persona [created by: Tatiana Sabanero, Alexicia Richardson, Dr. Cheryl Seals 2021]

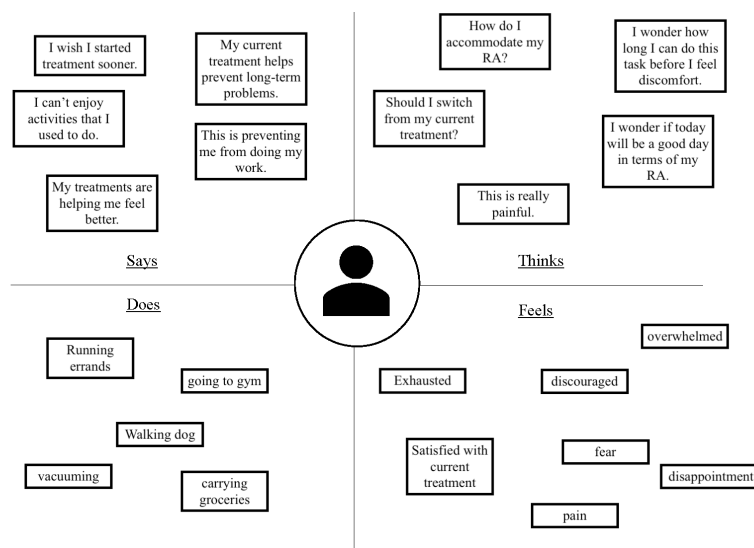


Figure 4.4: Empathy Map

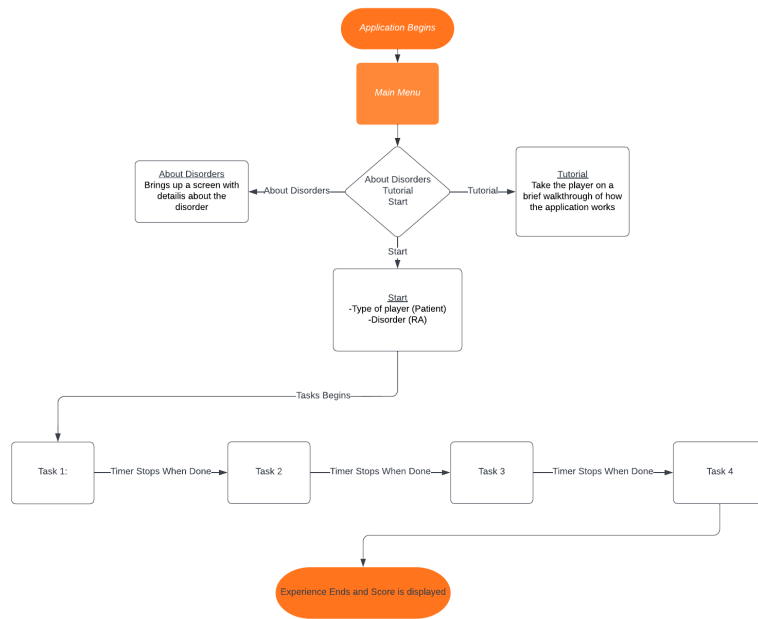


Figure 4.5: Game Flow Design

The following images will show what the design plan was for each aspect of the application. In Figure 4.6, the image shows the wireframe of the planned design for the home/main menu view for the users. The view consists of an image (signified by the grey box with an “X”), the application’s title, Empathy Builder, and three buttons. The first button is About Disorders, which will transition to the image shown in Figure 4.7. The second button is the Tutorial button that will transition to the image in Figure 4.8. The third button is Get Started. Before the Get Started Button transitions to the Gameplay, as represented in the design in Figure 4.9, it prompts the user to answer two questions. These two questions were developed for future stages of the application. The first question is if the user is a student or a patient. The second question prompts the user to choose which disease or disorder they will be experiencing. Once the user chooses, the game transitions to the scenes related to that disease or disorder, which is Rheumatoid Arthritis in this research.

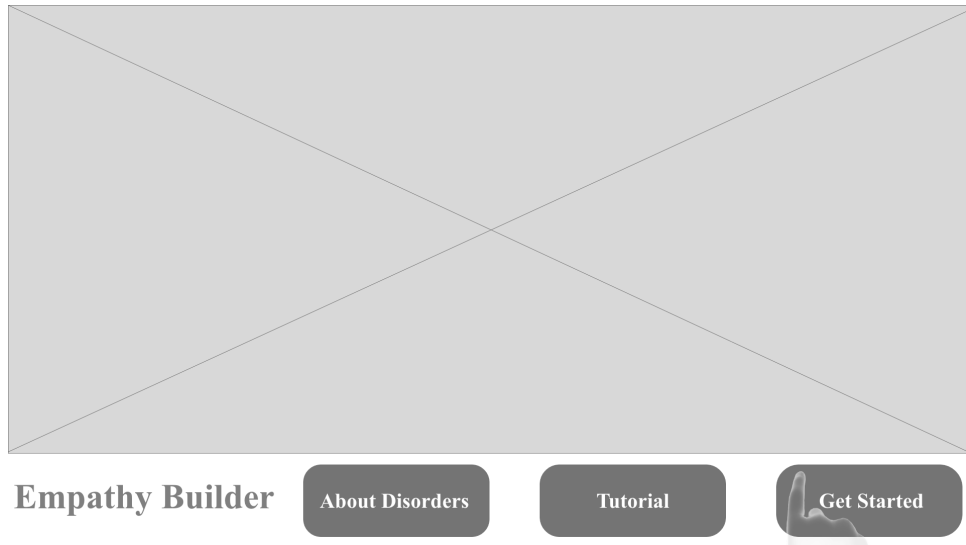


Figure 4.6: Main Menu UI

In Figure 4.7, the preliminary design for about disorders shows a drop-down menu on the top left. The user can use this dropdown to pick which disorder they want to know more about. That drop-down selection will populate text on the left side and images on the right. The images will represent the disorder that the user selected. The back arrow will transition the user back to their previous scene.

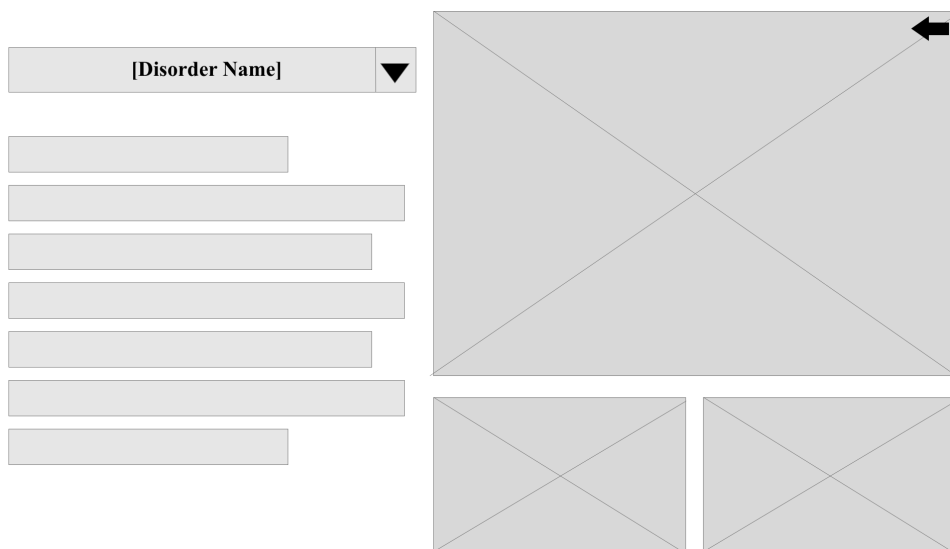


Figure 4.7: About Disorders UI

In Figure 4.8, the preliminary design for the Tutorial scene is shown. On the left, it represents a video showing how the experience is played, while the right offers text that gives the user instructions on navigating the experience. The back arrow still signifies returning to their previous scene.

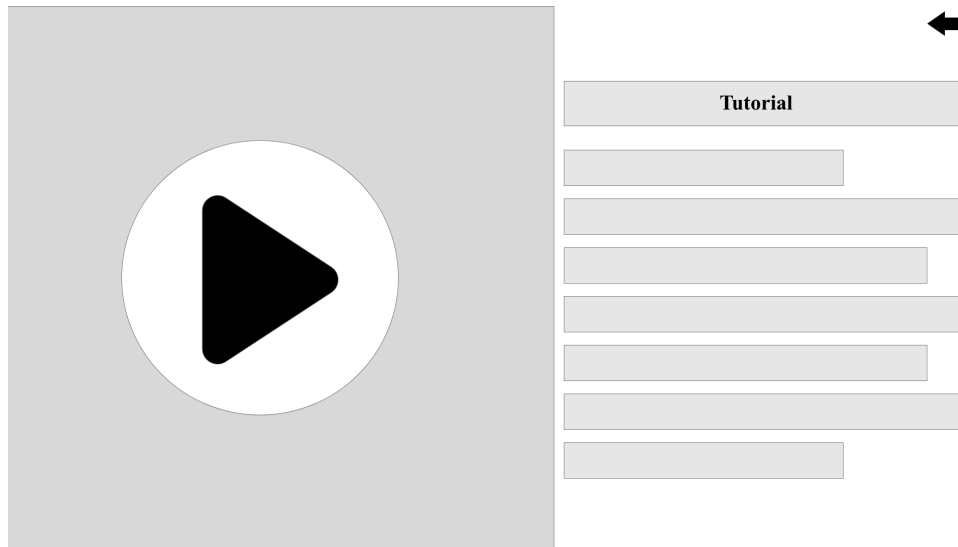


Figure 4.8: Tutorial

Figure 4.9 has a preliminary idea of what the gameplay would look like. In the top left, there is a progress bar and timer; in the top right, we have a pause and home button. The progress bar is meant to show the user how far along in line the application they have come and how much they have left. The timer shows how long they have been in the current task. The pause button will display a pause menu for the user to interact with, while the home button will give another menu for the user to interact with. The Quest symbol signifies the VR experience, while the hands show it is a first-person perspective experience.

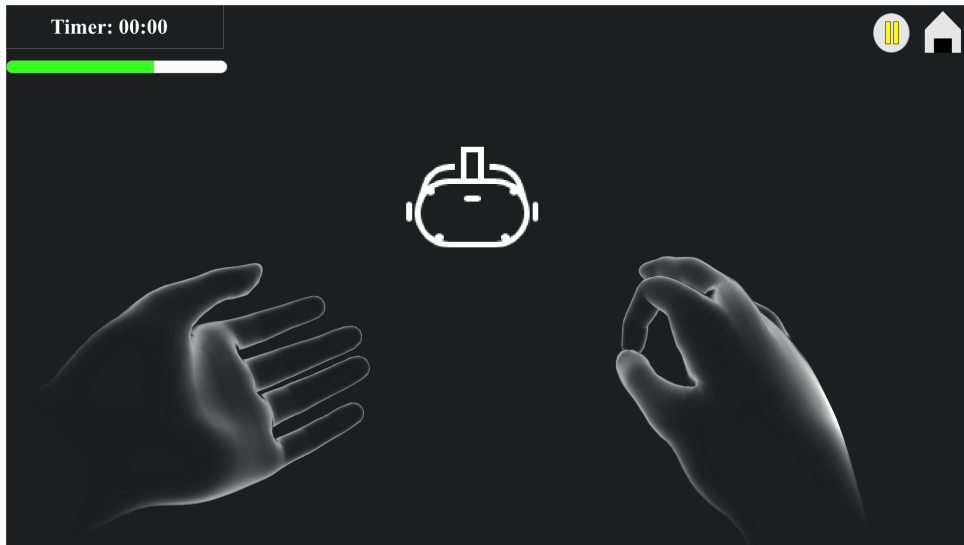


Figure 4.9: Game Scenario UI

In Figure 4.10, the preliminary design of the pause menu is shown. If the user needs a moment within the session, they will have the opportunity to pause the experience which also pauses the timer. When paused, they can opt to continue from where they left off, go to the tutorial scene using the Help button, switch controls, and quit the experience.

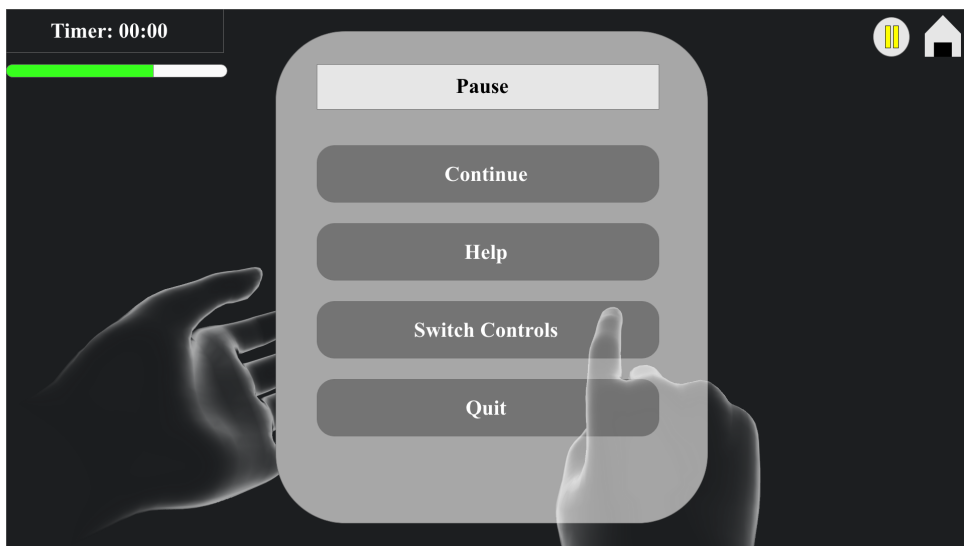


Figure 4.10: Pause Menu Display

Figure 4.11 shows the preliminary design for the switch controls option. The user can decide whether they want to use hand tracking or the HMD controllers. This offers the users the

opportunity to use different controls throughout the application and a smooth way to alternate between the two.

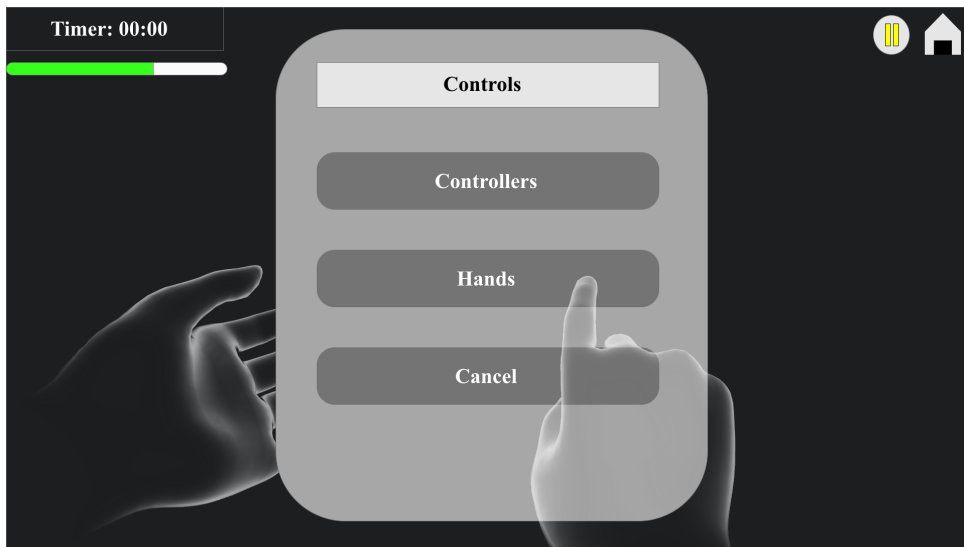


Figure 4.11: Switch Controls Menu Display

In Figure 4.12, the Quit Game and Home Button preliminary design is shown. Users are asked if they are sure they want to leave the game. If so, they can choose Leave Game which will direct them back to the Main Menu Scene. However, they can also choose to Continue Game and complete the rest of their experience.

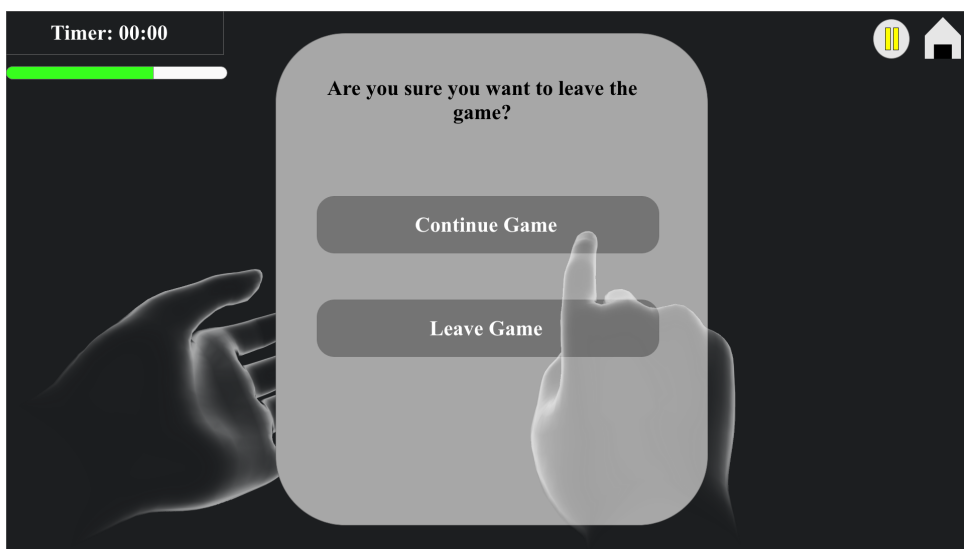


Figure 4.12: Quit-Return Home Menu Display

The final wireframe shown in Figure 4.13 is the Final Score preliminary design. This scene serves as the Game Over scene, showing the user a summary of their experience. At the top of the image, the final score and home button are shown. The final score will represent the user's score for the overall experience, and the home button will transition them back to the main menu scene. Underneath the final score are four image boxes representing each task the user had to complete. The text surrounding that image is the tasks name above the image, the score the user achieved on that specific task, whether the task was completed successfully, and the time to completion is listed under the image.

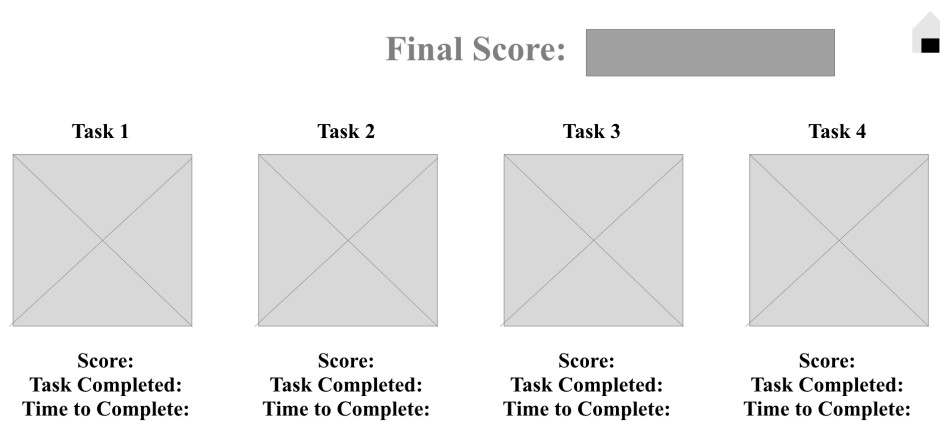


Figure 4.13: Final Score UI

## Chapter 5

### Development

#### 5.1 Plans for Application Development

The application will be developed using the Unity game engine with C# as the programming language. During the beginning stages of development, the wireframe design, as seen in Chapter 4, will be implemented in VR. That design will then be updated based on the conversations with VR and RA experts. While those updates are being made, the application will continue to be implemented. The priority in the development is creating scenes where each of the tasks can potentially take place. Along with scene development, the sub-menus will also be created. The final step in this development phase is confirming the application flow, making sure the application seamlessly flows from one scene to another.

Once the scenes are created, the next step is adding the necessary assets and functionality to a scene to simulate the activity the user is to complete. Once the first scene is fully implemented, before shifting to the next, testing will start. The scene should be tested to ensure it is usable, functional, and does not contain any significant bugs. The scene will be tested by experts in VR and shared with experts in RA via video for potential feedback or concerns. Following this first testing phase, the following scenarios will be developed.

While developing the subsequent scenarios, there will continue to be intermediate testing with the VR experts to verify that the application has a higher level of usability (effective, efficient, and/or user satisfaction) for the target population. Once the entire VR application is made, the application will be deployed and tested again.

The goal of this application is to be experienced in different levels of immersion to see which is more effective in impacting students' empathy, provides a better user experience and keeps the students the most engaged. The application will be developed from a first-person perspective where the hands of the user are the only visible body part in this experiment. Once development is complete, the application will be deployed and tested.

## 5.2 Application Development

Information in this section was first published in [55]. As mentioned previously, this is an iterative design process that led to changes even happening during the development phase. Development was done using Unity, unity assets, and models created by the research team. The following images show the final stages of the application. During this phase, the plan from section 5.1 and the design from Chapter 4, section 2 were used to develop this application. In Figure 5.1, the main menu is shown in a lobby-like room. The UI shows an image, the title in the bottom left, and the three buttons very similar to the design in Figure 4.6. The user's perspective is also shown in this scene with the hands. The hands are the only physical feature seen, making the experience from the first-person perspective. Another view of the lobby is seen in Figure 5.2.

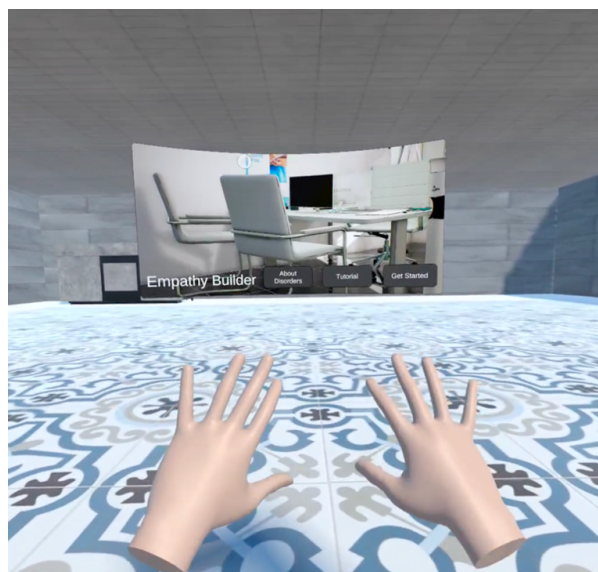


Figure 5.1: Main Menu Scene, image from [45]

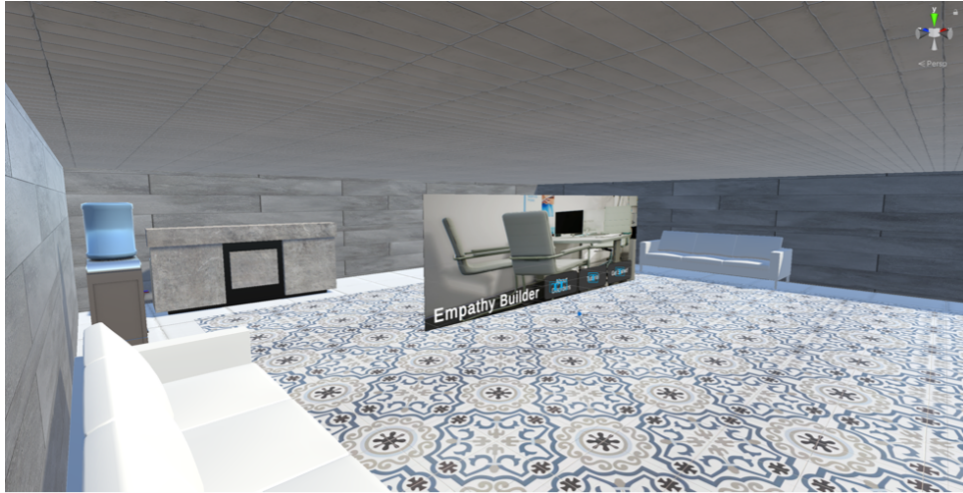


Figure 5.2: Lobby

In Figure 5.3, the About Disorders Design from Chapter 4 was created in VR. There are a few changes to this design compared to what it looked like in its preliminary design phase. Notable differences are instead of three images being displayed, the decision resulted in just one. Another change is the back button. In the design, the representation was shown using an arrow, but the button using wording was felt to be more straightforward and more concise in its purpose. The small circle on the drop-down box is seen by the user during their interaction with the user interface to show them where they are pointing. The left panel displays some information on RA, while the right shows the impact of RA on one's hands. In Figure 5.4, the tutorial scene setup is shown. The same drop-down box is used so the user can choose which experience to get more instructions for. When RA is chosen, the left panel provides some information on how the experience will go. The right panel provides a video of the game being played. This scene also has a back button that will transition the user back to their previous scene.

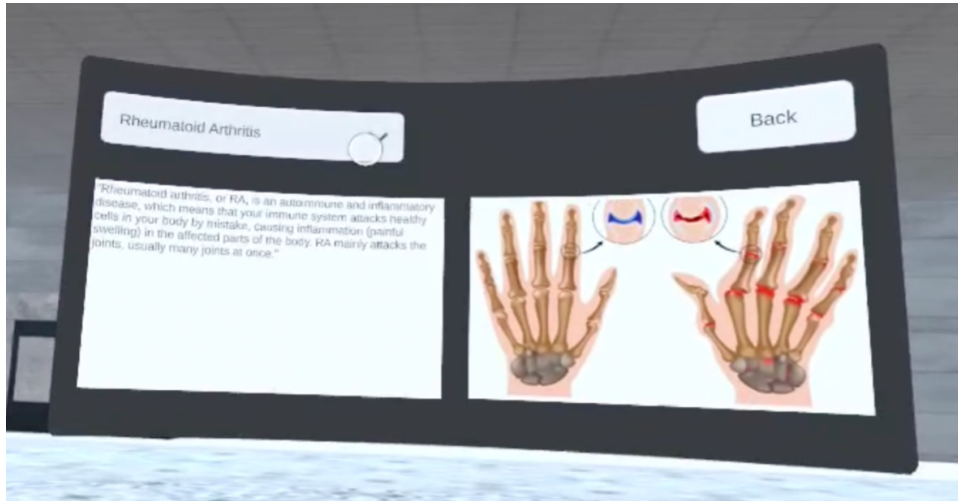


Figure 5.3: RA Selection Display

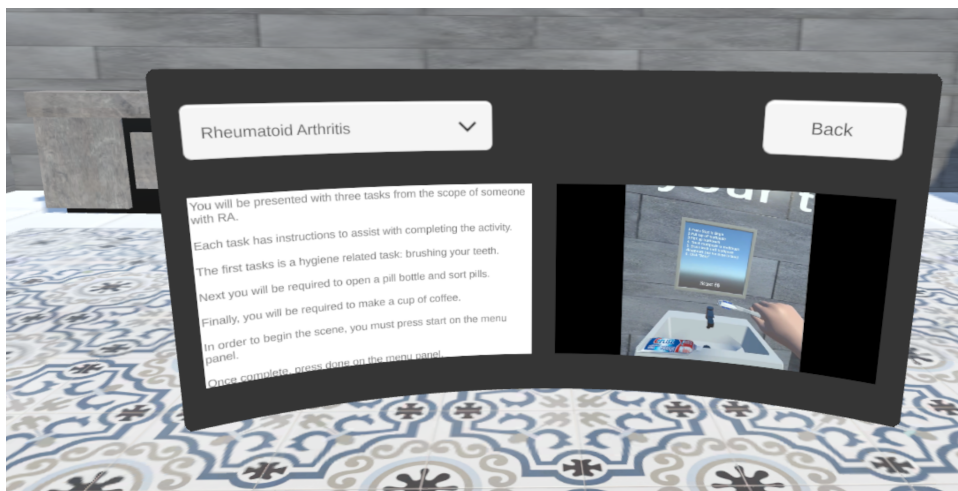


Figure 5.4: Tutorial Scene Set up

Figures 5.5 and 5.6 are the two options shown to a user before they begin the actual virtual reality experience. This development is mainly for future use of the application, allowing patients and students to experience each disease or disorder. With the future of the application in mind, this led to these design choices. The user is first prompted with what type of user they are. This is important because this project is done in partnership with the Harrison School of Pharmacy at Auburn University. After this pilot study with non-medical majors at Auburn University, the goal is to launch the application with pharmacy students. The objective is to

increase the empathy that pharmacy students have for their patients. Along with students, as previously mentioned, a goal is to also in the future have the application used by patients in an effort to make them more aware of what their future could be, increase their empathy for their future selves, and alter their attitudes towards treatment and medication. Following the question about what type of user is using the application, they are then asked which disorder/disease they want to experience. As seen in the current iteration, Figure 5.6 shows that two diseases and disorders are currently a part of this framework: Rheumatoid Arthritis and Color Blindness. Both experiences are complete and functional. This application is not only meant for RA, this application is just the beginning framework to an application that will potentially offer a variety of disorders and diseases for users to experience, ranging from joint mobility diseases to visual impairments and even to hearing impairments and many more.



Figure 5.5: Get Started User Type



Figure 5.6: Get Started Disorder Type

Once the user selects the type of user they are and Rheumatoid Arthritis, the scene will transition to the RA scenarios. Another noticeable change in the design is the menu shown in Figure 5.7. A game interaction panel was created to hold the start button, pause button, home button, done button, and timer. In Figure 4.9, the design shows a timer and progress bar in the top left panel, along with a home and pause button in the top right. This design was altered into this panel and did not include the progress bar because it was felt not to serve an actual purpose to the experience as every other feature. This panel will be to the right of the user in every scenario. The experience does not begin until the user presses the start button. Once the button is pushed, the timer will begin. The timer is located at the bottom to not serve as a distraction to the user. Underneath the start button is the pause button. The pause button will display the pause menu as seen in Figure 5.8 and that button will also pause the timer. The pause menu in Figure 5.8 has some differences compared to the wireframe in Figure 4.10. The most relevant difference is the user no longer has the option to switch controls via the panel. Instead, the application is developed in such a way that hand tracking is prioritized. The controllers can be recognized if within the view of the headset, which leads to the recommendation to keep them out of the field of view. The pause menu still contains the other three options to continue: which will start the timer from where it left off, help: which will transition the user to the Tutorial

Scene for instructions, and quit: which will bring up the menu to confirm whether the user wants to quit or continue. Underneath the pause button is the home button. The home button in Figure 5.7 will also display a menu confirming whether the user wants to quit or continue the game. The final button in the game interaction panel is the done button. This button is to be clicked once the user completes the scenario, and it will clock their time to be shared in the Final Results Scene. If the user chooses to click done before fully completing the scenario, it will still allow them to transition to the next scene; however, their score for that specific scene will be less than ideal due to it being incomplete.



Figure 5.7: Game Interaction Panel

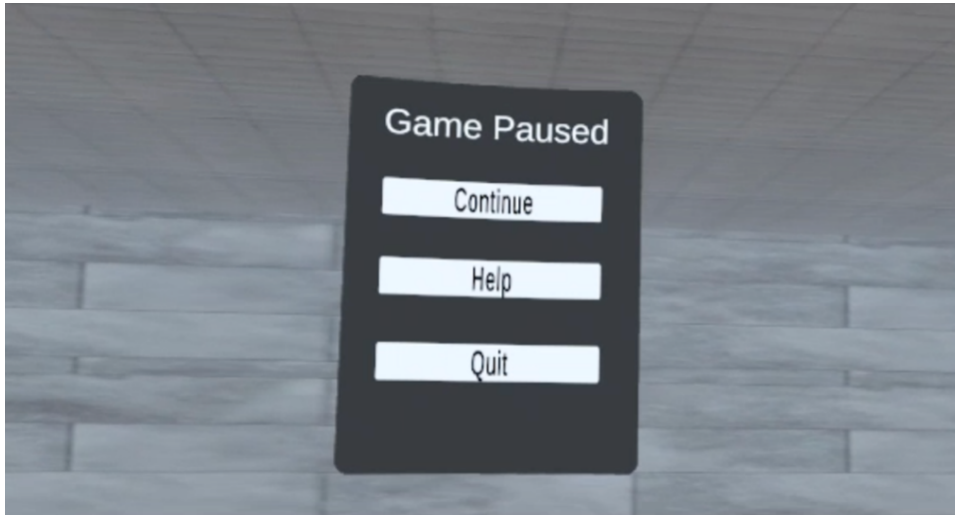


Figure 5.8: Pause Menu

Shown in Figure 5.9 is how the first task will be presented to the user. The application begins with the hygiene scene. In this scene, the participant is placed in front of a mirror with the objects they need to complete the scene. The scene is inside a bathroom and contains a toothbrush and toothpaste lying on the sink in front of the user. The instructions are along the mirror to guide them through the task. It offers step-by-step instructions on what to do in order to fully complete this task. The participants are instructed to press start to begin. Once they start, they should pick up the toothpaste and pull the top off. Once off, they should pick up the toothbrush and connect the toothpaste and toothbrush together to put toothpaste on the toothbrush. Once done, they are asked to mimic brushing their teeth until the toothpaste disappears from the brush and select done to move on.

Once that scene is complete, the user will be transitioned into their next scene, which is pill sorting. As seen in Figures 5.10 and 5.11, the user will be moved to a room with a table placed in front of them. On this table, pill boxes and a pill bottle will be in front of the user. Instructions on how to complete this scene are displayed on the wall directly in front of the user. To begin, the user must pick up the pill bottle and remove the lid. Once the lid is removed, the user must tilt the pill bottle until the pills are displayed on the table as seen in Figure 5.11. Once the pills are shown, the user can put the pill bottle down and begin sorting. For the sorting to

be deemed successful, the user must place one pill of each color in each of the pill boxes on the table. Once pill sorting is complete, the user will be given their final scene in Figure 5.12.

In their final scene, the user is placed in front of a table that consists of what is needed to make a cup of coffee. On the table, there is a coffee machine and a tray. On that tray, there is a coffee mug, a jug of milk, a plate with sugar cubes, and a spoon. Much like the pill sorting scene, the instructions for this scene are displayed on the back wall in front of the user. The user is asked to pour coffee into the cup, add sugar, and add milk to successfully make a cup of coffee. An example of this process is shown in Figure 5.13 where a user can be seen pouring coffee into the coffee mug.

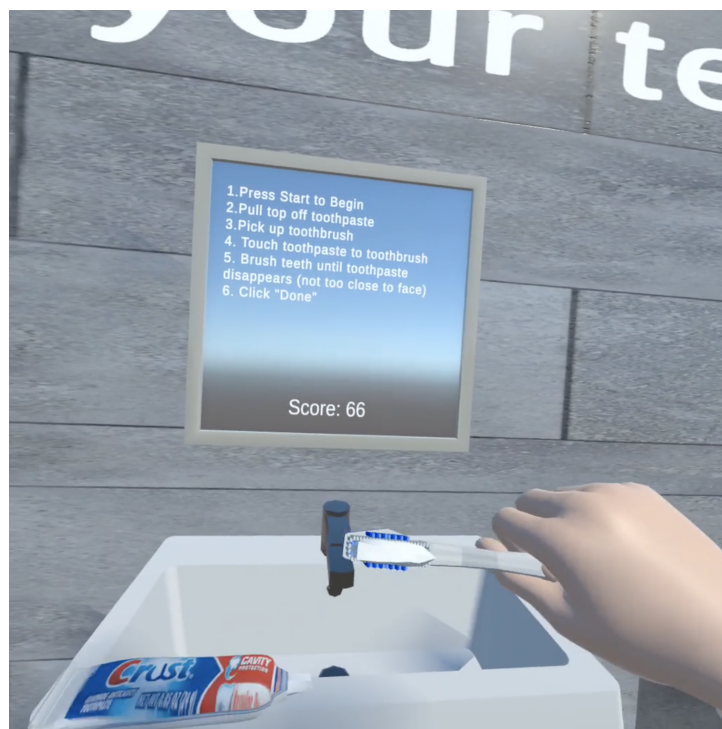


Figure 5.9: Hygiene Scene

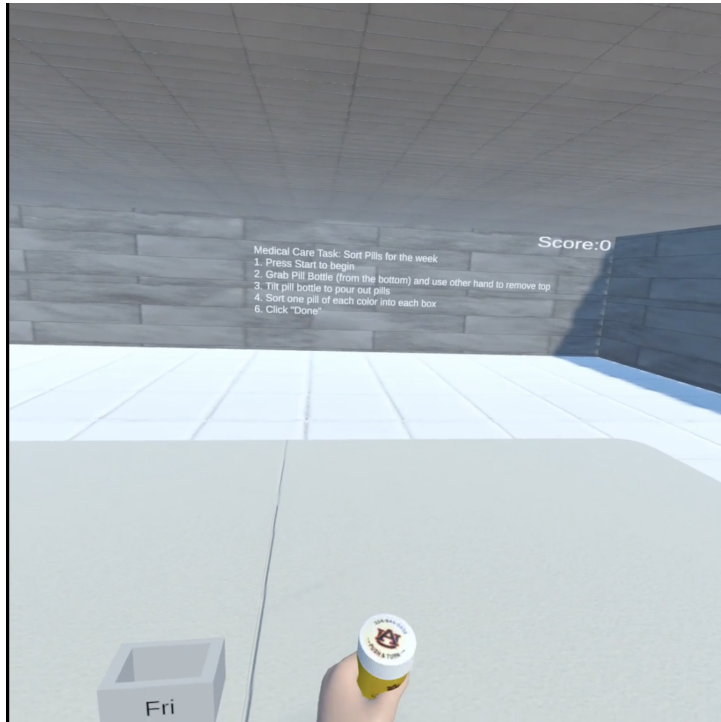


Figure 5.10: Pill Sorting Setup



Figure 5.11: Pill Sorting Scene

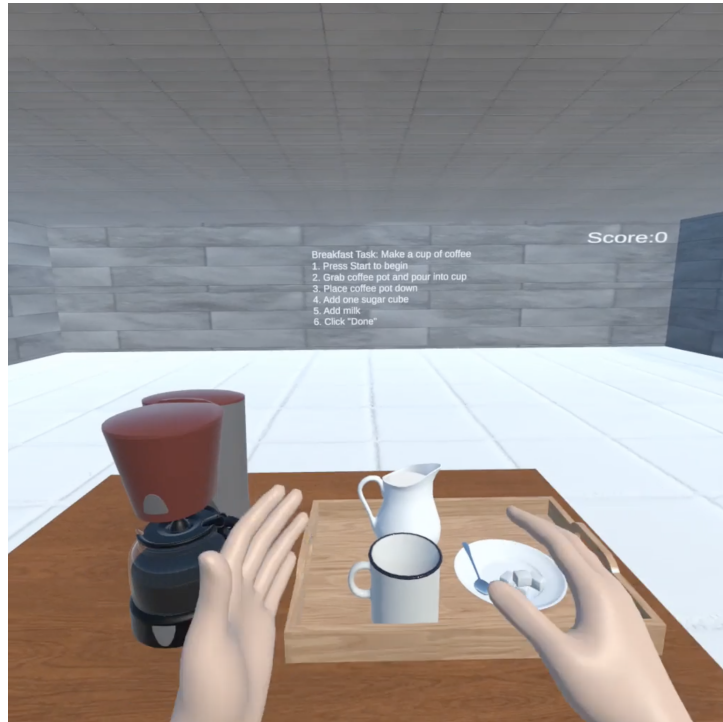


Figure 5.12: Coffee Set Up

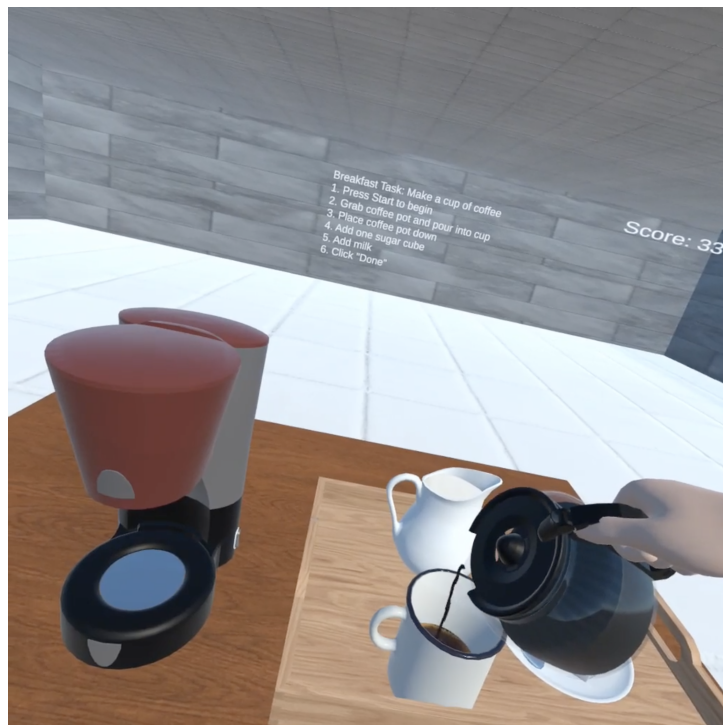


Figure 5.13: Pouring Coffee Scene

In Figure 5.14, the game-over scene is shown. Once the user completes all their tasks, they are transitioned to this scene to see how they have done. At the top of the user interaction panel, the text is shown letting the user know the game has ended and also has a home button. Below the home button, images are shown to represent each scene from the experiment. Underneath each scene, the user's score for that scene and the time it took to complete are displayed. The highest score that a user can receive on any scene is 100. A difference in this final design compared to the original is that there is no longer a total score feature, only a score for each task. The home button will take the user immediately back to the home screen to the main menu where they can choose what they would like to do next.

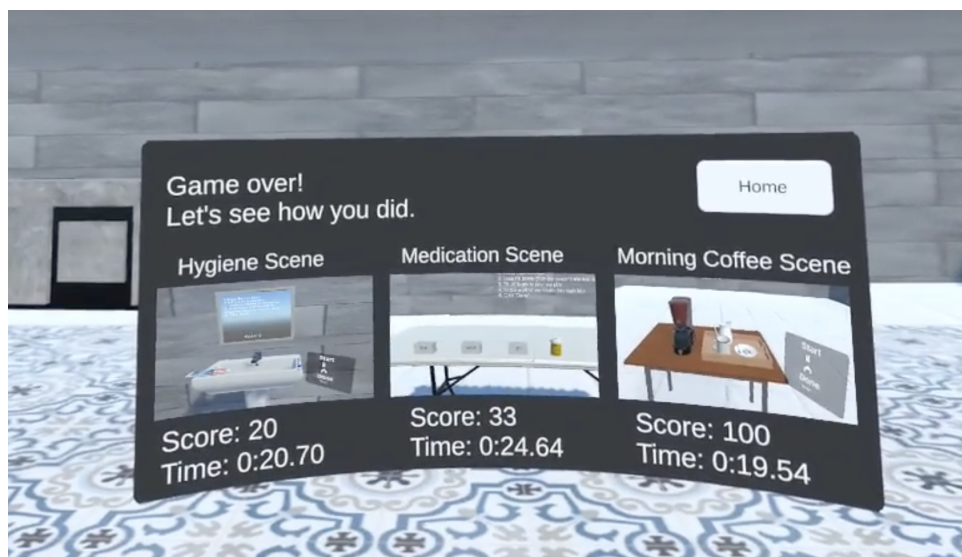


Figure 5.14: Game Over Scene

### 5.3 Development Considerations

During the development process, there were many issues encountered. Some issues that were faced included floor levels not matching up between scenes. In one scene, the setup may be perfect but as you transition, it tends to be a different floor height which could alter the way the user feels while completing the experiment along with increasing the difficulty to reach certain things within the scene. This issue needed to be fixed in order to create some consistency within the virtual environment. Another major issue encountered throughout this process was finding

a solution to simulate RA virtually. Initially, the plan was to use haptic gloves; however, there were not any that we would receive in time for the pilot launch of this application or receive at all. When the direction shifted to simulation gloves, it was learned that the Oculus Quest 2's hand-tracking features struggle to recognize hands while wearing certain colored gloves. This led to the use of the Cambridge Simulation gloves, but since it does not quite look like a hand, it also resulted in difficulties. The solution ended up being to add a beige-toned glove on top of the simulation gloves and that was successfully recognized by the Quest 2's hand-tracking algorithm. As shown in Figure 4.5, the original plan consisted of four tasks for the users to complete. However, due to wanting to limit their time in the headset to avoid motion sickness, this was reduced to three tasks. Other developmental considerations to keep in mind were the assets and the interaction with them. Due to this being a virtual reality application, some functionalities we were not able to accurately represent some the way it would be in real life. An example would be the pill bottle. To open the pill bottle virtually, it consists of grabbing the top and pulling it off while in the real world, it requires a twist and pull motion. In future upgrades of the application, the goal is to update the assets and experience to make it even more realistic. Many decisions and changes were made throughout the different iterations of this application all with the user in mind.

## Chapter 6

### Results

#### 6.1 Data Collection & Evaluation

To measure the user's awareness of RA, the users will be asked following each immersion level if they have a better awareness of the disorder following that experience. The awareness question will be used to help answer RQ1: Is an application centered around a patient's journey with RA more effective than the traditional method (i.e. normal routines while wearing simulation gloves) to bring awareness to how RA can impact a patient's life? In an effort to answer RQ2: "Does the immersive application enhance the user experience more than the non-immersive approach?", two user experience-based scales are used [51, 46]. The first scale captures how the users feel about the immersive and non-immersive experiences, while the second is used to investigate the users' sense of presence in the immersive experience. The third research question is RQ3: Does varying the level of immersion increase empathy, create better engagement or both in users? To answer RQ3, two scales will be used. The empathy scale used is from [5, 31, 32], while the user engagement scale is from [47]. The final research question this study looks to answer is RQ4: Does the strength of association between empathy improvement, UX, and engagement differ for each level of immersion? By comparing the differences in the results of the user engagement, user experience, and empathy scales, a statistical test will be used to observe the correlation between empathy and user engagement and empathy and user experience in a non-immersive vs. an immersive experience. Appendix A shows the pre and post-surveys used to assist in answering these research questions.

## 6.2 Evaluation & Analysis

Students were recruited for this study from Auburn University's campus. The target population in this pilot launch of the application involved students who were not majoring in medical-related fields. A total of 44 students completed the pre-survey. However, only 22 of that 44 signed up and attended a session to participate in the experiment which means we had a 50% dropout rate. In the experiment, half of the participants began with the traditional experience followed by the VR, and the other half began with VR followed by the traditional experience.

RQ1: Is an application centered around a patient's journey with RA more effective than the traditional method (i.e. normal routines while wearing simulation gloves) to bring awareness to how RA can impact a patient's life?

Before completing the experiment, the participants were required to complete a pre-survey. The students were asked about their familiarity with RA and VR in that pre-survey. Shown in Table 6.1 are the results from asking students how much they know about RA, VR, and experience levels for VR. The first column shows the scale used for the question. The total number of participants who answered with the rating in the first column is shown in columns two through four. In column 2 are the results from their responses when asked if they knew a lot about Rheumatoid Arthritis. Based on the results, only one student felt they knew much about RA before this experience, while 17 felt they did not know much about RA. Three of the 22 neither agreed nor disagreed that they knew much about RA. In column 3, the results are shown for the participants when asked if they knew a lot about virtual reality. In this case, 11 of the 22 participants felt they knew a lot about VR, while 4 did not. Seven of the 22 felt they did not agree or disagree with that statement. In column 4, the results are shown from the participants when asked if they had a lot of experience with VR. Although quite a few were familiar with VR, only 7 had a lot of experience with it. Ten felt they did not have a lot of experience with VR, and 5 neither agreed or disagreed with the statement. The final row shows the average response choice for each category. In the pre-survey, the participants were also asked if they personally knew someone with Rheumatoid Arthritis. Of those twenty-two

participants, seventeen knew someone with Rheumatoid Arthritis, while the remaining five said they did not. Overall, most of the participants admitted to not knowing much about RA, which is shown by the average being approximately 1.9, which lies between the strongly disagree and disagree responses. Following each experience, traditional and VR, the participants were asked about their awareness of the disease.

	RA Knowledge	VR Knowledge	VR Experience
Strongly Disagree (1)	8	0	2
Disagree(2)	9	4	8
Neither Agree nor Disagree (3)	4	7	5
Agree (4)	1	9	5
Strongly Agree (5)	0	2	2
<b>Mean</b>	1.909090909	3.409090909	2.863636364

Table 6.1: Pre-Survey Experience Questions

Table 6.2 shows the participants' responses to their awareness post-experiment. The first column represents the answer choices about their awareness following the two experiments: column 2(traditional) and column 3(virtual reality). The final row shows the average response to whether they had a better awareness following the experiment, which is also shown in Table 6.3 (results from SPSS). Following the traditional experiment, nineteen of the twenty-two participants felt they had a better awareness of the disorder after completing that experiment, with thirteen responding with definitely yes and six responding with probably yes. After completing the VR experiment, nineteen participants felt they had a better awareness of RA. Nine of the nineteen felt like they definitely had better awareness, while ten felt they probably did. Based on the averages, the traditional had a slight edge over increasing awareness of the disorder over virtual reality. However, virtual reality still had a great impact on awareness. In Table 6.4, the Wilcoxon Signed Ranked Test results show no significant difference in awareness after the traditional experiment compared to after the virtual reality experience ( $p = 0.408$ ).

In tables 6.5, 6.6, and 6.7 are the results from the Chi-Squared test to check the independence of the results based on which experiment the participant began with. Table 6.5 shows the crosstab results from the post-traditional awareness for RA survey question. As seen in the

	Post-Traditional	Post-VR
Definitely yes (1)	13	9
Probably yes (2)	6	10
Might or might not (3)	2	3
Probably not (4)	1	0
Definitely not(5)	0	0
<b>Mean</b>	1.590909091	1.727272727

Table 6.2: Post Experience - Awareness

	Wilcoxon Statistics		
	Mean	N	Std. Deviation
Traditional	1.59	22	0.854
Virtual Reality	1.73	22	0.703

Table 6.3: SPSS - Awareness Wilcoxon Statistics

	Wilcoxon Test Statistics		
	N	Z	Asymp. Sig.
Traditional-VR	22	-0.828	0.408

Table 6.4: SPSS - Awareness Wilcoxon Test Statistics

table, of the participants who began with the traditional experiment first, six definitely had a better awareness, two probably had a better awareness, and two may or might not have a better awareness. At the same time, one felt they probably did not have a better awareness. For those who started with VR, meaning the traditional experience was their final experience, the responses are much better. In this case, seven felt that they definitely had a better awareness, while 4 felt they probably had a better awareness of RA.

In table 6.6, the crosstab results are shown for the post-VR awareness survey question. Table 6.6 shows that for those who started with VR, three felt a definite increase in their awareness, seven felt they probably had a better awareness, while 2 felt they may or may not have a better awareness of RA. For those who began with the traditional experience, meaning that VR was their final experience, six felt that they definitely had a better awareness for RA, while three felt they probably had a better awareness and two felt they might or might not have a better awareness. In this case, it appears that there was an increase in those who felt they definitely

had a better awareness after their second experiment. However, one participant dropped from definitely yes or probably yes to might or not.

Table 6.7 shows the test statistic results when checking if the first experiment has any association with the responses to the awareness question. Regarding the post-traditional awareness ( $p = 0.291$ ) and post-VR awareness ( $p = 0.231$ ), there is no significant association between the first experiment and the responses to the awareness questions.

1st Experiment	Post-Traditional Awareness Chi-Squared Crosstab Statistics					
	Values	Def. Yes	Prob. Yes	Might or might not	Prob. Not	Total
Traditional	Count	6	2	2	1	11
	Expected Count	6.5	3.0	1.0	0.5	11.0
	Residual	-0.5	-1.0	1.0	0.5	-
VR	Count	7	4	0	0	11
	Expected Count	6.5	3.0	1.0	0.5	11.0
	Residual	0.5	1.0	-1.0	-0.5	-

Table 6.5: SPSS - Post-Traditional Awareness Chi-Squared Crosstab Statistics

1st Experiment	Post-VR Awareness Chi-Squared Crosstab Statistics				
	Values	Def. Yes	Prob. Yes	Might or might not	Total
Traditional	Count	6	3	2	11
	Expected Count	4.5	5.0	.5	11.0
	Residual	1.5	-2.0	0.5	-
VR	Count	3	7	1	11
	Expected Count	4.5	5.0	.5	11.0
	Residual	-1.5	2.0	-0.5	-

Table 6.6: SPSS - Post-VR Awareness Chi-Squared Crosstab Statistics

	Awareness Chi-Squared Test Statistics	
	Value	Asymp. Sig.
First Experiment * Post-Traditional Pearson Chi-Square	3.744	0.291
First Experiment * Post-VR Pearson Chi-Square	2.933	0.231

Table 6.7: SPSS - Awareness Chi-Squared Test Statistics

For the first research question, "Is an application centered around a patient's journey with RA more effective than the traditional method, specifically normal routines while wearing gloves that limit your joint mobility, to bring awareness to how RA can impact a patient's

life?, it appears that the average awareness following the traditional experiment is better than the average after the VR experience; however, there is no significant difference between the two ( $p = 0.408$ ). Both the traditional and VR experience yielded positive results in increasing awareness of the participants for RA, which is an essential goal of this research considering 17 of the 22 did not have much knowledge about RA coming into the experiment. Using the possibility of increased awareness, in the future, this application could create a better awareness for other disorders and diseases for those who are not diagnosed and for those who are in an effort to either increase knowledge on the subject. The goal is not only to impact empathy but also to educate and make users aware of others' circumstances that are different from their own.

RQ2: "Does the immersive application enhance the user experience more than the non-immersive approach?"

This section, published in [55], focuses on the differences between non-immersive and immersive experiences regarding user experience. To measure the participants' user experience, we utilized the User Experience Questionnaire (UEQ) [51]. This survey was also equipped with a Data Analysis Tool that analyzes and compares the results to the benchmark results of other applications within their dataset. The questions from the UEQ survey are broken up into five categories: attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty. The values used in our analysis were the scaled mean per person values from the Data Analysis Tool.

In Table 6.8, the results of our non-immersive experience are displayed. In comparison to the benchmark results, the non-immersive experience was considered below average in terms of attractiveness, with a mean of 0.92. In all other categories, the non-immersive experience performed well. The non-immersive experience ranked good in four categories compared to the benchmark results. Those categories were perspicuity with a mean of 1.81, dependability with a mean of 1.19, stimulation with a mean of 1.38 and novelty with a mean of 0.67. In terms of efficiency, the non-immersive experience was able to rank above average with a mean of 1.36 compared to the benchmark results from the dataset. To better show where the non-immersive application stands in comparison to the benchmark results, the Data Analysis Tool

also provides a chart that has color-coded ranges for their labels of success: excellent, good, above average, below average, and bad. The visual representation of our non-immersive results compared to their dataset of other applications is illustrated in Figure 6.1.

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	0.92	Below average	50% of results better, 25% of results worse
Perspiciuity	1.81	Good	10% of results better, 75% of results worse
Efficiency	1.36	Above average	25% of results better, 50% of results worse
Dependability	1.19	Good	25% of results better, 50% of results worse
Stimulation	1.38	Good	10% of results better, 75% of results worse
Novelty	0.67	Good	50% of results better, 25% of results worse

Table 6.8: UEQ Data Analysis Tool Benchmark Results - Non-immersive

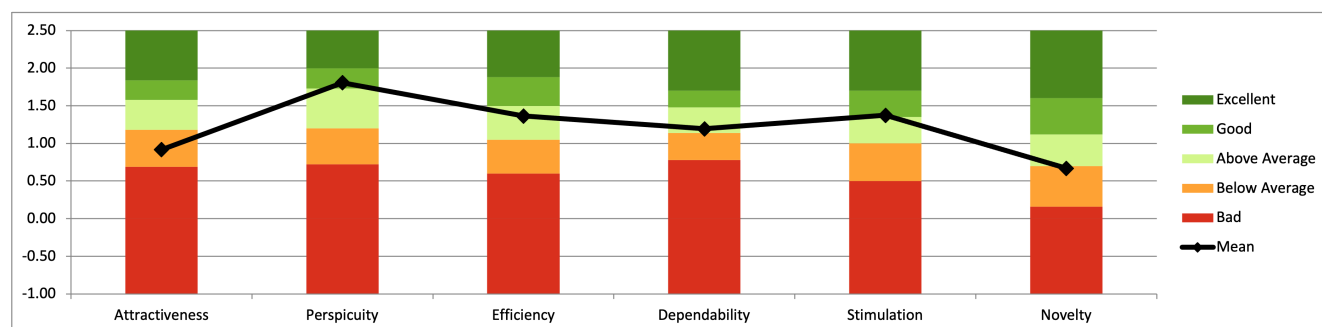


Figure 6.1: UEQ Data Analysis Tool Benchmark Chart Results - Non-Immersion

Table 6.9 shows the results from the Data Analysis Tool for the VR (immersive) experience. Compared to the benchmark results, the VR experience ranks below average in two categories. It is below average in efficiency with a mean of 0.89 and dependability with a mean of 1.00. However, the VR experience found some success in the remaining categories compared to the benchmark dataset results. In terms of novelty, the VR experience was ranked good with a mean of 1.42. Compared to the benchmark data, the VR experience was above average in attractiveness with a mean of 1.41 and perspiciuity with a mean of 1.40. Finally, in terms of stimulation, the VR experience ranked excellent with a mean of 1.73. This excellent ranking for the VR experience means that only 10% of the results in the dataset had a better score than it. The Data Analysis Tool chart to show where the VR application stands in terms of the ranking categories is shown in Figure 6.2.

Scale	Mean	Comparison to benchmark	Interpretation
Attractiveness	1.41	Above average	25% of results better, 50% of results worse
Perspicuity	1.40	Above average	25% of results better, 50% of results worse
Efficiency	0.89	Below average	50% of results better, 25% of results worse
Dependability	1.00	Below average	50% of results better, 25% of results worse
Stimulation	1.73	Excellent	In the range of the 10% best results
Novelty	1.42	Good	10% of results better, 75% of results worse

Table 6.9: UEQ Data Analysis Tool Benchmark Results - VR

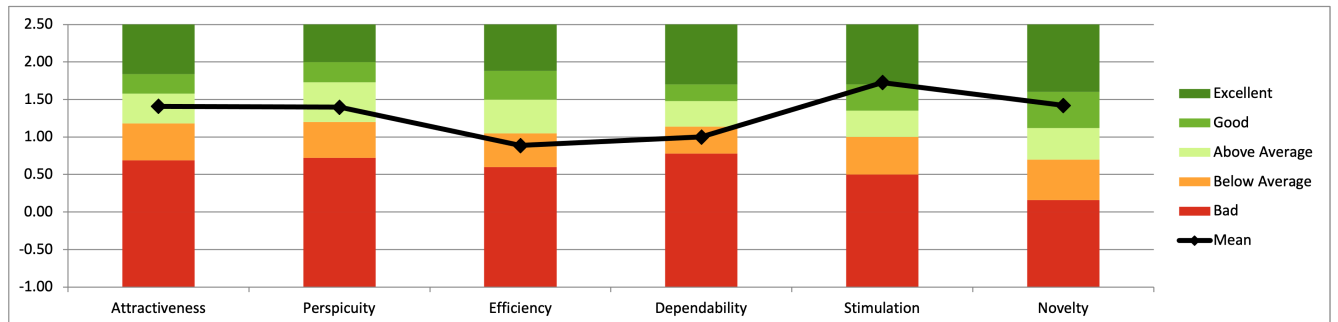


Figure 6.2: UEQ Data Analysis Tool Benchmark Chart Results - VR

In an effort to compare the differences in attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty between the non-immersive and VR (immersive) experiences, we used SPSS to run a statistical analysis on the data that was transformed via the Data Analysis Tool. The results from that analysis can be seen in Table 3. Based on the paired t-test results, there is no significant difference in attractiveness ( $p = 0.054$ ), perspicuity ( $p = 0.094$ ), or dependability ( $p = 0.359$ ). However, there is a significant difference in efficiency, stimulation, and novelty. In terms of efficiency, there was a significant difference between the non-immersive and immersive experiences ( $p = 0.023$ ,  $p < 0.05$ ), with the non-immersive experience being more efficient than the immersive experience. There were also significant differences between the stimulation ( $p = 0.020$ ,  $p < 0.05$ ) and novelty ( $p = 0.010$ ,  $p < 0.05$ ) of the non-immersive and immersive experiences. However, in terms of stimulation and novelty, the immersive experience outperformed the non-immersive.

For the VR experiment, in an effort to learn more about the immersive user experience, the participants also answered questions from the [46] survey. For future improvements, we looked at the involvement and control questions along with natural questions from the presence

Pair	NI Mean	I Mean	t	Two-sided p
NI Attractiveness v. I Attractiveness	0.917	1.409	-2.045	0.054
NI Perspicuity v. I Perspicuity	1.807	1.398	1.756	0.094
NI Efficiency v. I Efficiency	1.364	0.886	2.444	0.023
NI Dependability v. I Dependability	1.193	1.000	0.938	0.359
NI Stimulation v. I Stimulation	1.375	1.727	-2.512	0.020
NI Novelty v. I Novelty	0.671	1.421	-2.796	0.011
NI = Non-Immersive, I = Immersive				

Table 6.10: SPSS UEQ Results - Paired Sample t Test

questionnaire. In Table 6.11, the first column shows the questions that were asked to the participant about their VR experience. The following columns show the number of responses, mean, and standard deviation. The responses were collected on a 7-point scale where the far left represented "Not at all", the middle was "Somewhat", and the far right represented "Completely". The participants could choose a value between 1 and 7 to represent their feelings. In terms of involvement and control, it appears that the participants were between the ranges of 4 and 7 when it came to how much involvement and control they had in the VR experiment. When it comes to the natural feel of the application, the participants' responses would elude that it was somewhat of a natural feel while completing the experiment. In the future, the application would create an even more natural feel when haptic technology is introduced and make the users feel more involved and in control of the environment. The highest average occurred when participants were asked how involved they were in the VE, with a response of 5.95. In terms of controlling the events, users felt they could a little more than somewhat control them (4.36). Based on these results, some characteristics that we could improve in the future are increasing responsiveness, more natural interactions, fewer delays, and consistency with real-world experiences. Although those are some aspects to improve, the results show good responses for system involvement.

For the second research question, "Does the immersive application enhance the user experience more than the non-immersive approach?", based on the results, the VR application was a better overall experience for the participants in terms of attractiveness, stimulation, and novelty according to the UEQ data tool [51] while the traditional experience was better in terms of

perspicuity, dependability, and efficiency. Diving deeper into those categories, there were significant differences between the non-immersive and immersive applications in three categories: efficiency, stimulation, and novelty. Based on our results, the immersive enhances the user experience more than the non-immersive in certain areas but could use some improvements to outperform the non-immersive experience.

In terms of the VR application, this has shown the potential that it has to create a good user experience for those in the RA simulation experiment. However, we want to find ways in the future to make it more efficient and dependable. Introducing other technology that can help create a more natural experience along with a less frustrating experience has the potential to help the VR experiment compete with the traditional in terms of dependability and efficiency.

Question	N	Mean	Standard Deviation
How much were you able to control events?	22	4.36	1.465
How responsive was the environment to actions that you initiated (or performed)?	22	4.23	1.232
How much did the visual aspects of the environment involve you?	22	5.68	1.171
How compelling was your sense of objects moving through space?	22	4.91	1.444
Were you able to anticipate what would happen next in response to the actions that you performed?	22	4.64	1.733
How completely were you able to actively survey or search the environment using vision?	22	5.86	1.356
How compelling was your sense of moving around inside the virtual environment?	22	5.41	1.333
How involved were you in the virtual environment experience?	22	5.95	1.214
How much delay did you experience between your actions and expected outcomes?	22	4.32	1.644
How quickly did you adjust to the virtual environment experience?	22	4.95	1.527
How proficient in moving and interacting with the virtual environment did you feel at the end of the experience?	22	4.77	1.688
Were you involved in the experimental task to the extent that you lost track of time?	22	5.14	1.807
How natural did your interactions with the environment seem?*	22	4.18	1.563
How natural was the mechanism which controlled movement through the environment?*	22	4.45	1.471
How much did your experiences in the virtual environment seem consistent with your real-world experiences?*	22	4.55	1.471
*Natural Questions			

Table 6.11: Witmer's User Experience Survey Questions (Involvement/Control &amp; Natural)[46]

RQ3: Does each of the levels of immersion increase the empathy, create better engagement, or both in users?

In this research, published in [55], the focus surrounded how immersion can impact empathy and engagement. In an effort to investigate the difference in the participant's empathy, a paired samples t-test was ran using SPSS. The survey used for the empathy questions is from [5, 31, 32].

Table 6.12 shows the statistics for the participants' responses to the empathy questions in the pre-survey, post-traditional, and post-VR. In column 1 of Table 6.16 are the labels for the questions from the survey which have two categories: empathic concern and perspective-taking. The empathic concern questions analyze how the participants feel about others in situations out of their control, while the perspective-taking questions are used to analyze if the participants are capable of seeing things from the perspective of others. The survey was given on a 5-point scale where 1 represents that the phrase does not describe them well, and 5 signifies that it describes them well. For the reverse coded questions, 1 represents that it describes them well, while 5 represents that it does not. The data was transformed to match the appropriate scaling based on [31, 32]. This scale uses values 0 through 4 rather than 1 through 5, so when processing the data, our results were processed to match the original scale accurately. In column 2, the mean for each survey-empathy type combination is shown. Each participant's responses to the categories were summed to create a category score. The participants' responses to empathic concern were summed to one value, and their responses to perspective-taking were summed to one value for each survey response. The means are the average of those sums for each survey. In this case, the higher the mean, the better the responses were. Table 6.12 shows that the best responses for empathic concern occurred when the participants completed the pre-survey. However, for the perspective-taking questions, there was an increase in responses in both the non-immersive and immersive post-surveys, with better responses coming from the non-immersive application.

In an effort to compare the statistical difference between the pre-survey and each of the post-survey responses, a paired sampled t-test was used to analyze if there were any differences. Table 6.13 shows the results of that analysis. In column 1, the survey-empathy type pair is

shown, while column 2 is for the t score, and column 3 is the two-sided p-value. The analysis shows that there were no significant differences in the users' responses when comparing the pre-survey to each of the post-survey empathy results.

To compare the non-immersive improvement to the immersive improvement in empathy scores, change scores were calculated. Changes scores were calculated by taking the value of the post-survey result and subtracting the pre-survey value. This was done for both empathic concern and perspective-taking. Those differences were used for comparison via paired sample t-test in SPSS. In Table 6.14, the results from that paired-sample t-test are shown. There are no significant differences in the change scores between the non-immersive and immersive experiences regarding empathic concern ( $p = 0.853$ ) or perspective taking ( $p = 0.618$ ).

Survey-Type	Mean
PS Empathic Concern	20.45
NI Empathic Concern	20.23
I Empathic Concern	20.32
PS Perspective-Taking	18.64
NI Perspective-Taking	19.00
I Perspective-Taking	18.73
NI = Non-Immersive, I = Immersive, PS = Pre-Survey	

Table 6.12: SPSS Empathy Results - Mean

Pair	t	Two-sided p
PS Empathic Concern v. NI Empathic Concern	0.533	0.599
PS Empathic Concern v. I Empathic Concern	0.335	0.741
PS Perspective-Taking v. NI Perspective-Taking	-0.508	0.617
PS Perspective-Taking v. I Perspective-Taking	-0.134	0.895
NI = Non-Immersive, I = Immersive, PS = Pre-Survey		

Table 6.13: SPSS Empathy Results - Paired Sample t Test

Pair	NI - PS Mean	I - PS Mean	t	Two-sided p
NI - PS v. I - PS Empathic Concern	-0.23	-0.14	-0.188	0.853
NI - PS v. I - PS Perspective-Taking	0.36	0.09	0.506	0.618
NI = Non-Immersive, I = Immersive, PS = Pre-Survey				

Table 6.14: SPSS Empathy Change Score Results - Paired Sample t Test

Table 6.15 displays the results from the user engagement scale paired sample t-test [47]. In column 1, the pairs are listed that are compared using the paired sample t-test. The user

engagement scale can be divided into four categories: focused attention, perceived usability, aesthetic appeal, and rewarding. Column 2 and 3 shows the non-immersive and immersive means for each category. In column 4, the t scores are shown with column having the two-sided p-values. Per [47], the scores for each category were calculated by taking the sum of all the responses and dividing them by 3. In contrast, the overall engagement score comes from taking all responses from all questions and dividing them by 12. Based on those results (t-scores), the VR experience outperformed the traditional experience in focused attention, aesthetic appeal, and rewarding. In terms of perceived usability, the traditional experience had a better average. Overall, the VR experience made for better user engagement compared to the traditional experience.

Table 6.15 shows no significant difference in the perceived usability ( $p = 0.668$ ) or rewarding ( $p = 0.434$ ) categories. There are significant differences in focused attention ( $p = 0.009$ ,  $p < 0.05$ ) and aesthetic appeal ( $p = 0.027$ ,  $p < 0.05$ ). For both focused attention and aesthetic appeal, the immersive experience had a better outcome than the non-immersive experience. Overall, there were no significant differences in the non-immersive and immersive user engagement responses ( $p = 0.062$ ).

Pair	NI Mean	I Mean	t	Two-sided p
NI Focused Attention v. I Focused Attention	2.864	3.561	-2.878	0.009
NI Perceived Usability v. I Perceived Usability	3.652	3.576	0.435	0.668
NI Aesthetic Appeal v. I Aesthetic Appeal	3.576	4.061	-2.374	0.027
NI Rewarding v. I Rewarding	4.212	4.349	-0.798	0.434
NI Overall v. I Overall	3.576	3.886	-1.967	0.062
NI = Non-Immersive, I = Immersive				

Table 6.15: SPSS User Engagement Results - Paired Sample t Test

For the third research question, "Does each of the levels of immersion increase the empathy, create better engagement, or both in users?", the results have shown that neither the non-immersive or immersive experience had an impact on increasing the empathic concern of the participants. Still, both increased their perspective-taking responses with the non-immersive having the larger increase. We found no significant differences in empathic concern or perspective-taking responses from the comparisons to pre-survey to post or in the change scores.

Although the traditional had a better impact on perspective-taking, the more immersive experience (VR) is more engaging to users than the traditional experience. Contrary to the data showing that the VR experience was perceived less usable than the traditional, the users felt the VR experience allowed them to get lost and absorb what was going on within the experience. The users also felt the activity was more attractive, aesthetically pleasing, worthwhile, and rewarding. An increased engagement of participants within the experience could lead to the participants learning more and understanding the disease and disorders they are simulating. Although there was no significant difference in the user engagement responses between the non-immersive and immersive experiences, there were significant differences in two subcategories: focused attention and aesthetic appeal, both favoring the immersive experience.

RQ4: “Does the strength of association between empathy improvement, UX, and engagement differ for each level of immersion?”

In Table 6.16, a table shows the Bivariate Pearson Correlation results between the empathy and user experience categories. This table shows the correlations from questions asked after the traditional experiment. The empathy categories are listed in the first column, followed by the stat labels from the SPSS Pearson Correlation test. The Pearson correlation value represents if the correlation was positive, negative, or non-existent. Pearson correlation values range from -1 to +1, where -1 represents an absolute negative correlation, 0 is no correlation, and +1 is an absolute positive correlation. Based on [57, 56], correlations can be explained even further by how strong they are such as weakly correlated, moderately correlated, or strongly correlated [57, 56] as shown below:

- weakly correlated:  $0.1 < |r| < 0.3$
- moderately correlated:  $0.3 < |r| < 0.5$
- strongly correlated:  $0.5 < |r| < 1.0$ .

In the non-immersive Pearson correlation results, there are two significant correlations. The two significant correlations occur between perspective-taking and stimulation ( $p = 0.018$ )

and perspective-taking and novelty ( $p = 0.015$ ). Regarding correlation strengths, there are two negative weakly correlated pairs: empathic concern and efficiency ( $r = -0.155$ ) and perspective-taking and efficiency ( $r = -0.123$ ). There are also two positive weakly correlated pairs: empathic concern and stimulation ( $r = 0.222$ ) and perspective-taking and attractiveness ( $r = 0.234$ ). Two positive moderately correlated pairs are empathic concern and novelty ( $r = 0.358$ ) and perspective taking and stimulation ( $r = 0.498$ ). One positive strongly correlated pair for the non-immersive empathy vs. user experience questions is perspective-taking and novelty ( $r = 0.513$ ).

In the immersive Pearson correlation results, there is one significant correlation shown in Table 6.17. A significant correlation occurs between empathic concern and novelty ( $p = 0.043$ ). Regarding correlation strengths, there are two negative weakly correlated pairs: empathic concern and perspicuity ( $r = -0.105$ ) and empathic concern and dependability ( $r = -0.117$ ). There are also four positive weakly correlated pairs: empathic concern and attractiveness ( $r = 0.113$ ), empathic concern and stimulation ( $r = 0.110$ ), perspective-taking and stimulation ( $r = 0.183$ ), and perspective-taking and novelty ( $r = 0.142$ ). One positive moderately correlated pair for the immersive empathy vs. user experience questions is empathic concern and novelty ( $r = 0.435$ ).

Following the correlations between empathy and user experience, a Pearson correlation was also executed for empathy and user engagement with results shown in Table 6.18. No significant correlations existed in the non-immersive survey for empathy and user engagement. However, all correlations are positive. There are four positive weakly correlated pairs: empathic concern and focused attention ( $r = 0.224$ ), empathic concern and rewarding ( $r = 0.161$ ), perspective-taking and rewarding ( $r = 0.218$ ), and empathic concern and overall engagement ( $r = 0.158$ ). There are also two positive moderately correlated pairs: perspective-taking and focused attention ( $r = 0.338$ ) and perspective-taking and overall engagement ( $r = 0.304$ ).

Regarding the Pearson correlation between empathy and user engagement for the immersive survey responses, there are two negative correlations, and the remaining are positive as shown in Table 6.19. No significant correlations existed in the immersive survey for empathy and user engagement. There is one negative weakly correlated pair, empathic concern and perceived usability ( $r = 0.171$ ). There are seven positive weakly correlated pairs: empathic concern and focused attention ( $r = 0.192$ ), empathic concern and rewarding ( $r = 0.297$ ), empathic

concern and overall engagement ( $r = 0.107$ ), perspective-taking and perceived usability ( $r = 0.212$ ), perspective-taking and aesthetic appeal ( $r = 0.101$ ), perspective-taking and rewarding ( $r = 0.171$ ) and perspective-taking and overall engagement ( $r = 0.141$ ).

In regard to the strength in correlations, Table 6.20 shows which experience had the stronger correlation regardless of whether it was negative or not. In this case, the results show that each the non-immersive and immersive experiences had 6 correlations where it was better than the other. In terms of empathic concern, the stronger correlations occurred in the immersive experience, whereas in perspective-taking, the stronger correlations occurred within the non-immersive experience. The strongest correlation of them all occurred between perspective-taking and novelty in the non-immersive experience.

Table 6.21 shows which experience had the stronger correlation regardless of whether it was negative or not for the empathy and user engagement responses. When comparing the values, the absolute value is taken before deciding which value is higher in terms of correlation and labeled if negatively correlated. In this case, the results show that the non-immersive experience had stronger correlations than the immersive. The non-immersive was stronger in focused attention (empathic concern and perspective-taking), aesthetic appeal (empathic concern and perspective-taking), rewarding (perspective-taking) and overall (empathic concern and perspective-taking). The immersive experience had stronger correlations for perceived usability (empathic concern and perspective-taking) and rewarding (empathic concern).

Along with checking the correlations of the scores for the non-immersive and immersive empathy results with user experience and user engagement, the correlation association between the empathy change score, user experience, and user engagement was also examined. The change scores are the difference between the responses of the pre-survey and each of the non-immersive and immersive experiences.

In the non-immersive empathy change score Pearson correlation results with user experience shown in Table 6.22, there is one significant correlation. A significant correlation occurs between empathic concern and novelty ( $p = 0.034$ ). Regarding correlation strengths, there are four positive weakly correlated pairs: empathic concern and attractiveness ( $r = 0.297$ ), empathic concern and efficiency ( $r = 0.169$ ), perspective-taking and attractiveness ( $r = 0.235$ ), and

perspective-taking and efficiency ( $r = 0.183$ ). There are two three positive moderately correlated pairs: empathic concern and stimulation ( $r = 0.340$ ), empathic concern and novelty ( $r = 0.454$ ), and perspective-taking and novelty ( $r = 0.324$ ).

In the immersive Pearson correlation results against user experience in Table 6.23, there are four negative weakly correlated pairs: perspective-taking and attractiveness ( $r = -0.117$ ), perspective-taking and perspicuity ( $r = -0.205$ ), perspective-taking and dependability ( $r = -0.174$ ) and perspective-taking and stimulation ( $r = -0.120$ ). There are four positive weakly correlated pairs: empathic concern and attractiveness ( $r = 0.177$ ), empathic concern and stimulation ( $r = 0.186$ ), empathic concern and novelty ( $r = 0.199$ ), and perspective-taking and novelty ( $r = 0.142$ ). There is one positive moderately correlated pair: empathic concern and dependability ( $r = 0.302$ ).

After the correlations between empathy and user experience, a Pearson correlation was also executed for the empathy change scores and user engagement with results shown in Table 6.24. There are two significant correlations in the non-immersive change score correlation with user engagement. The significant correlations are between perspective-taking and aesthetic appeal ( $p = 0.003$ ) and perspective-taking and overall score ( $p = 0.034$ ). There are two positive weakly correlated pairs: empathic concern and rewarding ( $r = 0.104$ ) and perspective-taking and rewarding ( $r = 0.160$ ). There are seven positive moderately correlated pairs: empathic concern and focused attention ( $r = 0.343$ ), empathic concern and perceived usability ( $r = 0.336$ ), empathic concern and aesthetic appeal ( $r = 0.345$ ), empathic concern and overall score ( $r = 0.352$ ), perspective-taking and focused attention ( $r = 0.353$ ), perspective-taking and perceived usability ( $r = 0.310$ ), and perspective-taking and overall score ( $r = 0.455$ ). There is one positive strongly correlated pair, perspective-taking and aesthetic appeal ( $r = 0.597$ ).

Regarding the Pearson correlation between empathy and user engagement for the immersive survey responses, there are three negative correlations, and the remaining are positive as shown in Table 6.25. There is one negative weakly correlated pair: empathic concern and perceived usability ( $r = -0.166$ ). There are six positive weakly correlated pairs: empathic concern and focused attention ( $r = 0.249$ ), empathic concern and aesthetic appeal ( $r = 0.239$ ), empathic

concern and rewarding ( $r = 0.103$ ), empathic concern and overall score ( $r = 0.141$ ), perspective-taking and perceived usability ( $r = 0.268$ ), and perspective-taking and overall score ( $r = 0.103$ ).

For the final research question, "Does the strength of association between empathy improvement, UX, and engagement differ for each level of immersion?", we used SPSS to run a Pearson correlation on the empathy improvement and UX responses and empathy improvement and user engagement responses from the non-immersive and immersive surveys. Regarding strength in correlations, Table 6.26 shows which experience had the stronger correlation regardless of whether it was negative or not. In this case, the results show that the non-immersive experience was stronger for more user experience categories than the immersive experience. In terms of empathic concern, the stronger correlations occurred in the non-immersive experience, whereas in perspective-taking, the immersive and non-immersive experiences each won three of the six categories. The strongest correlation of them all occurred between empathic concern and novelty in the non-immersive experience.

Table 6.27 shows which experience had the stronger correlation regardless of whether it was negative or not for the empathy and user engagement responses. In this case, the results show that the non-immersive experience had stronger correlations than the immersive in every category. The strongest correlation occurred between the perspective-taking and aesthetic appeal of the non-immersive application. This shows us that there is a difference in the strength of association for each level of immersion between empathy improvement, UX, and user engagement with stronger correlations favoring the non-immersive experience.

		Pearson Correlation Non-Immersive Empathy - UEQ							
		NL_Attractiveness	NL_Perspiciuity	NL_Efficiency	NL_Dependability	NL_Stimulation	NL_Novelty		
NIEC	Pearson Correlation	0.015	0.066	-0.155	-0.053	0.222	0.358		
	Sig.	0.948	0.772	0.490	0.815	0.320	0.102		
	N	22	22	22	22	22	22		
NIPPT	Pearson Correlation	0.234	0.002	-0.123	-0.010	0.498*	0.513*		
	Sig.	0.295	0.992	0.585	0.964	0.018	0.015		
	N	22	22	22	22	22	22		
NI = Non-Immersive, EC = Empathic Concern, PT = Perspective-Taking, * = p < 0.05, ** = p < 0.01									

Table 6.16: SPSS - Pearson Correlation Non-Immersive Empathy - UEQ

		Pearson Correlation Immersive Empathy - UEQ						
		I_Attractiveness	I_Perspicuity	I_Efficiency	I_Dependability	I_Stimulation	I_Novelty	
I_EC	Pearson Correlation	0.113	-0.105	-0.089	-0.117	0.110	0.435*	
	Sig.	0.618	0.643	0.693	0.604	0.625	0.043	
	N	22	22	22	22	22	22	
I_PT	Pearson Correlation	0.076	-0.040	0.003	0.036	0.183	0.142	
	Sig.	0.737	0.861	0.989	0.874	0.414	0.527	
	N	22	22	22	22	22	22	
I = Immersive, EC = Empathic Concern, PT = Perspective-Taking, * = p < 0.05, ** = p < 0.01								

Table 6.17: SPSS - Pearson Correlation Immersive Empathy - UEQ

		Pearson Correlation Non-Immersive Empathy - User Engagement					
		NI_FA Score	NI_PU Score	NI_AE Score	NI_RW Score	NI_Overall Score	
NI_EC	Pearson Correlation	0.224	0.057	0.082	0.161	0.158	
	Sig.	0.315	0.801	0.717	0.473	0.484	
	N	22	22	22	22	22	
NI_PT	Pearson Correlation	0.338	0.091	0.327	0.218	0.304	
	Sig.	0.123	0.687	0.138	0.329	0.168	
	N	22	22	22	22	22	
NI = Non-Immersive, EC = Empathic Concern, PT = Perspective-Taking, * = p < 0.05, ** = p < 0.01 FA = Focused Attention, PU = Perceived Usability, AE = Aesthetic Appeal, RW = Rewarding							

Table 6.18: SPSS - Pearson Correlation Non-Immersive Empathy - User Engagement

	Pearson Correlation	Pearson Correlation Immersive Empathy - User Engagement					
		I_FA Score	I_PU Score	I_AE Score	I_RW Score	I_Overall Score	
I_EC	Pearson Correlation Sig. N	0.192 0.391 22	-0.171 0.448 22	0.068 0.764 22	0.297 0.180 22	0.107 0.637 22	
I_PT	Pearson Correlation Sig. N	-0.010 0.965 22	0.212 0.342 22	0.101 0.654 22	0.171 0.448 22	0.141 0.532 22	
I = Immersive, EC = Empathic Concern, PT = Perspective-Taking, * = p < 0.05, ** = p < 0.01 FA = Focused Attention, PU = Perceived Usability, AE = Aesthetic Appeal, RW = Rewarding							

Table 6.19: SPSS - Pearson Correlation Immersive Empathy - User Engagement

Empathy	Attractiveness	Perspicuity	Efficiency	Dependability	Stimulation	Novelty
EC	I	I (negatively)	NI (negatively)	I (negatively)	NI	I
PT	NI	I (negatively)	NI (negatively)	I	NI	NI
NI = Non-Immersive, I = Immersive, EC = Empathic Concern, PT = Perspective-Taking						

Table 6.20: Strongest Correlation - Empathy - User Experience

Empathy	FA	PU	AE	RW	Overall
EC	NI	I (negatively)	NI	I	NI
PT	NI	I	NI	NI	NI
NI = Non-Immersive, I = Immersive, EC = Empathic Concern, PT = Perspective-Taking FA = Focused Attention, PU = Perceived Usability, AE = Aesthetic Appeal, RW = Rewarding					

Table 6.21: Strongest Correlation - Empathy - User Engagement

		Pearson Correlation Non-Immersive Empathy Change Score - UEQ						
		NL_Attractiveness	NL_Perspicuity	NL_Efficiency	NL_Dependability	NL_Stimulation	NL_Novelty	
NL_CS_EC	Pearson Correlation	0.297	-0.047	0.169	-0.001	0.340	0.454*	
	Sig.	0.179	0.835	0.453	0.997	0.122	0.034	
	N	22	22	22	22	22	22	
NL_CS_PT	Pearson Correlation	0.235	-0.072	0.183	0.082	0.087	0.324	
	Sig.	0.292	0.750	0.416	0.717	0.701	0.141	
	N	22	22	22	22	22	22	
NI = Non-Immersive, EC = Empathic Concern, PT = Perspective-Taking, CS = Change Score * = p < 0.05, ** = p < 0.01								

Table 6.22: SPSS - Pearson Correlation Non-Immersive Empathy Change Score - UEQ

		Pearson Correlation Immersive Empathy Change Score - UEQ							
		I_Attractiveness	I_Perspicuity	I_Efficiency	I_Dependability	I_Stimulation	I_Novelty		
I_CS_EC	Pearson Correlation	0.177	-0.033	0.083	0.302	0.186	0.199		
	Sig.	0.430	0.885	0.715	0.172	0.406	0.373		
	N	22	22	22	22	22	22		
I_CS_PT	Pearson Correlation	-0.117	-0.205	0.055	-0.174	-0.120	0.142		
	Sig.	0.603	0.360	0.809	0.438	0.596	0.527		
	N	22	22	22	22	22	22		
I = Immersive, EC = Empathic Concern, PT = Perspective-Taking, CS = Change Score, * = p < 0.05, ** = p < 0.01									

Table 6.23: SPSS - Pearson Correlation Immersive Empathy Change Score - UEQ

		Pearson Correlation Non-Immersive Empathy Change Score - User Engagement					
		NI_FA Score	NI_PU Score	NI_AE Score	NI_RW Score	NI_Overall Score	
NL_CS_EC	Pearson Correlation	0.343	0.336	0.345	0.104	0.352	
	Sig.	0.118	0.126	0.116	0.644	0.108	
	N	22	22	22	22	22	
NL_CS_PT	Pearson Correlation	0.353	0.310	0.597**	0.160	0.455*	
	Sig.	0.107	0.161	0.003	0.476	0.034	
	N	22	22	22	22	22	

NI = Non-Immersive, EC = Empathic Concern, PT = Perspective-Taking, CS = Change Score, \* = p < 0.05, \*\* = p < 0.01  
FA = Focused Attention, PU = Perceived Usability, AE = Aesthetic Appeal, RW = Rewarding

Table 6.24: SPSS - Pearson Correlation Non-Immersive Empathy Change Score - User Engagement

		Pearson Correlation Immersive Empathy Change Score - User Engagement					
		I_FA Score	I_PU Score	I_AE Score	I_RW Score	I_Overall Score	
I_CS_EC	Pearson Correlation	0.249	-0.166	0.239	0.103	0.141	
	Sig.	0.264	0.461	0.284	0.647	0.530	
	N	22	22	22	22	22	
I_CS_PT	Pearson Correlation	-0.019	0.268	0.084	-0.039	0.103	
	Sig.	0.933	0.227	0.709	0.864	0.647	
	N	22	22	22	22	22	
I = Immersive, EC = Empathic Concern, PT = Perspective-Taking, CS = Change Score, * = p < 0.05, ** = p < 0.01 FA = Focused Attention, PU = Perceived Usability, AE = Aesthetic Appeal, RW = Rewarding							

Table 6.25: SPSS - Pearson Correlation Immersive Empathy Change Score - User Engagement

Empathy	Attractiveness	Perspicuity	Efficiency	Dependability	Stimulation	Novelty
EC CS	NI	NI (negatively)	NI	I	NI	NI
PT CS	NI	I (negatively)	NI	I (negatively)	I (negatively)	NI
NI = Non-Immersive, I = Immersive EC = Empathic Concern, PT = Perspective-Taking, CS = Change Score						

Table 6.26: Strongest Correlation - Empathy - User Experience

Empathy	FA	PU	AE	RW	Overall
EC CS	NI	NI	NI	NI	NI
PT CS	NI	NI	NI	NI	NI
NI = Non-Immersive, I = Immersive EC = Empathic Concern, PT = Perspective-Taking, CS = Change Score FA = Focused Attention, PU = Perceived Usability, AE = Aesthetic Appeal, RW = Rewarding					

Table 6.27: Strongest Correlation - Empathy - User Engagement

## Chapter 7

### Conclusions & Future Work

#### 7.1 Conclusions

In this research, we designed and developed an application geared towards creating a better user experience and engagement than traditional, low-fidelity experiences. This research was also geared towards increasing the empathy of the participants. The application created in this research is the beginning framework for an empathy-building application that will host many disorder and disease simulations. This work was specifically focused on Rheumatoid Arthritis. The objective was to create an immersive experience that allowed students to see what it is like in a typical day for RA patients. The experience was created in VR and in a traditional setting (low-fidelity) to compare which impacted the students more. This study looked at the empathy comparisons before the experiment, post-traditional, and post-VR. We also looked at the differences in the participants' user experience and user engagement between the non-immersive and immersive experiments.

In the end, we learned that students' awareness of RA increased after both experiments. We also learned that the participants had a better experience via UEQ in the VR experience rather than the traditional one. The UEQ allowed us to compare our results to some benchmark results stored in its analysis tool. The traditional experience was above average in efficiency and good in perspicuity, dependability, stimulation, and novelty. Meanwhile, the VR experiment was above average in attractiveness and perspicuity, good in novelty, and excellent in stimulation. Regarding empathy, there were some improvements in the averages for perspective-taking

questions, but the larger increase came from the traditional application. There were no significant changes in empathy and possibly due to the lack of power that would allow us to detect a difference. We also discovered that the participants were more engaged in the VR application than the traditional one. This work is only the beginning of what we hope to be a very impactful application in the area of medical education. Along the way, we encountered quite a few limitations and complications that led to us making changes to our designs and plans.

## 7.2 Limitations and Complications

Many limitations came up through this research process. Initially, the plans were to observe the impact of the different immersion levels for RA patients. The objectives were to show early-stage RA patients what their future could be like if they did not take any steps to mitigate their disease. The focus was to increase their empathy for their future selves and self-efficacy. In the end, we wanted to increase their adherence to treatment so that they could attempt to slow down their disease progression. Due to the nature of the experiment at this time, with the technology and the uncertainty behind COVID and monkey pox, the focus of the research shifted from patients to university students.

With COVID and monkey-pox being recent illnesses that people have contracted, our research is restricted to the Auburn-Opelika area, specifically Auburn University students. At any moment, the community spread levels can change and require changes in the experimental protocol, so we always had to be aware of what our levels were. During the initial planning, we were at a high risk, and by the time we began the experiment, it reduced to low spread. Being low, we screened the students and researchers for COVID once they arrived at the I&RC. Another limitation is that we could not have participants with any contraindications to using the VR headset or simulation gloves. Contraindications included illnesses, deformity or pain in the hand, pregnancy, vision abnormalities (crossed eyes or lazy eye), or other serious medical conditions. Students who were also prone to motion sickness were not eligible to participate.

Other complications we encountered were technology centered. In the beginning, we started developing the application using Unreal Engine because of the high-quality graphics it

has and its compatibility with the TESLASUIT. However, once we planned to use the TESLASUIT and TESLAGLOVE, we discovered the glove's initial SDK would possibly only be for Unity which led to our switch in development platforms (although now the website says coming soon for both Unity and Unreal). Due to these issues, we tried to use the headset's hand tracking with RA simulation gloves.

Another complication came with the Oculus Quest 2 headset's hand-tracking features. Since we did not have haptic or force feedback gloves during this time, we decided to use simulation gloves. We used these black RA simulation gloves in our first attempt at using simulation gloves. While testing these gloves, we discovered that the headset's hand tracking would not consistently track the movements of these gloves. We believe this could be due to the color contrast of the gloves and the way the headset recognizes hands. Before this, we also looked to use the gloves from [52], but we feared the color and thickness of the gloves would cause trouble for the headset. The second attempt at solving this involved purchasing a Leap-Motion to test if their hand-tracking features would work with the black RA simulation gloves. This process would have required implementation changes; therefore, before thoroughly testing this idea, we made one last attempt by purchasing the Cambridge simulation gloves. The Quest 2 also could not accurately track the user's hands with that apparatus on, which is why they wear beige-toned gloves on top of the Cambridge simulation gloves. From testing that combination, we found that the headset could consistently track the user's hands which is why that combination was used in the experiment.

### 7.3 Future Work

In the future, this research will be expanded in two ways: (1) the addition of technology and (2) the addition of new diseases and disorders into the framework. These two expansions could allow for a more enhanced experience for users and educate them more on the difficulties that people have with their specific disease or disorder.

In regards to the addition of technology, as mentioned previously, this research was limited to simulation gloves to simulate the joint mobility difficulties that RA patients experience. In the future, this can be upgraded to use haptic and force feedback gloves to enhance the

immersive experience in simulating RA. Currently, for RA simulation, the focus is surrounding their hand joint mobility limitations. This can be expanded to a full-body experience. The TESLASUIT [49] and TESLAGLOVE [48] could be used to create a full-body immersive simulation experience.

In the future, when measuring empathy, the belief is that a better scale can be chosen, developed, or altered. In the research, we used the IRI scale [5, 31, 32], which is a very popular scale to measure empathy. We used the empathic concern and perspective-taking questions from the scale for our participants to answer. The questions are asking questions about people in general and not specifically RA patients, and although there was some improvement in empathy, a more RA-centered survey may have performed even better.

In the future, this framework is also planned to be expanded to more than just Rheumatoid Arthritis. Other joint mobility diseases or disorders can be added as well. However, even outside of the realm of joint mobility, this application can add visual and audiological impairments for users to experience. This could also be used to increase users' empathy for others and educate them on what others go through. It is one thing to hear from others about their experiences, while it is completely different to experience some of what they endure on a daily basis.

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## Appendices

**AUBURN UNIVERSITY INSTITUTIONAL REVIEW BOARD for RESEARCH INVOLVING HUMAN SUBJECTS**

**PROTOCOL REVIEW FORM  
FULL BOARD or EXPEDITED REVIEW**

For assistance, contact: **The Office of Research Compliance (ORC)**

Phone: **334-844-5966** E-Mail: [IRBAdmin@auburn.edu](mailto:IRBAdmin@auburn.edu) Web Address: <http://www.auburn.edu/research/vpr/ohs>

**Submit completed form and supporting materials as one PDF through the [IRB Submission Page](#)**

*Handwritten forms are not accepted. Where links are found hold down the control button (Ctrl) then click the link.*

1. Proposed Start Date of Study: 10/10/2022  
**2022**

Today's Date: **July 13,**

Submission Status (Check One):  New  Revisions (to address IRB Review Comments)

Proposed Review Category (Check One):  Full Board (greater than minimal risk)  Expedited

If Expedited, Indicate Category(ies) ([Link to Expedited Category Review Sheet](#)) *Click or tap to enter category.*

2. Project Title: A Virtual Reality Framework to support Rheumatoid Arthritis Education: The Impact of Different Immersion Levels on the Empathy and Engagement of College Students

3. Principal Investigator (PI): Alexicia D. Richardson

Degree(s): BWE – Software Option

Rank/Title: Graduate Student

Department/School: Computer Science and Software

Engineering

Role/responsibilities in this project: To work on software development, room reservation, informed consent, risk and safety monitoring, delivery of VR experience, data collection, data cleaning and analysis, and report writing.

Preferred Phone Number: 251-593-5397

AU Email: [adr0021@auburn.edu](mailto:adr0021@auburn.edu)

Faculty Advisor Principal Investigator (if applicable): **Dr. Cheryl D. Seals**

Rank/Title: Professor

Department/School: Computer Science and Software Engineering

Role/responsibilities in this project: To supervise the development and analysis of this research project.

Preferred Phone Number: 334-332-8282

AU Email: [sealscd@auburn.edu](mailto:sealscd@auburn.edu)

Department Head: **Dr. Hari Narayanan**

Department/School: Computer Science and Software Engineering

Preferred Phone Number: 334-844-6312

AU Email: [naraynh@auburn.edu](mailto:naraynh@auburn.edu)

Role/responsibilities in this project: Will review and approve the project.

4. Funding Support:  N/A  Internal External Agency: *Click or tap here to enter text.* Pending  Received

For federal funding, list funding agency and grant number (if available): *Click or tap here to enter text.*

5. a) List any contractors, sub-contractors, and other entities associated with this project: NA

b) List any other AU IRB approved protocols associated with this study and describe the association: *Click or tap here to enter text.*

c) List any other institutions associated with this study and submit a copy of their IRB approval(s): NA

**Protocol Packet Checklist**

Check all applicable boxes. A completed checklist is required.

- Protocol Review Form** (All required signatures included and all sections completed)  
(Examples of appended documents are found on the website: <https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs>)
- CITI Training Certificates** for key personnel
- Consent Form or Information Letter** and any releases (audio, video or photo) that participants will review and/or sign
- Appendix A** "Reference List"
- Appendix B** if e-mails, flyers, advertisements, social media posts, generalized announcements or scripts, etc., will be used to recruit participants.

- Appendix C** if data collection sheets, surveys, tests, other recording instruments, interview scripts, etc. will be used for data collection. Attach documents in the order they are listed in item 13c. **Continued on Page 2**
- Appendix D** if they study will use a debriefing form or will include emergency plans procedures and medical referral lists. (A referral list may be attached to the consent document.)
- Appendix E** if research is being conducted at sites other than Auburn University or in cooperation with other entities. A **permission letter** from the site/ program director must be included indicating their cooperation or involvement in the project. NOTE: If the proposed research is a multi-site project, involving investigators or participants at other academic institutions, hospitals or private research organizations, a letter of **IRB approval** from each entity is required prior to initiating the project.
- Appendix F** Written evidence of approval by the host country, local IRB or institutions if research is conducted outside the United States

## 6. General Research Project Characteristics

<b>6A. Research Methodology</b>			
Check all descriptions that best apply to the research methodology.			
Data Source(s): <input checked="" type="checkbox"/> New Data <input type="checkbox"/> Existing Data	Will recorded data directly or indirectly identify participants? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
<b>Data collection will involve the use of:</b> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> <input type="checkbox"/> Educational Tests (cognitive diagnostic, aptitude, etc.)  <input type="checkbox"/> Interview  <input type="checkbox"/> Observation  <input type="checkbox"/> Locations or Tracking Measures  <input checked="" type="checkbox"/> Physical / Physiological Measures or Specimens  <input checked="" type="checkbox"/> Surveys / Questionnaires  <input type="checkbox"/> Other: <a href="#">Click or tap here to enter text.</a> </td> <td style="width: 50%; vertical-align: top;"> <input checked="" type="checkbox"/> Internet / Electronic  <input type="checkbox"/> Audio  <input type="checkbox"/> Video  <input type="checkbox"/> Photos  <input type="checkbox"/> Digital Images  <input type="checkbox"/> Private records or files         </td> </tr> </table>		<input type="checkbox"/> Educational Tests (cognitive diagnostic, aptitude, etc.) <input type="checkbox"/> Interview <input type="checkbox"/> Observation <input type="checkbox"/> Locations or Tracking Measures <input checked="" type="checkbox"/> Physical / Physiological Measures or Specimens <input checked="" type="checkbox"/> Surveys / Questionnaires <input type="checkbox"/> Other: <a href="#">Click or tap here to enter text.</a>	<input checked="" type="checkbox"/> Internet / Electronic <input type="checkbox"/> Audio <input type="checkbox"/> Video <input type="checkbox"/> Photos <input type="checkbox"/> Digital Images <input type="checkbox"/> Private records or files
<input type="checkbox"/> Educational Tests (cognitive diagnostic, aptitude, etc.) <input type="checkbox"/> Interview <input type="checkbox"/> Observation <input type="checkbox"/> Locations or Tracking Measures <input checked="" type="checkbox"/> Physical / Physiological Measures or Specimens <input checked="" type="checkbox"/> Surveys / Questionnaires <input type="checkbox"/> Other: <a href="#">Click or tap here to enter text.</a>	<input checked="" type="checkbox"/> Internet / Electronic <input type="checkbox"/> Audio <input type="checkbox"/> Video <input type="checkbox"/> Photos <input type="checkbox"/> Digital Images <input type="checkbox"/> Private records or files		
<b>6B. Participant Information</b>	<b>6C. Risks to Participants</b>		
<b>Check all descriptors that apply to the TARGET population.</b> (link to <a href="#">definition of target population</a> ) <input type="checkbox"/> Males <input type="checkbox"/> Females <input checked="" type="checkbox"/> AU students  <b>Vulnerable Populations</b> <input type="checkbox"/> Pregnant Women/Fetuses <input type="checkbox"/> Prisoners <input type="checkbox"/> Institutionalized <input type="checkbox"/> Children and / or Adolescents (under age 18 in AL; if minor participants, at least 2 adults must be present during all research procedures that include the minors)  <b>Persons with:</b> <input type="checkbox"/> Economic Disadvantages <input type="checkbox"/> Physical Disabilities <input type="checkbox"/> Educational Disadvantages <input type="checkbox"/> Intellectual Disabilities  <b>Will participants be compensated?</b> <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<b>Identify all risks participants might encounter in this research.</b>  <input checked="" type="checkbox"/> Breach of Confidentiality* <input type="checkbox"/> Coercion <input type="checkbox"/> Deception <input checked="" type="checkbox"/> Physical <input checked="" type="checkbox"/> Psychological <input type="checkbox"/> Social <input type="checkbox"/> None <input checked="" type="checkbox"/> Other (COVID-19, other medical): <b>COVID-19 infection risk</b>  *Note that if the investigator is using or accessing confidential or identifiable data, breach of confidentiality is always a risk.		
<b>6D. Corresponding Approval/ Oversight</b>			
<ul style="list-style-type: none"> <li>• <b>Does the study include participant exposure to radiation?</b> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                If yes indicate: <input type="checkbox"/> DEXA <input type="checkbox"/> PQCT <input type="checkbox"/> Other</li> <li>• <b>Is IBC Approval required for this study?</b>  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                 If yes, BUA # <a href="#">Click or tap here to enter text.</a>      <b>Expiration Date</b> <a href="#">Click or tap to enter a date.</a></li> <li>• <b>Is IACUC Approval required for this study?</b>  <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No                 If yes, PRN # <a href="#">Click or tap here to enter text.</a>      <b>Expiration Date</b> <a href="#">Click or tap to enter a date.</a></li> </ul>			

- Does this study involve the Auburn University MRI Center?

Yes  No

Which MRI(s) will be used for this project? (Check all that apply)

3T  7T

Does any portion of this project require review by the MRI Safety Advisory Council?

Yes  No

Continued on Page 3

Signature of one MRI Center Representative: \_\_\_\_\_

**Required for all projects involving the AU MRI Center**

Appropriate MRI Center Representatives:

Dr. Thomas S. Denney, Director AU MRI Center

Dr. Ron Beyers, MR Safety Officer

## 7. Project Assurances

### 7A. Principal Investigator's Assurances

1. I certify that all information provided in this application is complete and correct.
2. I understand that, as Principal Investigator, I have ultimate responsibility for the conduct of this study, the ethical performance this project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by the Auburn University IRB.
3. I certify that all individuals involved with the conduct of this project are qualified to carry out their specified roles and responsibilities and are in compliance with Auburn University policies regarding the collection and analysis of the research data.
4. I agree to comply with all Auburn policies and procedures, as well as with all applicable federal, state, and local laws regarding the protection of human subjects, including, but not limited to the following:
  - a. Conducting the project by qualified personnel according to the approved protocol
  - b. Implementing no changes in the approved protocol or consent form without prior approval from the Office of Research Compliance
  - c. Obtaining the legally effective informed consent from each participant or their legally responsible representative prior to their participation in this project using only the currently approved, stamped consent form
  - d. Promptly reporting significant adverse events and / or effects to the Office of Research Compliance in writing within 5 working days of the occurrence.
5. If I will be unavailable to direct this research personally, I will arrange for a co-investigator to assume direct responsibility in my absence. This person has not been named as co-investigator in this application, or I will advise ORC, by letter, in advance of such arrangements.
6. I agree to conduct this study only during the period approved by the Auburn University IRB.
7. I will prepare and submit a renewal request and supply all supporting documents to the Office of Research Compliance before the approval period has expired if it is necessary to continue the research project beyond the time period approved by the Auburn University IRB.
8. I will prepare and submit a final report upon completion of this research project.

My signature indicates I have read, understand and agree to conduct this research project in accordance with the assurances listed above.

Alexicia D. Richardson  
Principal Investigator Name

*Alexicia Richardson*  
Principal Investigator Signature

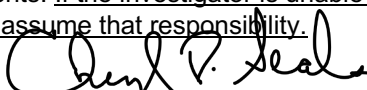
\_9/29/2022\_  
Date

### 7B. Faculty Advisor / Sponsor's Assurances

1. I have read the protocol submitted for this project for content, clarity, and methodology.
2. By my signature as faculty advisor / sponsor on this research application, I certify that the student or guest investigator is knowledgeable about the regulations and policies governing research with human subjects and has sufficient training and experience to conduct this particular study in accord with the approved protocol.
3. I agree to meet with the investigator on a regular basis to monitor study progress. Should problems arise during the course of the study, I agree to be available, personally, to supervise the investigator in solving them.
4. I assure that the investigator will promptly report significant incidents and / or adverse events and / or effects to the ORC in writing within 5 working days of the occurrence.
5. If I will be unavailable, I will arrange for an alternate faculty sponsor to assume responsibility during my absence, and I

will advise the ORC by letter of such arrangements. If the investigator is unable to fulfill requirements for submission of renewals, modifications or the final report, I will assume that responsibility.

Cheryl D. Seals  
Faculty Advisor / Sponsor Name

  
Faculty Advisor Signature

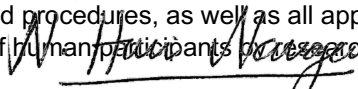
10/6/2022  
Date

Continued on Page 4

### 7C. Department Head's Assurance

By my signature as department head, I certify that I will cooperate with the administration in the application and enforcement of all Auburn University policies and procedures, as well as all applicable federal, state, and local laws regarding the protection and ethical treatment of human participants or researchers in my department.

Hari Narayanan  
Department Head Name

  
Department Head Signature

10/14/22  
Date

## 8. Project Overview:

### 8A. A summary of relevant research findings leading to this research proposal:

(Cite source; include a "Reference List" as **Appendix A.**)

The use of virtual reality in the medical field has become more popular and is multi-purposeful in that area. We've seen research like [6] where the authors develop a game that promotes physical activity in older patients, specifically those with RA. In the work of Venuturupalli et al. [5], the focus of their work was to reduce pain and anxiety in patients suffering from rheumatic autoimmune disorders. VR has also been utilized to increase patient empathy in the training of medical professionals and students as seen in [7]. Li et al. conducted an experiment to increase the empathy for patients with Parkinson's Disease by medical students and professionals. In the literature, we have reviewed virtual reality experiments to increase empathy. These experiments have been deemed successful in increasing the empathy that medical students and medical professionals have for their patients [3, 4]. Authors have also considered an increase in one's empathy for themselves [2]. The success of these virtual reality scenarios indicates that VR will potentially have that same impact on Auburn University students. Based on the successes reviewed in the literature, we believe we can use VR to make an impact on students for patients with RA.

### 8B. A brief summary/abstract of the study methodology, including design, population, and variables of interest.

(350 word maximum, in language understandable to someone who is not familiar with your area of study. Note this summary/abstract can be used to prepare the concise summary in the consent document.):  
The main objective of this study is to observe the differences in empathy, user experience, and user engagement in students during activities that simulate difficulties that RA patients endure while trying to complete their daily activities. There will be two levels of immersion: traditional (non-immersive) and virtual reality. The traditional approach will be completed without a virtual reality headset while the headset will be worn for the virtual reality approach. Both levels will include a glove. The subjects of this experiment are students 19 and up and experts. For example, the traditional approach will involve three activities: brushing teeth (only the set up and mimic brushing, no actual brush to teeth contact), opening pill bottles and sorting them, and making a cup of coffee. These will be setup using real life objects and the participants will be asked to wear the gloves to complete the activity. The immersive experience includes those same activities, but virtually. The participants will be asked to wear an Oculus Quest 2 headset along with the gloves and complete the tasks virtually. Each of the three activities, non-immersive and immersive will be capped off at 1 minute and 30 seconds. The goal is to have anywhere between 36-50 students participate in the study. These students will be recruited from the Auburn University. There will be an incentive of a \$20 gift card for these students to participate in and complete our study. The incentives will be given to 50 participants. For the experts, we will have between 6 to 8 to participate in the study. The experts will be colleagues around the area who are knowledgeable in the topic of VR or RA. The experts will be used to assist in the design of the application and evaluate the system's usability.

## 9. Purpose

### 9A. State the purpose of the study and all research questions or aims. (Include a sentence that begins, "The purpose of this study is...")

The purpose of this study is to increase empathy in students for people who have rheumatoid arthritis along with educate students about the difficulties that RA patients endure while trying to complete their daily activities. It will be a comparative study where we are comparing the impact of different levels of immersion on the student's empathy and engagement. The experiment is planned to be carried out as follows. Those who choose to participate will click the pre-survey link in the recruitment email and complete the survey. Once complete, they will be directed to a SignUp genius page to select a date and time to complete the experiment.

The participants will be asked to come on Auburn University's campus to carry out the experiment in the presence of researchers. Each participant will only be asked to attend for 1 session to complete the experience that last approximately 40-45 minutes. They will be informed on how the experiment will work and asked to sign a consent form if they are choosing to participate. The participants will be asked to participate in the patient journey experience from different levels of immersion. Each level of immersion will simulate what it is like to have RA without any steps to mitigate the progression of the disease. Each of these experiences will range from 3 to 5 minutes involving the participants completing the daily activities of the experiment. Following the completion of a level of immersion, the participant will be asked to complete a post-experience survey before continuing to the next immersion level. The post-survey questionnaire should take less than 5 minutes to complete and includes empathy, user experience, user engagement, and awareness questions.

**9B. Describe how results of this study will be used? (e.g., presentation? publication? thesis? dissertation?)**

**Results of the study will be presented in local, regional, national, and international venues. Results of the study will be used in a dissertation and presented at conferences. The work will also be published as we already have one publication for the preliminary design of the application.**

**10. Key Personnel.** Describe responsibilities as specifically as possible. Include information on research training or certifications related to this project. **To determine key personnel see decision tree at <https://cws.auburn.edu/OVPR/pm/compliance/irb/training>. Submit a copy of CITI training documentation for all key personnel.** (For additional personnel, add lines as needed).

To determine Auburn University HIPAA – covered entities click link to [HIPAA Policy](#).

If any key personnel have a formal association with institutions/entities involved in the study (for example is an employee or supervisor at the site research will occur), describe that affiliation. For all non-AU affiliated key personnel, submit a copy of their IRB approval.

**Principal Investigator:** Alexicia Richardson

**Email Address:** adr0021@auburn.edu

**Dept. / Affiliation:** Computer Science and Software Engineering

**Rank/Title:** Graduate Student

**Degree(s):** BS

**HIPAA Covered Entity?** Yes  No

**Roles / Responsibilities:** Will lead in project conceptualization, recruiting, application development and testing, consenting, running participants through learning activity, debriefing process, data collection, data analysis, and report writing.

- AU affiliated?  Yes  No If no, name of home institution: [Click or tap here to enter text.](#)

- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project?  Yes  No

- If yes, briefly describe the potential or real conflict of interest: [Click or tap here to enter text.](#)

- Completed required CITI training?  Yes  No If NO, complete the appropriate [CITI basic course](#) and update the revised Exempt Application form.

- If YES, choose course(s) the researcher has completed: Human Sciences Basic Course 2/14/2025

Expiration Date

**Co-Investigator:** Kimberly Garza

**Email Address:** kbl0005@auburn.edu

**Dept / Affiliation:** HORP

**Rank/Title:** Associate Professor

**Degree(s):** PharmD, MBA, PhD

**HIPAA Covered Entity?** Yes  No

**Roles / Responsibilities:** Will assist project conceptualization, running participants through learning activity, debriefing process, data collection, data analysis, and report writing.

- AU affiliated?  Yes  No If no, name of home institution: [Click or tap here to enter text.](#)

- Plan for IRB approval for non-AU affiliated personnel? [Click or tap here to enter text.](#)

- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project?  Yes  No

- If yes, briefly describe the potential or real conflict of interest: [Click or tap here to enter text.](#)



## 11. Location of research.

**11A. List all locations where data collection will occur.** If applicable, attach permission letters as Appendix E. (School systems, organizations, businesses, buildings and room numbers, servers for web surveys, etc.) **Be as specific as possible.** (See sample letters at <https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs>)

**The activity will take place on Auburn's campus, specifically in the Innovation and Research Commons VR space on the first floor of the main library. The participants will be sat down and monitored to complete the post-experience surveys.**

**11B. Will study data be stored within a HIPAA covered facility? Yes  No**

**If yes, which facility(ies)** (To determine AU HIPAA covered entities, go to VII of the [HIPPA Hybrid Entity Policy](#)):  
Click or tap here to enter text.

**12. Participants** (If minor participants, at least 2 adults must be present during all research procedures that include the minors.)

**12A. Describe the targeted/ intended participant population for the study. Include the anticipated number of participants and inclusion and exclusion criteria and the procedures to ensure more than 1 adult is present during all research procedures which include the minor.**

Check here if existing data will be used and describe the population from whom data was collected including the number of data files.

Check here if permission to access existing data is required and submit a copy of the agreement to access.

The subjects of this experiment are students 1 and older and experts. The students will be a mix of those who are familiar with RA and those who are not. The goal is to have anywhere between 36-50 students participate in the study. These patients will be recruited from the Auburn University by email. For the experts, we will have between 6 to 8 to participate in the study. The experts will be colleagues around the area who are knowledgeable in the topic of VR or RA. The experts will be used to assist in the design of the application and evaluate the system's usability. Participants will not be eligible to participate in the experiment if they have contraindications to their use, including cold, flu, headache, migraines, earache, severe deformity or pain in the hand, pregnancy, pre-existing binocular vision abnormalities (crossed eyes or lazy eye), or other serious medical condition.

**12B. Describe, step-by-step in lay language all procedures to recruit participants.** Include in [Appendix B](#) a copy of all e-mails, flyers, advertisements, recruiting scripts, invitations, etc., that will be used to invite people to participate. (See sample documents at <https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs>)

We will send a recruitment email (shown in Appendix B) with a pre-survey linked to the email for those to complete who wish to participate. We will recruit by having the email sent out to Engineering student organizations, Engineering students via faculty, and College of Liberal Art students via faculty (e.g. Psychology). The pre-survey is shown in Appendix B. **By consenting to the pre-survey, the students are also consenting to giving their first name, last name, and email to signup for a session via SignUp Genius.** The students will be automatically directed to SignUp Genius via Qualtrics at the completion of the pre-survey.

**12C. Minimum number of participants required to validate the study? 36**

**Number of participants expected to enroll? 50**

**Provide the rationale for the number of participants.** Based on other studies, we feel this is an acceptable range to observe the impact that VR has on the empathy of its users.

**Is there a limit to the number of participants that will be included in the study?**

No  Yes, the number is 50

**12D. Describe the process to compensate, amount and method of compensation and/or incentives for participants. [AU Procurement and Business Services \(PBS\) policies](#)**

(benefits to participants are NOT compensation)

If participants will not be compensated, check here:

Indicate the amount of compensation per procedure and in total: \$20 gift card per person, \$1000 for max 50 people

Indicate the type of compensation:  Monetary  Incentives

Raffle or Drawing incentive (Include the chances of winning.)

Extra Credit (State the value)

Other

Describe how compensation will be distributed (USPS, email, etc.): Compensation will be distributed via email to those selected.

### 13. Project Design & Methods

**13A. Describe, step-by-step, all procedures and methods that will be used to consent participants. If a waiver is being requested, indicate the waiver, and describe how the study meets the criteria for the waiver. If minors will be enrolled describe the process to obtain parental/ legally authorized guardian permission.**

Waiver of Consent (including using existing data)

Waiver of Documentation of Consent (use of Information Letter)

Waiver of Parental Permission (for college students 18 years or younger)

Two consent processes will occur, but students will have to be a part of both for their information to be used. We will begin with sending recruitment emails out with a link to the pre-survey. The first consent process is during the pre-survey phase. The students will be asked to consent to using their auburn id for the pre and both post surveys (in the pre-survey consent form) along with consenting to submitting their first name, last name, and email via SignUp Genius to sign up for the experiment. Students will utilize a sign-up system, such as SignUp Genius, to reserve a 45-minute time slot to participate in the activity. When students arrive, they will be screened for COVID and asked questions to confirm VR eligibility. The second consent process is if they clear both screenings, a member of the research team will ask them if they have any concerns about the experiment and have them sign the consent form to participate in the experiment followed by the actual experiment. The signed copies of the pre-survey consent forms will be stored in AU Box. The signed copies of the experiment consent form will be stored in Dr. Seals' office. Students will also receive a copy for them to keep of the experiment consent form and a downloadable copy of the pre-survey consent form via qualtrics.

**13B. In lay language, understandable by someone not familiar with the area of study, describe the complete research design and methods that will be used to address the purpose. Include a clear description of when, where and how data will be collected. Include specific information about participants' time and effort.**

The experiment is planned to be carried out as follows. Those who choose to participate will complete the pre-survey linked in the recruitment email asking them about demographic information, if they know a lot about RA or if family members have RA, prior experience questions and empathy questions. Following the survey, the users will be sent a SignUp genius to pick a 45-minute slot to come and participate in the study on Auburn University's campus in the presence of researchers. They will be informed on how the experiment will work and given a consent form. The participants will be asked to participate in the patient journey experience from different levels of immersion. Each level of immersion will simulate what it is like to have RA in a late disease progression stage. The first level of immersion being no immersion, participants will be put in the gloves and set up to begin the experiment to complete the three activities: brushing teeth, opening pill bottle, and making a cup of coffee, each only lasting 1 minute and 30 seconds. Immediately after finishing the non-immersive experience, the gloves will be removed, and the participants will be asked to complete a survey on that experience. Once the survey is complete, the VR experience will begin. The users will put the gloves on first and then the Oculus Quest 2 headset. In the headset, the user will begin completing the same activities, but virtually. Once they complete the activity, their gloves will be removed so they can take off the headset. Each activity will have 1 minute and 30 seconds to complete just like the non-immersive experience. Following the completion of the VR experience, the participant will be asked to complete a post-experience survey. Each post-survey questionnaire should take approximately 10 minutes to complete and includes questions on empathy, user experience, user engagement, and awareness.

**13C. List all data collection instruments used in this project, in the order they appear in Appendix C.**

(e.g., surveys and questionnaires in the format that will be presented to participants, educational tests, data collection sheets, interview questions, audio/video taping methods etc.)

All data will be collected using Qualtrics surveys on tablet or desktop computers. The *Pre-Intervention Questionnaire* will contain: (1) Demographic items, (2) knowledge about RA, (3) Prior Experience and (4) Empathy [8, 9]. A post survey will be given after each level of immersion containing questions pertaining to (1) Empathy [8, 9], (2) User Experience [10, 11], (3) User Engagement [12] and (4) Awareness.

**13D. Data analysis: Describe how data will be analyzed. If a data collection form (DCF) will be used, submit a copy of the DCF.**

Empathy, user engagement, and user experience will all be compared. Each will be compared with a statistical hypothesis test. We will observe the differences of groups as well if they can be noticeably split based on information retrieved in the surveys.

**13E. List any drugs, medications, supplements, or imaging agents that participants will ingest/ receive during participation in the study or indicate not applicable (N/A).**

N/A

**14. Risks & Discomforts: List and describe all the risks participants may encounter in this research including risks from item 6d of this form, in this research. If deception will be part of the study, provide the rationale for the deception, describe the debriefing process, and attach a copy of the debriefing form that will be used as Appendix D. (Examples of possible risks are in section #6C)**

Potential risks include both physical and psychological discomfort. Participants may experience simulator sickness, headache, or physical discomfort wearing the VR headset and/or simulation glove. Due to the nature of the experience (simulation of physical impairment), participants may experience psychological distress. Breach of confidentiality is also a possibility. Lastly, because participants and researchers will be in close proximity to one another and physical contact will be necessary to help the participant don the VR headset and gloves, this study will be a Category A study involving High-Risk Procedures for COVID-19 transmission. The COVID-19 2022 Precautions Matrix will be used to determine appropriate precautions to be implemented at the time of data collection(s) for a Category A study.

**15. Precautions / Minimization of Risks**

**15A.** Identify and describe all precautions that will be taken to eliminate or reduce risks listed in items 6.c. and 14. If participants can be classified as a "vulnerable" population, describe additional safeguards that will be used to assure the ethical treatment of vulnerable individuals. If applicable, submit a copy of any emergency plans/procedures and medical referral lists in Appendix D. (Sample documents can be found online at

<https://cws.auburn.edu/OVPR/pm/compliance/irb/sampledocs/precautions>)

To minimize risk of physical discomfort or injury, participants will be seated at all times during the procedure and total time in the VR application will be limited to no more than 10 minutes. Participants will be advised to let the researcher know if at any time they experience dizziness or discomfort from the VR headset or glove. If a participant verbalizes discomfort in anyway, the activity will be immediately stopped for them and they will not be allowed to continue. If they must stop the experiment, the participant will sit in the presence of a researcher to verify that they are okay after having to stop. If the participant is still having discomfort, they will get the proper recommendations on who to see for help. To minimize risk of psychological distress, the researchers will follow up the experience with a debrief in which they will provide the participant time to rest and verify they aren't dizzy. To minimize breach of confidentiality, data downloaded from Qualtrics will be coded, the participants's Auburn username will not be downloaded with the results. The results will only contain their answers to survey questions and the code to represent who they are. Lastly, to mitigate risk of spread of infection, the researchers will follow the IRB COVID protocols according to level of community spread. For example, in a situation of low community spread, participants

and researchers will be screened for COVID symptoms the day before and upon arrival to the study site and will be dismissed if any symptoms are reported. All AU COVID guidelines will be followed. VR and haptic equipment will be sanitized using a UV light box and surfaces will be wiped down with disinfecting wipes in between participants. Participants will be asked to wash hands thoroughly with soap and water before wearing the glove. Masks will also be provided in case a student wants to wear one but not required. COVID and VR screening questions can be seen in Appendix D.

**15B. If the internet, mobile apps, or other electronic means will be used to collect data, describe confidentiality**

Data collection will be conducted using online surveys through Qualtrics, accessed using a tablet or desktop computer on site. Qualtrics employs measures to ensure data security, including Transport Layer Security (TLS) encryption for all transmitted data. Data downloaded from Qualtrics will be coded, the user's name will not be downloaded with the results and only key personnel included in this protocol will be able to access the data.

**15C. Additional Safeguards**

Will DEXA, pQCT, or other devices which emit radiation be used?  Yes  No

If yes, the IRB will notify the Auburn Department of Risk Management and Safety, who will contact the Alabama Department of Public Health (ADPH) and secure approval. Research which includes device(s) which emit radiation may NOT be initiated NOR will IRB stamped consent documents be issued until the IRB is notified of ADPH approval.

Will a Certificate of Confidentiality (CoC) issued by NIH be obtained  Yes  No If yes, include CoC language in consent documents and include the documentation of CoC approval. Research which includes a CoC may not be initiated NOR will IRB stamped consent documents be issued until the IRB is notified of CoC approval. [AU Required CoC Language](#)

Is the study a [clinical trial](#)?  Yes  No

If yes, provide the National Clinical Trial (NCT) # [Click or tap here to enter text.](#) and include required clinical trial information in all consent documents. [AU Clinical Trial Information](#)

**16. Benefits**

**16A. List all realistic direct benefits participants can expect by participating in this study.** (Compensation is not a benefit) If participants will not directly benefit check here.

Participants will engage in a learning experience that will promote empathy for patients living with rheumatoid arthritis and also allow us to understand the impacts different levels of immersion can have on empathy, user experience and user engagement.

**16B. List realistic benefits for the general population that may be generated from this study.**

Society will benefit from the contribution to the VR knowledge and to the literature on empathy-building learning activities. This will also add to the literature on the impact of different levels of immersion on empathy, user experience and user engagement.

**17. Protection of Data**

**17A. Data are collected:**

- Anonymously with no direct or indirect coding, link, or awareness by key personnel of who participated in the study (skip to item E)
- Confidentially, but without a link to participant's data to any identifying information (collected as "confidential" but recorded and analyzed "anonymous") (Skip to item E).

**Confidentially with collection and protection of linkages to identifiable information.**

**17B. If data are collected with identifiers and coded or as coded or linked to identifying information, describe the identifiers and how identifiers are linked to participants' data.**

Student's Auburn username will be entered into both the pre-intervention and post-intervention questionnaires in order to link them, but will be coded before downloaded.

**17C. Provide the rationale for need to code participants' data or link the data with identifying information.**

In order to measure change in student empathy for patients with physical impairments from baseline to post-intervention to assess effectiveness of the learning activity, pre-intervention and post-intervention questionnaires must be linked.

**17D. Describe how and where identifying data and/or code lists will be stored. (Building, room number, AU BOX?) Describe how the location where data is stored will be secured. For electronic data, describe security measures. If applicable, describe where IRB-approved and participant signed consent documents will be kept on campus for 3 years after the study ends.**

Identifying data will be collected using online surveys. Electronic data will be stored in Qualtrics and data downloaded from Qualtrics will be coded, the user's name will not be downloaded with the results. Signed consent forms will be retained for 3 years after the study ends and will be kept in a locked filing cabinet in Dr. Seals office. Electronic data downloaded from Qualtrics will be stored via AU Box.

**17E. Describe how and where data will be stored (e.g., hard copy, audio/ visual files, electronic data, etc.), and how the location where data is stored is separated from identifying data and will be secured. For electronic data, describe security. Note use of a flash drive or portable hard drive is not appropriate if identifiable data will be stored; rather, identifying participant data must be stored on secured servers.**

Electronic data will be stored in Qualtrics and data downloaded from Qualtrics will be coded, the user's name will not be downloaded with the results. Signed consent forms will be retained for 3 years after the study ends and will be kept in a locked filing cabinet in Dr. Seals office.

**17F. List the names of all who will have access to participants' data? (If a student PI, the faculty advisor must have full access and be able to produce study data in the case of a federal or institutional audit.)**

PI Alexicia Richardson, Gary Hawkins, Cheryl Seals, Kimberly Garza, Tianshi Xie

**17G. When is the latest date that identifying information or links will be retained and how will that information or links be destroyed? (Check here if only anonymous data will be retained )**

Identifying data will be stored for three years after the study has ended via AU Box and de-identified data will be stored indefinitely.

Pre-Survey Consent Form: This is the form attached to the Qualtrics survey that students can download to retain a copy.



**AUBURN UNIVERSITY**  
**SAMUEL GINN COLLEGE OF ENGINEERING**

DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

**(NOTE: DO NOT SIGN THIS DOCUMENT UNLESS AN IRB APPROVAL STAMP  
WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)**

**INFORMED CONSENT**

**for a Research Study entitled:**

**“A Virtual Reality Framework to support Rheumatoid Arthritis Education: The Impact of  
Different Immersion Levels on the Empathy and Engagement of College Students”**

Hello! You are invited to participate in a research study to evaluate the impact that immersion levels have on empathy, user engagement, and user experience. The study is being conducted by PhD candidate, Alexicia Richardson, under the direction of Dr. Cheryl Seals in the Auburn University Department of Computer Science and Software Engineering.

You are invited to participate if you are age 19 or older and attend Auburn University. Your participation is completely voluntary. If you decide to participate in this research you will be asked to complete an a pre-survey, participate in the experiment, and complete two post surveys during the experiment. At the end of the pre-survey, you will be redirected to a SignUp Genius form. That form will ask you to pick at time to attend a session to complete the remainder of the experiment and will ask you to enter your first name, last name, and email so a reminder the day before you attend can be sent to you. Your commitment time for this survey will be approximately 10-15 minutes.

You are not eligible to use virtual reality or the glove if you have contraindications to their use, including cold, flu, headache, migraines, earache, severe deformity or pain in the hand, pregnancy, pre-existing binocular vision abnormalities (crossed eyes or lazy eye), or other serious medical condition. If you have any of these, please ignore this survey.

**What will be involved if you participate?** If you choose to participate in this research, you will be directed to a SignUp Genius immediately following this survey (do

not close the survey out as it should automatically direct you). In this pre-survey and the two post surveys, you will be asked demographic information, personal information such as your Auburn ID, empathy, user experience, and user engagement questions. As mentioned, following this survey you will be directed to a SignUp Genius form to pick one 45 minute slot to come to Auburn University's RBD Library to complete the experiment. SignUp Genius will prompt you for your time slot, first name, last name, and email. By giving that email, that is how you will receive compensation for completing the entire experiment. The entire experiment involves this pre-survey, signing up, attending your session and consenting to that experiment, the experiment, and two post surveys.

**Are there any risks or discomforts?** The risks in this survey and sign up is confidentiality. Confidentiality of information may be a concern; thus, all survey responses will be kept confidential and will be stored in secure data servers.

**Are there any benefits to yourself or others?** By participating in the study, you will have an opportunity to better understand patients living with rheumatoid arthritis. The researchers will benefit from your participation because it will help improve their understanding of how to design activities to make it easier for one to be more empathetic towards others along with how engaging their activity is.

**Will you receive compensation for participating?** All participants who fully complete the study will receive a \$20 gift card.

**Are there any costs?** There will be no financial costs to you for participating in the study.

**If you change your mind about participating, you can withdraw at any time during the study.** Your participation is completely voluntary. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with the study investigators or Auburn University. If you choose to withdraw, your data will be deleted from the database. You can withdraw from this survey by closing out your browser.

**Any information obtained in connection with this study will remain confidential.** Your data will be stored on a secure server approved by Auburn University with password-protected access granted only to researchers involved in the study. Information obtained through your participation may be published in a professional journal or presented at a professional meeting.

**By providing your signature below, you are agreeing that the personal information provided in the pre-survey and two post surveys can be used to match your responses and to providing your name and email to schedule a time to complete the experiment via SignUp Genius. No personal information from the surveys will be downloaded and will only be seen by those approved via IRB.**

**If you have questions about the study,** please contact Alexicia Richardson at [adr0021@auburn.edu](mailto:adr0021@auburn.edu) or Dr. Cheryl Seals at [sealscd@auburn.edu](mailto:sealscd@auburn.edu).

**If you have questions about your rights as a research participant,** you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334) 844-5966 or e-mail at [IRBadmin@auburn.edu](mailto:IRBadmin@auburn.edu) or [IRBChair@auburn.edu](mailto:IRBChair@auburn.edu).

**HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY.**

\_\_\_\_\_  
Participant's signature                      Date                      Investigator obtaining consent                      Date

\_\_\_\_\_  
Printed Name    Printed Name

*Version date: October 25, 2022*

**Participant's Initials** \_\_\_\_\_



**AUBURN UNIVERSITY**  
**SAMUEL GINN COLLEGE OF ENGINEERING**

DEPARTMENT OF COMPUTER SCIENCE AND SOFTWARE ENGINEERING

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WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)**

**INFORMED CONSENT**

**for a Research Study entitled:**

**“A Virtual Reality Framework to support Rheumatoid Arthritis Education: The Impact of  
Different Immersion Levels on the Empathy and Engagement of College Students”**

**You are invited to participate in a research study entitled, “A Virtual Reality Framework to support Rheumatoid Arthritis Education: The Impact of Different Immersion Levels on the Empathy and Engagement of College Students,”** to observe the differences in empathy, user experience, and user engagement in students during activities that simulate difficulties that RA patients endure while trying to complete their daily activities. The study is being conducted by graduate student Alexicia Richardson and Dr. Cheryl D. Seals at Auburn University. In order to be eligible for the study, you must be 19 years of age or older. You are not eligible to use virtual reality or glove if you have contraindications to their use, including cold, flu, headache, migraines, earache, severe deformity or pain in the hand, pregnancy, pre-existing binocular vision abnormalities (crossed eyes or lazy eye), or other serious medical condition.

**What will be involved if you participate?** If you decide to participate in this research study, you will sign up for one 45-minute time slot and report to the study site at the reserved time – students on the Auburn campus will report to the Innovation and Research Commons on the first floor of the Auburn University main library. Research personnel will be available to address any questions or concerns you may have about the study, assist you in putting on the VR headset and glove, and walk you through the activity. The VR headset used in the experiment will be an Oculus Quest 2. There will be two gloves used: the Cambridge simulation glove and a beige toned glove to assist the headset in recognizing the user’s hands shown in Figures 1 and 2. Both of these gloves will be used for the immersive and non-immersive experience. The research team will assist you in putting on and removing the gloves and headset.



Figure 1: Cambridge glove [<http://www.inclusivedesigntoolkit.com/gloves/gloves.html>]



Figure 2: Beige glove over simulation glove

You will complete short online questionnaires immediately after each experience. These questionnaires will include an empathy scale, a user experience scale, user engagement scales, and questions on awareness. After completion of the post-intervention questionnaire, you will participate in a debrief in which research personnel will provide you with a list of resources in the event you experience psychological distress and need to speak to a trained counselor. The debrief will also give you an opportunity to rest and regain your balance before leaving the site.

**Are there any risks or discomforts?** The risks associated with participating in this study include physical and psychological discomfort, breach of confidentiality, and risk of COVID 19. Potential physical discomfort may include simulator (motion) sickness, headache, or discomfort wearing the virtual reality headset or glove. Psychological discomfort may result from experiencing challenges that patients with physical impairments face in daily life. **Confidentiality of information may be a concern; thus, all survey responses will be kept confidential and will be stored in secure data servers.**

Due to face-to-face interaction with members of the research team, there is a risk that you may be exposed to COVID-19 and the possibility that you may contract the virus. For most people, COVID-19 causes only mild or moderate symptoms. For some, especially older adults, and people with existing health problems, it can cause more severe illness. Current information suggests that about 2% of people who are infected with COVID-19 might die as a result. To minimize your risk of exposure we will screen participants and researchers at the research site, require the use of appropriate personal protective equipment, decontaminate surfaces and equipment before and after each use, and ask that you wash your hands thoroughly with soap and water prior to putting on the glove. You will need to follow any precautions or procedures outlined by Auburn University and, when applicable, offsite locations.

**Are there any benefits to yourself or others?** By participating in the study, you will have an opportunity to better understand patients living with rheumatoid arthritis. The researchers will benefit from your participation because it will help improve their understanding of how to design activities to make it easier for one to be more empathetic towards others along with how engaging their activity is.

**Will you receive compensation for participating?** All participants who fully complete the study will receive a \$20 gift card.

**Are there any costs?** There will be no financial costs to you for participating in the study.

**If you change your mind about participating**, you can withdraw at any time during the study by alerting the research personnel. Your participation is completely voluntary. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with the study investigators or Auburn University. If you choose to withdraw, your data will be deleted from the database.

**Any information obtained in connection with this study will remain confidential.** Your data will be stored on a secure server approved by Auburn University with password-protected access granted only to researchers involved in the study. Information obtained through your participation may be published in a professional journal or presented at a professional meeting.

**If you have questions about the study**, *please ask them now*, or please contact Alexicia Richardson at [adr0021@auburn.edu](mailto:adr0021@auburn.edu) or Dr. Cheryl Seals at [sealscd@auburn.edu](mailto:sealscd@auburn.edu).

**If you have questions about your rights as a research participant**, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334) 844-5966 or e-mail at [IRBAdmin@auburn.edu](mailto:IRBAdmin@auburn.edu) or [IRBChair@auburn.edu](mailto:IRBChair@auburn.edu).

**HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE INDICATES YOUR WILLINGNESS TO PARTICIPATE.**

\_\_\_\_\_  
Participant's signature                      Date                      Investigator obtaining consent                      Date

\_\_\_\_\_  
Printed Name    Printed Name

*Version date: October 25, 2022*

Participant's Initials \_\_\_\_\_

Revised 02/22/2022

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## Appendix B (Other Materials)

### Gloves

Two pair of gloves will be used, one pair being the Cambridge Simulation Gloves<sup>1</sup>. The Cambridge Simulation Gloves are designed to demonstrate the difficulties of someone with conditions that limit their hand mobility. Due to the virtual reality headset not being able to recognize them on their own, a pair of beige like gloves will be worn on top of them. Images of the gloves are shown below:



Figure 1: Cambridge glove<sup>1</sup>



Figure 2: Beige Glove over Cambridge glove

<http://www.inclusivedesigntoolkit.com/gloves/gloves.html><sup>1</sup>

Revised 02/22/2022

## **Recruitment Email**

Dear student,

Thank you for taking the time to read this email. My name is Alexicia Richardson - a Ph.D. candidate studying Computer Science and Software Engineering here at Auburn University. Together with my advisor, Dr. Cheryl Seals, we are carrying out an experiment on the impacts on empathy, user experience, and user engagement using different levels of immersion. Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete an online survey to give some preliminary information before the experiment. Once the survey is complete, you will be automatically redirected to a site to sign up for a time to complete the remainder of the experiment. If you choose to participate in the study, you will be given an incentive of a \$20 gift card. You only qualify for the gift card if you complete all stages of the experiment: pre-survey and a 40–45-minute experiment session that involves a non-immersive and immersive experience and two post surveys. Your commitment time for this pre-survey will be approximately 10 - 15 minutes.

If you have questions about this study, please contact Alexicia Richardson at [adr0021@auburn.edu](mailto:adr0021@auburn.edu) or Dr. Cheryl Seals at [sealscd@auburn.edu](mailto:sealscd@auburn.edu).

Confidential survey link: [https://auburn.qualtrics.com/jfe/form/SV\\_bmFsj7xpe9OsymW](https://auburn.qualtrics.com/jfe/form/SV_bmFsj7xpe9OsymW)

Thank you for your consideration,

Alexicia Richardson

## **Appendix C (Surveys)**

<http://www.inclusivedesigntoolkit.com/gloves/gloves.html><sup>1</sup>

## Pre-Survey

### Introduction

Hello! You are invited to participate in a research study to evaluate the impact that immersion levels have on empathy, user engagement, and user experience. The study is being conducted by PhD candidate, Alexicia Richardson, under the direction of Dr. Cheryl Seals in the Auburn University Department of Computer Science and Software Engineering.

You are invited to participate if you are age 19 or older and attend Auburn University. Your participation is completely voluntary. If you decide to participate in this research you will be asked to complete an a pre-survey, participate in the experiment, and complete two post surveys during the experiment. At the end of the pre-survey, you will be redirected to a SignUp Genius form. That form will ask you to pick at time to attend a session to complete the remainder of the experiment and will ask you to enter your first name, last name, and email so a reminder the day before you attend can be sent to you. Your commitment time for this survey will be approximately 10-15 minutes.

You are not eligible to use virtual reality or the glove if you have contraindications to their use, including cold, flu, headache, migraines, earache, severe deformity or pain in the hand, pregnancy, pre-existing binocular vision abnormalities (crossed eyes or lazy eye), or other serious medical condition. If you have any of these, please ignore this survey.

**What will be involved if you participate?** If you choose to participate in this research, you will be directed to a SignUp Genius immediately following this survey (do not close the

survey out as it should automatically direct you). In this pre-survey and the two post surveys, you will be asked demographic information, personal information such as your Auburn ID, empathy, user experience, and user engagement questions. As mentioned, following this survey you will be directed to a SignUp Genius form to pick one 45 minute slot to come to Auburn University's RBD Library to complete the experiment. SignUp Genius will prompt you for your time slot, first name, last name, and email. By giving that email, that is how you will receive compensation for completing the entire experiment. The entire experiment involves this pre-survey, signing up, attending your session and consenting to that experiment, the experiment, and two post surveys.

**Are there any risks or discomforts?** The risks in this survey and sign up is confidentiality. Confidentiality of information may be a concern; thus, all survey responses will be kept confidential and will be stored in secure data servers.

**Are there any benefits to yourself or others?** By participating in the study, you will have an opportunity to better understand patients living with rheumatoid arthritis. The researchers will benefit from your participation because it will help improve their understanding of how to design activities to make it easier for one to be more empathetic towards others along with how engaging their activity is.

**Will you receive compensation for participating?** All participants who fully complete the study will receive a \$20 gift card.

**Are there any costs?** There will be no financial costs to you for participating in the study.

**If you change your mind about participating, you can withdraw at any time during the study.** Your participation is completely voluntary. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with the study investigators or Auburn University. If you choose to withdraw, your data will be deleted from the database. You can withdraw from this survey by closing out your browser.

**Any information obtained in connection with this study will remain confidential.** Your data will be stored on a secure server approved by Auburn University with password-protected access granted only to researchers involved in the study. Information obtained through your participation may be published in a professional journal or presented at a

professional meeting.

**By providing your signature below, you are agreeing that the personal information provided in the pre-survey and two post surveys can be used to match your responses and to providing your name and email to schedule a time to complete the experiment via SignUp Genius. No personal information from the surveys will be downloaded and will only be seen by those approved via IRB.**

**If you have questions about the study,** please contact Alexicia Richardson at [adr0021@auburn.edu](mailto:adr0021@auburn.edu) or Dr. Cheryl Seals at [sealscd@auburn.edu](mailto:sealscd@auburn.edu).

**If you have questions about your rights as a research participant,** you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334) 844-5966 or e-mail at [IRBadmin@auburn.edu](mailto:IRBadmin@auburn.edu) or [IRBChair@auburn.edu](mailto:IRBChair@auburn.edu).

**HAVING READ THE INFORMATION PROVIDED, YOU MUST DECIDE WHETHER OR NOT YOU WISH TO PARTICIPATE IN THIS RESEARCH STUDY.**

**Attached is a downloadable copy of this consent form that you can keep for your records.**

**Form:** [Pre-Survey Consent Document](#)

×

**SIGN HERE**

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clear

## Demographics

What is your Auburn username? (example: adr0021)

What is your sex?

- Male
- Female
- Non-binary
- Prefer not to say

Which of the following describes your age?

- 19-25
- 26-40
- 41-64
- 65+

Are you of Hispanic or Latino Origin?

- Yes
- No

Which best describes your race?

- American Indian or Alaska Native
- Asian
- Black or African American

- Native Hawaiian or other Pacific Islander
- White
- Multiracial, please specify
- Other Race, please specify

What is your major?

## Prior Experience

Please share your experience levels for each question below.

	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
I know a lot about Rheumatoid Arthritis.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know a lot about virtual reality.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a lot of experience using virtual reality. (i.e. developer or user)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you know anyone personally who has Rheumatoid Arthritis?

- Yes
- No

## Empathy Questions

The following statements ask about how you feel in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate option: 1 being it does not describe you well, 5 being it describes you well or somewhere in between (2-4).

	Does Not Describe Me Well (1)	2	3	4	Describes Me Very Well (5)
I often have tender, concerned feelings for people less fortunate than me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sometimes I don't feel very sorry for other people when they are having problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I see someone being taken advantage of, I feel kind of protective towards them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other people's misfortunes do not usually disturb me a great deal.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I see someone being treated unfairly, I sometimes don't feel very much pity for them.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am often quite touched by things that I see happen.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would describe myself as a pretty soft-hearted person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I sometimes find it difficult to see things from the "other guy's" point of view.

I try to look at everybody's side of a disagreement before I make a decision.

I sometimes try to understand my friends better by imagining how things look from their perspective.

If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.

I believe that there are two sides to every question and try to look at them both.

When I'm upset at someone, I usually try to "put myself in his shoes" for a while.

Before criticizing somebody, I try to imagine how I would feel if I were in their place.

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**Post Traditional (Non-Immersive) Survey Below****Info**

What is your Auburn username? (example: adr0021)

**Empathy**

The following statements ask about how you feel in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate option: 1 being it does not describe you well, 5 being it describes you well or somewhere in between (2-4).

	Does Not Describe Me Well (1)	2	3	4	Describes Me Very Well (5)
I often have tender, concerned feelings for people less fortunate than me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sometimes I don't feel very sorry for other people when they are having problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I see someone					

being taken advantage of, I feel kind of protective towards them.

Other people's misfortunes do not usually disturb me a great deal.

When I see someone being treated unfairly, I sometimes don't feel very much pity for them.

I am often quite touched by things that I see happen.

I would describe myself as a pretty soft-hearted person.

I sometimes find it difficult to see things from the "other guy's" point of view.

I try to look at everybody's side of a disagreement before I make a decision.

I sometimes try to understand my friends better by imagining how things look from their perspective.

If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.

I believe that there are two sides to every question and try to

look at them both.

When I'm upset at someone, I usually try to "put myself in his shoes" for a while.

Before criticizing somebody, I try to imagine how I would feel if I were in their place.

### User Experience

For the assessment of the product, please fill out the following questionnaire. Choose a bubble that expresses how you feel about the activity that you just participated in. (Traditional)

Example:

attractive	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive
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This response would mean that you rate the application as more attractive than unattractive.

annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow



	Disagree	Disagree	disagree	Agree	agree
I lost myself in this experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The time I spent using this activity just slipped away.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was absorbed in this experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt frustrated while using this activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found this activity confusing to use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using this activity was taxing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This activity was attractive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This activity was aesthetically appealing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This activity appealed to my senses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using this acvitivity was worthwhile.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My experience was rewarding.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt interested in this experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Block 4

Do you have a better awareness of the disorder after completing experiment?

Definitely  
yes

Probably  
yes

Might or  
might not

Probably  
not

Definitely  
not

I have a better  
awareness of the  
disorder after  
completing the  
experiment.

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**Post VR (Immersive) Survey Below****Info**

What is your Auburn username? (example: adr0021)

**Empathy**

The following statements ask about how you feel in a variety of situations. For each item, indicate how well it describes you by choosing the appropriate option: 1 being it does not describe you well, 5 being it describes you well or somewhere in between (2-4).

	Does Not Describe Me Well (1)	2	3	4	Describes Me Very Well (5)
I often have tender, concerned feelings for people less fortunate than me.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sometimes I don't feel very sorry for other people when they are having problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When I see someone					

being taken advantage of, I feel kind of protective towards them.

Other people's misfortunes do not usually disturb me a great deal.

When I see someone being treated unfairly, I sometimes don't feel very much pity for them.

I am often quite touched by things that I see happen.

I would describe myself as a pretty soft-hearted person.

I sometimes find it difficult to see things from the "other guy's" point of view.

I try to look at everybody's side of a disagreement before I make a decision.

I sometimes try to understand my friends better by imagining how things look from their perspective.

If I'm sure I'm right about something, I don't waste much time listening to other people's arguments.

I believe that there are two sides to every question and try to

look at them both.

When I'm upset at someone, I usually try to "put myself in his shoes" for a while.

Before criticizing somebody, I try to imagine how I would feel if I were in their place.

### User Experience

For the assessment of the product, please fill out the following questionnaire. Choose a bubble that expresses how you feel about the activity that you just participated in. (VR)

Example:

attractive	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive
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This response would mean that you rate the application as more attractive than unattractive.

annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	enjoyable
not understandable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	understandable
creative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	dull
easy to learn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	difficult to learn
valuable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	inferior
boring	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	exciting
not interesting	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	interesting
unpredictable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	predictable
fast	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	slow

inventive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	conventional
obstructive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	supportive
good	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	bad
complicated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	easy
unlikable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasing
usual	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	leading edge
unpleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	pleasant
secure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	not secure
motivating	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	demotivating
meets expectations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	does not meet expectations
inefficient	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	efficient
clear	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	confusing
impractical	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	practical
organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	cluttered
attractive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unattractive
friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	unfriendly
conservative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	innovative

Fill out the following questions about your experience in the VR activity.

	Not At All			Somewhat		Completely	
	1	2	3	4	5	6	7
How much were you able to control events?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

How responsive was the environment to actions that you initiated (or performed)?

How much did the visual aspects of the environment involve you?

How compelling was your sense of objects moving through space?

Were you able to anticipate what would happen next in response to the actions that you performed?

How completely were you able to actively survey or search the environment using vision?

How compelling was your sense of moving around inside the virtual environment?

How involved were you in the virtual environment experience?

How much delay did you experience between your actions and expected outcomes?

How quickly did you adjust to the virtual environment experience?

How proficient in moving and interacting with the virtual environment did you feel at the end of the experience?

Were you involved in the experimental task to the extent that you lost track of time?

How natural did your interactions with the environment seem?

How natural was the mechanism which controlled movement through the environment?

How much did your experiences in the virtual environment seem consistent with your real-world experiences?

### User Engagement

Fill out this survey by decided how much the statement describes your experience with the activity you just completed. (VR)

	Strongly Disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I lost myself in this experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The time I spent using this activity just	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

slipped away.

I was absorbed in this experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt frustrated while using this activity.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I found this activity confusing to use.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using this activity was taxing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This activity was attractive.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This activity was aesthetically appealing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This activity appealed to my senses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using this activity was worthwhile.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My experience was rewarding.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt interested in this experience.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### Other Questions

Do you have a better awareness of the disorder after completing experiment?

	Definitely yes	Probably yes	Might or might not	Probably not	Definitely not
I have a better awareness of the disorder after	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

completing the  
experiment.

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## Appendix D

Students will be asked if they are dizzy or nauseous and given this sheet before leaving. If students reply yes to feeling dizzy and nauseous, they will be monitored for 5 minutes. After the 5 minutes, if they still feel that way, they will be recommended to get the appropriate medical attention.

### Referral List

If you have experienced distress because of your participation in this study, a referral list of mental health providers is included below for your use. (Please remember that any cost in seeking medical assistance is at your own expense.)

#### On Campus Services:

- Auburn University Student Counseling and Psychological Services (SCPS)
  - Phone: 334-844-5123
  - Services are no charge for students. Up to 10 sessions allowed per academic year/ Crisis walk-in/call-in service during business hours; crisis call in service after-hours & weekends
- Auburn University Psychological Services Center (AUPSC)
  - Phone: 334-844-4889
  - First appointment (\$80), Subsequent appointments (\$30-\$60 based on income or \$30 for AU students)
- Auburn University Marriage and Family Center
  - Phone: 334-844-4478
  - First appointment (\$20), Subsequent appointments (\$50 based on income or \$20 for AU students)
- Tiger Education Screening Intervention
  - Phone: 334-844-1311
  - No charge for self-referred AU students, \$125 for mandated referrals
- Auburn University Public Safety
  - Phone: 334-844-8888
- Auburn University Medical Clinic
  - Phone: 334-844-4416

#### Off Campus Services

- Clinical Psychologists, PC
  - Phone: 334-821-3350
  - \$150 first appointment, \$130 other appointments, Insurance accepted
- Auburn Psychology Group, LLC
  - Phone: 334-887-4343
  - \$160 first appointment, \$140 other appointments, Insurance accepted
- East Alabama Mental Health
  - Phone: 800-815-0630
  - Phone: 334-742-2877
  - Phone: 334-742-2700
  - Help available 24/7, \$8 - \$80 based on income
- East Alabama Alcoholism and Substance Abuse Services
  - Phone: 334-742-2130
  - Outpatient and court-ordered referrals, call for a quote

#### Emergency Services

- National Suicide Prevention Lifeline
  - Phone: 1-800-273-TALK (8255)
  - No charge This lifeline is free, confidential, and always available
- Emergency Services
  - Phone: 911
  - Dependent on insurance
- East Alabama Medical Center Emergency Department
  - Phone: 334-528-1150
  - Dependent on insurance

## **COVID-Screening**

**Please look and answer the questions below. If you answer “yes” to any of the questions, please see a research assistant. For any questions or concerns, please contact Alexicia Richardson at [adr0021@auburn.edu](mailto:adr0021@auburn.edu) or Dr. Cheryl Seals at [sealscd@auburn.edu](mailto:sealscd@auburn.edu).**

1. Do you have a fever or respiratory symptoms? Symptoms include fever, acute respiratory infection, persistent cough, sore throat, fatigue, shortness of breath, or sudden loss of taste or smell without fever?
2. Are you waiting on COVID-19 results?
3. Have you been asked to self-isolate by doctor?
4. In the past three weeks, have you visited another state, country, facility with substantial or high community transmission of COVID-19.

## **VR and Glove Screening**

**Please look and answer the questions below pertaining to your eligibility for Virtual Reality and the simulation gloves. Do not say your individual answers aloud. If you answer “yes” to any of the questions, you will unfortunately be disqualified from participating in the study.**

1. Are you prone to motion sickness?
2. Do you currently have a cold or the flu?
3. Do you have a headache, migraines, or earache?
4. Do you have severe deformity or pain in either of your hands?
5. Are you pregnant?
6. Do you have pre-existing binocular vision abnormalities (crossed eyes or lazy eye)?
7. Do you have any other serious medical condition that would prevent you from being able to use a virtual reality headset?
8. Do you have any other serious medical conditions that would prevent you from being able to use a joint mobility simulation glove?

## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS\*

\* NOTE: Scores on this [Requirements Report](#) reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Kimberly Garza (ID: 522681)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kbl0005@auburn.edu
- **Institution Unit:** Health Outcomes Research and Policy
- **Phone:** 334-844-8360
  
- **Curriculum Group:** IRB #1 Health Science Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB #1 Health Science Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in biomedical research with human subjects.
  
- **Record ID:** 36216431
- **Completion Date:** 26-Jun-2020
- **Expiration Date:** 26-Jun-2023
- **Minimum Passing:** 80
- **Reported Score\*:** 94

#### REQUIRED AND ELECTIVE MODULES ONLY

	DATE COMPLETED	SCORE
Belmont Report and Its Principles (ID: 1127)	25-Jun-2020	3/3 (100%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	26-Jun-2020	4/5 (80%)
Informed Consent (ID: 3)	26-Jun-2020	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	25-Jun-2020	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	26-Jun-2020	4/4 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	26-Jun-2020	5/5 (100%)
Students in Research (ID: 1321)	25-Jun-2020	4/5 (80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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#### Collaborative Institutional Training Initiative (CITI Program)

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Phone: 888-529-5929

Web: <https://www.citiprogram.org>

## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 2 OF 2 COURSEWORK TRANSCRIPT\*\*

\*\* NOTE: Scores on this [Transcript Report](#) reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Kimberly Garza (ID: 522681)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kbl0005@auburn.edu
- **Institution Unit:** Health Outcomes Research and Policy
- **Phone:** 334-844-8360
  
- **Curriculum Group:** IRB #1 Health Science Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB #1 Health Science Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in biomedical research with human subjects.
  
- **Record ID:** 36216431
- **Report Date:** 29-Jul-2020
- **Current Score\*\*:** 94

#### REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES

	MOST RECENT	SCORE
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	26-Jun-2020	4/5 (80%)
Students in Research (ID: 1321)	25-Jun-2020	4/5 (80%)
Informed Consent (ID: 3)	26-Jun-2020	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	26-Jun-2020	4/4 (100%)
Belmont Report and Its Principles (ID: 1127)	25-Jun-2020	3/3 (100%)
Privacy and Confidentiality - SBE (ID: 505)	25-Jun-2020	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	26-Jun-2020	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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#### Collaborative Institutional Training Initiative (CITI Program)

Email: [support@citiprogram.org](mailto:support@citiprogram.org)

Phone: 888-529-5929

Web: <https://www.citiprogram.org>

## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS\*

\* NOTE: Scores on this [Requirements Report](#) reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Kimberly Garza (ID: 522681)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kbl0005@auburn.edu
- **Institution Unit:** Health Outcomes Research and Policy
- **Phone:** 334-844-8360
  
- **Curriculum Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in Social/Behavioral Research with human subjects.
  
- **Record ID:** 36216432
- **Completion Date:** 25-Jun-2020
- **Expiration Date:** 25-Jun-2023
- **Minimum Passing:** 80
- **Reported Score\*:** 91

#### REQUIRED AND ELECTIVE MODULES ONLY

	DATE COMPLETED	SCORE
Belmont Report and Its Principles (ID: 1127)	25-Jun-2020	3/3 (100%)
The Federal Regulations - SBE (ID: 502)	25-Jun-2020	4/5 (80%)
Assessing Risk - SBE (ID: 503)	25-Jun-2020	5/5 (100%)
Informed Consent - SBE (ID: 504)	25-Jun-2020	4/5 (80%)
Privacy and Confidentiality - SBE (ID: 505)	25-Jun-2020	5/5 (100%)
Students in Research (ID: 1321)	25-Jun-2020	4/5 (80%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	25-Jun-2020	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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#### Collaborative Institutional Training Initiative (CITI Program)

Email: [support@citiprogram.org](mailto:support@citiprogram.org)

Phone: 888-529-5929

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# COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

## COMPLETION REPORT - PART 2 OF 2 COURSEWORK TRANSCRIPT\*\*

\*\* NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Kimberly Garza (ID: 522681)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kbl0005@auburn.edu
- **Institution Unit:** Health Outcomes Research and Policy
- **Phone:** 334-844-8360
  
- **Curriculum Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in Social/Behavioral Research with human subjects.
  
- **Record ID:** 36216432
- **Report Date:** 29-Jul-2020
- **Current Score\*\*:** 91

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Students in Research (ID: 1321)	25-Jun-2020	4/5 (80%)
Belmont Report and Its Principles (ID: 1127)	25-Jun-2020	3/3 (100%)
The Federal Regulations - SBE (ID: 502)	25-Jun-2020	4/5 (80%)
Assessing Risk - SBE (ID: 503)	25-Jun-2020	5/5 (100%)
Informed Consent - SBE (ID: 504)	25-Jun-2020	4/5 (80%)
Privacy and Confidentiality - SBE (ID: 505)	25-Jun-2020	5/5 (100%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	25-Jun-2020	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: [www.citiprogram.org/verify/?k87b20afe-1361-449e-95b9-0b3064c54520-36216432](http://www.citiprogram.org/verify/?k87b20afe-1361-449e-95b9-0b3064c54520-36216432)

Collaborative Institutional Training Initiative (CITI Program)

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Phone: 888-529-5929

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# COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

## COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS\*

\* NOTE: Scores on this [Requirements Report](#) reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Kimberly Garza (ID: 522681)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kbl0005@auburn.edu
- **Institution Unit:** Pharmacy Care Systems
- **Phone:** 334-844-8360

- **Curriculum Group:** Responsible Conduct of Research for Biomedical
- **Course Learner Group:** Biomedical Sciences RCR
- **Stage:** Stage 2 - RCR Refresher
- **Description:** This course is for investigators, staff and students with an interest or focus in **Biomedical Research**. This course contains text, embedded case studies AND quizzes.

- **Record ID:** 31279274
- **Completion Date:** 09-Jul-2019
- **Expiration Date:** 07-Jul-2024
- **Minimum Passing:** 80
- **Reported Score\*:** 100

### REQUIRED AND ELECTIVE MODULES ONLY

	DATE COMPLETED	SCORE
Authorship (RCR-Refresher) (ID: 15661)	08-Jul-2019	5/5 (100%)
Collaborative Research (RCR-Refresher) (ID: 15662)	08-Jul-2019	5/5 (100%)
Conflicts of Interest (RCR-Refresher) (ID: 15663)	08-Jul-2019	5/5 (100%)
Data Management (RCR-Refresher) (ID: 15664)	08-Jul-2019	5/5 (100%)
Peer Review (RCR-Refresher) (ID: 15665)	09-Jul-2019	5/5 (100%)
Research Misconduct (RCR-Refresher) (ID: 15666)	09-Jul-2019	5/5 (100%)
Mentoring (RCR-Refresher) (ID: 15667)	09-Jul-2019	5/5 (100%)
Research Involving Human Subjects (RCR-Refresher) (ID: 15668)	09-Jul-2019	5/5 (100%)
Using Animal Subjects in Research (RCR-Refresher) (ID: 15669)	09-Jul-2019	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: [www.citiprogram.org/verify/?k809c2795-dd3a-418b-92ce-46b1a4a93c18-31279274](http://www.citiprogram.org/verify/?k809c2795-dd3a-418b-92ce-46b1a4a93c18-31279274)

### Collaborative Institutional Training Initiative (CITI Program)

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## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 2 OF 2 COURSEWORK TRANSCRIPT\*\*

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- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kbl0005@auburn.edu
- **Institution Unit:** Pharmacy Care Systems
- **Phone:** 334-844-8360
  
- **Curriculum Group:** Responsible Conduct of Research for Biomedical
- **Course Learner Group:** Biomedical Sciences RCR
- **Stage:** Stage 2 - RCR Refresher
- **Description:** This course is for investigators, staff and students with an interest or focus in **Biomedical Research**. This course contains text, embedded case studies AND quizzes.
  
- **Record ID:** 31279274
- **Report Date:** 09-Jul-2019
- **Current Score\*\*:** 100

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Authorship (RCR-Refresher) (ID: 15661)	08-Jul-2019	5/5 (100%)
Collaborative Research (RCR-Refresher) (ID: 15662)	08-Jul-2019	5/5 (100%)
Research Involving Human Subjects (RCR-Refresher) (ID: 15668)	09-Jul-2019	5/5 (100%)
Conflicts of Interest (RCR-Refresher) (ID: 15663)	08-Jul-2019	5/5 (100%)
Data Management (RCR-Refresher) (ID: 15664)	08-Jul-2019	5/5 (100%)
Peer Review (RCR-Refresher) (ID: 15665)	09-Jul-2019	5/5 (100%)
Research Misconduct (RCR-Refresher) (ID: 15666)	09-Jul-2019	5/5 (100%)
Mentoring (RCR-Refresher) (ID: 15667)	09-Jul-2019	5/5 (100%)
Using Animal Subjects in Research (RCR-Refresher) (ID: 15669)	09-Jul-2019	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS\*

\* NOTE: Scores on this [Requirements Report](#) reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Kimberly Garza (ID: 522681)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kb10005@auburn.edu
- **Institution Unit:** Pharmacy Care Systems
- **Phone:** 334-844-8360
  
- **Curriculum Group:** IRB Additional Modules
- **Course Learner Group:** HIPAA and Human Subjects Research
- **Stage:** Stage 1 - Basic Course
  
- **Record ID:** 24242040
- **Completion Date:** 20-Sep-2019
- **Expiration Date:** 19-Sep-2022
- **Minimum Passing:** 80
- **Reported Score\*:** 80

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Research and HIPAA Privacy Protections (ID: 14)	20-Sep-2019	4/5 (80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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#### Collaborative Institutional Training Initiative (CITI Program)

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Phone: 888-529-5929

Web: <https://www.citiprogram.org>

## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 2 OF 2 COURSEWORK TRANSCRIPT\*\*

\*\* NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Kimberly Garza (ID: 522681)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** kbl0005@auburn.edu
- **Institution Unit:** Pharmacy Care Systems
- **Phone:** 334-844-8360
  
- **Curriculum Group:** IRB Additional Modules
- **Course Learner Group:** HIPAA and Human Subjects Research
- **Stage:** Stage 1 - Basic Course
  
- **Record ID:** 24242040
- **Report Date:** 20-Sep-2019
- **Current Score\*\*:** 80

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Research and HIPAA Privacy Protections (ID: 14)	20-Sep-2019	4/5 (80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: [www.citiprogram.org/verify/?k3d6ec222-1327-4854-a31a-d4c59bf918d7-24242040](http://www.citiprogram.org/verify/?k3d6ec222-1327-4854-a31a-d4c59bf918d7-24242040)

#### Collaborative Institutional Training Initiative (CITI Program)

Email: [support@citiprogram.org](mailto:support@citiprogram.org)

Phone: 888-529-5929

Web: <https://www.citiprogram.org>



Completion Date 18-Jan-2022  
Expiration Date 17-Jan-2025  
Record ID 42389702

This is to certify that:

**Cheryl Seals**

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

**IRB # 2 Social and Behavioral Emphasis - AU Personnel - Basic/Refresher**  
(Curriculum Group)

**IRB # 2 Social and Behavioral Emphasis - AU Personnel**  
(Course Learner Group)

**1 - Basic Course**  
(Stage)

Under requirements set by:

**Auburn University**

**CITI**  
Collaborative Institutional Training Initiative

Verify at [www.citiprogram.org/verify/?w17198472-33b9-4149-9b8d-37254afd1268-42389702](http://www.citiprogram.org/verify/?w17198472-33b9-4149-9b8d-37254afd1268-42389702)



Completion Date 16-Jan-2022  
Expiration Date 15-Jan-2027  
Record ID 28084134

This is to certify that:

**Cheryl Seals**

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

**Responsible Conduct of Research for Social and Behavioral**

(Curriculum Group)

**Social, Behavioral and Education Sciences RCR**

(Course Learner Group)

**2 - RCR Refresher**

(Stage)

Under requirements set by:

**Auburn University**

**CITI**  
Collaborative Institutional Training Initiative

Verify at [www.citiprogram.org/verify/?w4491791b-7b1c-42c2-8904-14b05eb9bce3-28084134](http://www.citiprogram.org/verify/?w4491791b-7b1c-42c2-8904-14b05eb9bce3-28084134)



Completion Date 27-Sep-2021  
Expiration Date 26-Sep-2024  
Record ID 42389703

This is to certify that:

**Cheryl Seals**

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

**IRB Additional Modules**

(Curriculum Group)

**Conflicts of Interest in Research Involving Human Subjects**

(Course Learner Group)

**1 - Basic Course**

(Stage)

Under requirements set by:

**Auburn University**

**CITI**  
Collaborative Institutional Training Initiative

Verify at [www.citiprogram.org/verify/?w80c2506c-69bc-496a-9e12-9fdaf9438f1e-42389703](http://www.citiprogram.org/verify/?w80c2506c-69bc-496a-9e12-9fdaf9438f1e-42389703)



Completion Date 23-Sep-2021  
Expiration Date 22-Sep-2024  
Record ID 42389704

This is to certify that:

**Cheryl Seals**

Has completed the following Citi Program course:

Not valid for renewal of certification through CME.

**IRB Additional Modules**

(Curriculum Group)

**History and Ethical Principles - SBE**

(Course Learner Group)

**1 - Basic Course**

(Stage)

Under requirements set by:

**Auburn University**

**CITI**  
Collaborative Institutional Training Initiative

Verify at [www.citiprogram.org/verify/?wcabe5863-d5b4-4f39-a42b-5b18db20c4d4-42389704](http://www.citiprogram.org/verify/?wcabe5863-d5b4-4f39-a42b-5b18db20c4d4-42389704)



Completion Date 15-Feb-2022  
Expiration Date 14-Feb-2025  
Record ID 47445241

This is to certify that:

**Alexicia Richardson**

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

**IRB # 2 Social and Behavioral Emphasis - AU Personnel - Basic/Refresher**  
(Curriculum Group)

**IRB # 2 Social and Behavioral Emphasis - AU Personnel**  
(Course Learner Group)

**1 - Basic Course**  
(Stage)

Under requirements set by:

**Auburn University**



Verify at [www.citiprogram.org/verify/?w7a538916-a109-4cff-99c3-6c6f85cfb1e8-47445241](http://www.citiprogram.org/verify/?w7a538916-a109-4cff-99c3-6c6f85cfb1e8-47445241)



Completion Date 26-Oct-2022  
Expiration Date 25-Oct-2025  
Record ID 50318758

This is to certify that:

**Alexicia Richardson**

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

**Responsible Conduct of Research**

(Curriculum Group)

**AU Basic RCR Training for ALL Faculty, Staff, Postdocs, and Students**

(Course Learner Group)

**1 - RCR**

(Stage)

Under requirements set by:

**Auburn University**



Verify at [www.citiprogram.org/verify/?w8c4bbb44-52af-46d6-8617-08e0ef5b6083-50318758](http://www.citiprogram.org/verify/?w8c4bbb44-52af-46d6-8617-08e0ef5b6083-50318758)



Completion Date 26-Feb-2021  
Expiration Date 25-Feb-2026  
Record ID 41201235

This is to certify that:

**Alexicia Richardson**

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

**Responsible Conduct of Research for Social and Behavioral**

(Curriculum Group)

**Social, Behavioral and Education Sciences RCR**

(Course Learner Group)

**1 - RCR**

(Stage)

Under requirements set by:

**Auburn University**



Verify at [www.citiprogram.org/verify/?wc80e6d53-8fbc-4aad-915b-c48e496d4690-41201235](http://www.citiprogram.org/verify/?wc80e6d53-8fbc-4aad-915b-c48e496d4690-41201235)

## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS\*

\* NOTE: Scores on this [Requirements Report](#) reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Tianshi Xie (ID: 8308449)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** tzx0019@tigermail.auburn.edu
- **Institution Unit:** computer science
- **Phone:** 334.844.6319
  
- **Curriculum Group:** IRB #1 Health Science Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB #1 Health Science Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in biomedical research with human subjects.
  
- **Record ID:** 45385998
- **Completion Date:** 13-Oct-2021
- **Expiration Date:** 12-Oct-2024
- **Minimum Passing:** 80
- **Reported Score\*:** 97

#### REQUIRED AND ELECTIVE MODULES ONLY

	DATE COMPLETED	SCORE
Belmont Report and Its Principles (ID: 1127)	13-Oct-2021	3/3 (100%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	13-Oct-2021	5/5 (100%)
Informed Consent (ID: 3)	13-Oct-2021	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	13-Oct-2021	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	13-Oct-2021	4/4 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	13-Oct-2021	5/5 (100%)
Students in Research (ID: 1321)	13-Oct-2021	4/5 (80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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#### Collaborative Institutional Training Initiative (CITI Program)

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## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 2 OF 2 COURSEWORK TRANSCRIPT\*\*

\*\* NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Tianshi Xie (ID: 8308449)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** tzx0019@tigermail.auburn.edu
- **Institution Unit:** computer science
- **Phone:** 334.844.6319
  
- **Curriculum Group:** IRB #1 Health Science Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB #1 Health Science Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in biomedical research with human subjects.
  
- **Record ID:** 45385998
- **Report Date:** 14-Oct-2021
- **Current Score\*\*:** 97

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	13-Oct-2021	5/5 (100%)
Students in Research (ID: 1321)	13-Oct-2021	4/5 (80%)
Informed Consent (ID: 3)	13-Oct-2021	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	13-Oct-2021	4/4 (100%)
Belmont Report and Its Principles (ID: 1127)	13-Oct-2021	3/3 (100%)
Privacy and Confidentiality - SBE (ID: 505)	13-Oct-2021	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	13-Oct-2021	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 1 OF 2 COURSEWORK REQUIREMENTS\*

\* NOTE: Scores on this [Requirements Report](#) reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Tianshi Xie (ID: 8308449)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** tzx0019@tigermail.auburn.edu
- **Institution Unit:** computer science
- **Phone:** 334.844.6319
  
- **Curriculum Group:** IRB Additional Modules
- **Course Learner Group:** HIPAA and Human Subjects Research
- **Stage:** Stage 1 - Basic Course
  
- **Record ID:** 45385997
- **Completion Date:** 13-Oct-2021
- **Expiration Date:** 12-Oct-2024
- **Minimum Passing:** 80
- **Reported Score\*:** 100

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Research and HIPAA Privacy Protections (ID: 14)	13-Oct-2021	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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## COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

### COMPLETION REPORT - PART 2 OF 2 COURSEWORK TRANSCRIPT\*\*

\*\* NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Tianshi Xie (ID: 8308449)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** tzx0019@tigermail.auburn.edu
- **Institution Unit:** computer science
- **Phone:** 334.844.6319
  
- **Curriculum Group:** IRB Additional Modules
- **Course Learner Group:** HIPAA and Human Subjects Research
- **Stage:** Stage 1 - Basic Course
  
- **Record ID:** 45385997
- **Report Date:** 14-Oct-2021
- **Current Score\*\*:** 100

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Research and HIPAA Privacy Protections (ID: 14)	13-Oct-2021	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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Collaborative Institutional Training Initiative (CITI Program)

Email: [support@citiprogram.org](mailto:support@citiprogram.org)

Phone: 888-529-5929

Web: <https://www.citiprogram.org>



Completion Date 13-Aug-2021  
Expiration Date 12-Aug-2024  
Record ID 44119596

This is to certify that:

**Gary Hawkins**

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

**IRB #1 Health Science Emphasis - AU Personnel - Basic/Refresher**  
(Curriculum Group)

**IRB #1 Health Science Emphasis - AU Personnel**  
(Course Learner Group)

**1 - Basic Course**  
(Stage)

Under requirements set by:

**Auburn University**

**CITI**  
Collaborative Institutional Training Initiative

Verify at [www.citiprogram.org/verify/?w22a5017c-1f35-4f73-8e30-3e5c35dd6e0c-44119596](http://www.citiprogram.org/verify/?w22a5017c-1f35-4f73-8e30-3e5c35dd6e0c-44119596)

## NPar Tests

### Notes

<b>Output Created</b>		<b>06-FEB-2023 22:03:05</b>
<b>Comments</b>		
<b>Input</b>	<b>Data</b>	<b>/Users/alexiciarichardson/Desktop/New Results SPSS/Post-Survey+Traditional_Awareness.sav</b>
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	<b>N of Rows in Working Data File</b>	<b>22</b>
<b>Missing Value Handling</b>	<b>Definition of Missing</b>	<b>User-defined missing values are treated as missing.</b>
	<b>Cases Used</b>	<b>Statistics for each test are based on all cases with valid data for the variable(s) used in that test.</b>
<b>Syntax</b>		<b>NPAR TESTS</b>  <b>/WILCOXON=Traditional_Awareness WITH VR_Awareness (PAIRED)</b> <b>/STATISTICS DESCRIPTIVES QUARTILES</b> <b>/MISSING ANALYSIS.</b>
<b>Resources</b>	<b>Processor Time</b>	<b>00:00:00.01</b>
	<b>Elapsed Time</b>	<b>00:00:00.00</b>
	<b>Number of Cases Allowed<sup>a</sup></b>	<b>449389</b>

a. Based on availability of workspace memory.

### Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles 25th
T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.	22	1.59	.854	1	4	1.00
VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.	22	1.73	.703	1	3	1.00

### Descriptive Statistics

	Percentiles	
	50th (Median)	75th
T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.	1.00	2.00
VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.	2.00	2.00

### Wilcoxon Signed Ranks Test

### Ranks

		N	Mean Rank	Sum of Ranks
VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment. - T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.	Negative Ranks	1 <sup>a</sup>	4.50	4.50
	Positive Ranks	4 <sup>b</sup>	2.63	10.50
	Ties	17 <sup>c</sup>		
	Total	22		

- a. VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment. < T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.
- b. VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment. > T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.
- c. VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment. = T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.

## Test Statistics<sup>a</sup>

VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment. - T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.

Z	-.828 <sup>b</sup>
Asymp. Sig. (2-tailed)	.408

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

## Crosstabs

### Notes

<b>Output Created</b>		<b>01-MAR-2023 18:45:27</b>
<b>Comments</b>		
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<b>Missing Value Handling</b>	<b>Definition of Missing</b>	<b>User-defined missing values are treated as missing.</b>
	<b>Cases Used</b>	<b>Statistics for each table are based on all the cases with valid data in the specified range(s) for all variables in each table.</b>
<b>Syntax</b>		<b>CROSSTABS</b> <b>/TABLES=First_Experiment BY</b> <b>Traditional_Awareness</b> <b>VR_Awareness</b> <b>/FORMAT=AVALUE</b> <b>TABLES</b> <b>/STATISTICS=CHISQ</b> <b>/CELLS=COUNT</b> <b>EXPECTED RESID</b> <b>/COUNT ROUND CELL.</b>
<b>Resources</b>	<b>Processor Time</b>	<b>00:00:00.01</b>
	<b>Elapsed Time</b>	<b>00:00:00.00</b>
	<b>Dimensions Requested</b>	<b>2</b>
	<b>Cells Available</b>	<b>524245</b>

### Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
First_Experiment * T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.	22	100.0%	0	0.0%	22	100.0%
First_Experiment * VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.	22	100.0%	0	0.0%	22	100.0%

**First\_Experiment \* T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.**

### Crosstab

T-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after ...

			Definitely yes	Probably yes	Might or might not
First_Experiment	Traditional	Count	6	2	2
		Expected Count	6.5	3.0	1.0
		Residual	-.5	-1.0	1.0
	VR	Count	7	4	0
		Expected Count	6.5	3.0	1.0
		Residual	.5	1.0	-1.0
Total		Count	13	6	2
		Expected Count	13.0	6.0	2.0

**Crosstab**

		T-Do you have a better awareness of ...		
		Probably not	Total	
First_Experiment	Traditional	Count	1	11
		Expected Count	.5	11.0
		Residual	.5	
	VR	Count	0	11
		Expected Count	.5	11.0
		Residual	-.5	
Total	Count	1	22	
	Expected Count	1.0	22.0	

**Chi-Square Tests**

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.744 <sup>a</sup>	3	.291
Likelihood Ratio	4.915	3	.178
Linear-by-Linear Association	1.558	1	.212
N of Valid Cases	22		

a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .50.

**First\_Experiment \* VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.**

### Crosstab

VR-Do you have a better awareness of the disorder after completing experiment? - I have a better awareness of the disorder after completing the experiment.

			Definitely yes	Probably yes	Might or might not
First_Experiment	Traditional	Count	6	3	2
		Expected Count	4.5	5.0	1.5
		Residual	1.5	-2.0	.5
	VR	Count	3	7	1
		Expected Count	4.5	5.0	1.5
		Residual	-1.5	2.0	-.5
Total	Count	9	10	3	
	Expected Count	9.0	10.0	3.0	

### Crosstab

			Total
First_Experiment	Traditional	Count	11
		Expected Count	11.0
		Residual	
	VR	Count	11
		Expected Count	11.0
		Residual	
Total	Count	22	
	Expected Count	22.0	

### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.933 <sup>a</sup>	2	.231
Likelihood Ratio	3.005	2	.223
Linear-by-Linear Association	.368	1	.544
N of Valid Cases	22		

a. 4 cells (66.7%) have expected count less than 5. The minimum expected count is 1.50.

## T-Test

### Notes

<b>Output Created</b>		21-FEB-2023 08:23:57
<b>Comments</b>		
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<b>Missing Value Handling</b>	<b>Definition of Missing</b>	User defined missing values are treated as missing.
	<b>Cases Used</b>	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
<b>Syntax</b>	<b>T-TEST</b> <b>PAIRS=T_Attractiveness</b> <b>T_Perspicuity</b> <b>T_Efficiency</b> <b>T_Dependability</b> <b>T_Stimulation T_Novelty</b> <b>WITH</b> <b>VR_Attractiveness</b> <b>VR_Perspicuity</b> <b>VR_Efficiency</b> <b>VR_Dependability</b> <b>VR_Stimulation</b> <b>VR_Novelty</b> <b>(PAIRED)</b> <b>/ES DISPLAY(TRUE)</b> <b>STANDARDIZER(SD)</b> <b>/CRITERIA=CI(.9500)</b> <b>/MISSING=ANALYSIS.</b>	
<b>Resources</b>	<b>Processor Time</b>	00:00:00.02
	<b>Elapsed Time</b>	00:00:00.00

[DataSet1] /Users/alexiciarichardson/Desktop/New Results SPSS/Post-Survey\_UEQ\_Data\_Tool\_Info.sav

### Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T_Attractiveness	.9173	22	1.07668	.22955
	VR_Attractiveness	1.4091	22	1.15887	.24707
Pair 2	T_Perspicuity	1.8068	22	1.12051	.23889
	VR_Perspicuity	1.3977	22	1.18688	.25304
Pair 3	T_Efficiency	1.3636	22	1.03431	.22052
	VR_Efficiency	.8864	22	.87874	.18735
Pair 4	T_Dependability	1.1932	22	.94470	.20141
	VR_Dependability	1.0000	22	1.15728	.24673
Pair 5	T_Stimulation	1.3750	22	.93780	.19994
	VR_Stimulation	1.7273	22	.96025	.20473
Pair 6	T_Novelty	.6705	22	.98919	.21090
	VR_Novelty	1.4205	22	.90759	.19350

### Paired Samples Correlations

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	T_Attractiveness & VR_Attractiveness	22	.493	.010	.020
Pair 2	T_Perspicuity & VR_Perspicuity	22	.553	.004	.008
Pair 3	T_Efficiency & VR_Efficiency	22	.552	.004	.008
Pair 4	T_Dependability & VR_Dependability	22	.593	.002	.004
Pair 5	T_Stimulation & VR_Stimulation	22	.760	<.001	<.001
Pair 6	T_Novelty & VR_Novelty	22	.122	.294	.589

**Paired Samples Test**

		Paired Differences			95% Confidence ...
		Mean	Std. Deviation	Std. Error Mean	Lower
Pair 1	T_Attractiveness - VR_Attractiveness	-.49182	1.12804	.24050	-.99196
Pair 2	T_Perspicuity - VR_Perspicuity	.40909	1.09258	.23294	-.07533
Pair 3	T_Efficiency - VR_Efficiency	.47727	.91583	.19526	.07122
Pair 4	T_Dependability - VR_Dependability	.19318	.96650	.20606	-.23534
Pair 5	T_Stimulation - VR_Stimulation	-.35227	.65764	.14021	-.64386
Pair 6	T_Novelty - VR_Novelty	-.75000	1.25831	.26827	-1.30790

**Paired Samples Test**

		Paired ...			Significance
		95% Confidence Interval of the ...	t	df	One-Sided p
		Upper			
Pair 1	T_Attractiveness - VR_Attractiveness	.00833	-2.045	21	.027
Pair 2	T_Perspicuity - VR_Perspicuity	.89351	1.756	21	.047
Pair 3	T_Efficiency - VR_Efficiency	.88333	2.444	21	.012
Pair 4	T_Dependability - VR_Dependability	.62170	.938	21	.180
Pair 5	T_Stimulation - VR_Stimulation	-.06069	-2.512	21	.010
Pair 6	T_Novelty - VR_Novelty	-.19210	-2.796	21	.005

### Paired Samples Test

Significance

		Two-Sided p
Pair 1	T_Attractiveness - VR_Attractiveness	.054
Pair 2	T_Perspicuity - VR_Perspicuity	.094
Pair 3	T_Efficiency - VR_Efficiency	.023
Pair 4	T_Dependability - VR_Dependability	.359
Pair 5	T_Stimulation - VR_Stimulation	.020
Pair 6	T_Novelty - VR_Novelty	.011

### Paired Samples Effect Sizes

			Standardizer <sup>a</sup>	Point Estimate	95% ... Lower
Pair 1	T_Attractiveness - VR_Attractiveness	Cohen's d	1.12804	-.436	-.869
		Hedges' correction	1.17043	-.420	-.838
Pair 2	T_Perspicuity - VR_Perspicuity	Cohen's d	1.09258	.374	-.062
		Hedges' correction	1.13363	.361	-.060
Pair 3	T_Efficiency - VR_Efficiency	Cohen's d	.91583	.521	.069
		Hedges' correction	.95025	.502	.067
Pair 4	T_Dependability - VR_Dependability	Cohen's d	.96650	.200	-.225
		Hedges' correction	1.00282	.193	-.216
Pair 5	T_Stimulation - VR_Stimulation	Cohen's d	.65764	-.536	-.978
		Hedges' correction	.68236	-.516	-.943
Pair 6	T_Novelty - VR_Novelty	Cohen's d	1.25831	-.596	-1.045
		Hedges' correction	1.30559	-.574	-1.007

### Paired Samples Effect Sizes

			95% ... Upper
Pair 1	T_Attractiveness - VR_Attractiveness	Cohen's d	.007
		Hedges' correction	.006
Pair 2	T_Perspicuity - VR_Perspicuity	Cohen's d	.803
		Hedges' correction	.774
Pair 3	T_Efficiency - VR_Efficiency	Cohen's d	.962
		Hedges' correction	.927
Pair 4	T_Dependability - VR_Dependability	Cohen's d	.620
		Hedges' correction	.597
Pair 5	T_Stimulation - VR_Stimulation	Cohen's d	-.082
		Hedges' correction	-.079
Pair 6	T_Novelty - VR_Novelty	Cohen's d	-.135
		Hedges' correction	-.131

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

## T-Test

### Notes

<b>Output Created</b>		23-FEB-2023 16:57:45
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<b>Missing Value Handling</b>	<b>Definition of Missing</b>	User defined missing values are treated as missing.
	<b>Cases Used</b>	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
<b>Syntax</b>	<pre>T-TEST PAIRS=T_PS_EC_SUB T_PS_PT_SUB PS_EC PS_EC PS_PT PS_PT T_PT T_EC WITH VR_PS_EC SUB VR_PS_PT SUB T_EC VR_EC T_PT VR_PT VR_PT VR_EC (PAIRED) /ES DISPLAY(TRUE) STANDARDIZER(SD) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.</pre>	
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	<b>Elapsed Time</b>	00:00:00.00

### Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T_PS_EC_SUB	-.23	22	1.998	.426
	VR_PS_EC_SUB	-.14	22	1.910	.407
Pair 2	T_PS_PT_SUB	.36	22	3.360	.716
	VR_PS_PT_SUB	.09	22	3.191	.680
Pair 3	PS_EC	20.45	22	4.149	.885
	T_EC	20.23	22	4.023	.858
Pair 4	PS_EC	20.45	22	4.149	.885
	VR_EC	20.32	22	4.224	.901
Pair 5	PS_PT	18.64	22	5.323	1.135
	T_PT	19.00	22	4.947	1.055
Pair 6	PS_PT	18.64	22	5.323	1.135
	VR_PT	18.73	22	5.444	1.161
Pair 7	T_PT	19.00	22	4.947	1.055
	VR_PT	18.73	22	5.444	1.161
Pair 8	T_EC	20.23	22	4.023	.858
	VR_EC	20.32	22	4.224	.901

### Paired Samples Correlations

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	T_PS_EC_SUB & VR_PS_EC_SUB	22	.328	.068	.136
Pair 2	T_PS_PT_SUB & VR_PS_PT_SUB	22	.703	<.001	<.001
Pair 3	PS_EC & T_EC	22	.881	<.001	<.001
Pair 4	PS_EC & VR_EC	22	.896	<.001	<.001
Pair 5	PS_PT & T_PT	22	.788	<.001	<.001
Pair 6	PS_PT & VR_PT	22	.825	<.001	<.001
Pair 7	T_PT & VR_PT	22	.886	<.001	<.001
Pair 8	T_EC & VR_EC	22	.850	<.001	<.001

### Paired Samples Test

		Paired Differences			95% Confidence ...
		Mean	Std. Deviation	Std. Error Mean	Lower
Pair 1	T_PS_EC_SUB - VR_PS_EC_SUB	-.091	2.266	.483	-1.096
Pair 2	T_PS_PT_SUB - VR_PS_PT_SUB	.273	2.529	.539	-.849
Pair 3	PS_EC - T_EC	.227	1.998	.426	-.659
Pair 4	PS_EC - VR_EC	.136	1.910	.407	-.710
Pair 5	PS_PT - T_PT	-.364	3.360	.716	-1.853
Pair 6	PS_PT - VR_PT	-.091	3.191	.680	-1.506
Pair 7	T_PT - VR_PT	.273	2.529	.539	-.849
Pair 8	T_EC - VR_EC	-.091	2.266	.483	-1.096

### Paired Samples Test

		Paired ...			Significance
		95% Confidence Interval of the ...	t	df	One-Sided p
		Upper			
Pair 1	T_PS_EC_SUB - VR_PS_EC_SUB	.914	-.188	21	.426
Pair 2	T_PS_PT_SUB - VR_PS_PT_SUB	1.394	.506	21	.309
Pair 3	PS_EC - T_EC	1.113	.533	21	.300
Pair 4	PS_EC - VR_EC	.983	.335	21	.371
Pair 5	PS_PT - T_PT	1.126	-.508	21	.309
Pair 6	PS_PT - VR_PT	1.324	-.134	21	.447
Pair 7	T_PT - VR_PT	1.394	.506	21	.309
Pair 8	T_EC - VR_EC	.914	-.188	21	.426

### Paired Samples Test

		Significance
		Two-Sided p
Pair 1	T_PS_EC_SUB - VR_PS_EC_SUB	.853
Pair 2	T_PS_PT_SUB - VR_PS_PT_SUB	.618
Pair 3	PS_EC - T_EC	.599
Pair 4	PS_EC - VR_EC	.741
Pair 5	PS_PT - T_PT	.617
Pair 6	PS_PT - VR_PT	.895
Pair 7	T_PT - VR_PT	.618
Pair 8	T_EC - VR_EC	.853

### Paired Samples Effect Sizes

			Standardizer <sup>a</sup>	Point Estimate	95% ... Lower
Pair 1	T_PS_EC_SUB - VR_PS_EC_SUB	Cohen's d	2.266	-.040	-.458
		Hedges' correction	2.351	-.039	-.441
Pair 2	T_PS_PT_SUB - VR_PS_PT_SUB	Cohen's d	2.529	.108	-.313
		Hedges' correction	2.625	.104	-.301
Pair 3	PS_EC - T_EC	Cohen's d	1.998	.114	-.307
		Hedges' correction	2.073	.110	-.296
Pair 4	PS_EC - VR_EC	Cohen's d	1.910	.071	-.348
		Hedges' correction	1.982	.069	-.335
Pair 5	PS_PT - T_PT	Cohen's d	3.360	-.108	-.526
		Hedges' correction	3.486	-.104	-.507
Pair 6	PS_PT - VR_PT	Cohen's d	3.191	-.028	-.446
		Hedges' correction	3.311	-.027	-.430
Pair 7	T_PT - VR_PT	Cohen's d	2.529	.108	-.313
		Hedges' correction	2.625	.104	-.301
Pair 8	T_EC - VR_EC	Cohen's d	2.266	-.040	-.458
		Hedges' correction	2.351	-.039	-.441

### Paired Samples Effect Sizes

			95% ... Upper
Pair 1	T_PS_EC_SUB - VR_PS_EC_SUB	Cohen's d	.378
		Hedges' correction	.365
Pair 2	T_PS_PT_SUB - VR_PS_PT_SUB	Cohen's d	.526
		Hedges' correction	.507
Pair 3	PS_EC - T_EC	Cohen's d	.532
		Hedges' correction	.512
Pair 4	PS_EC - VR_EC	Cohen's d	.489
		Hedges' correction	.471
Pair 5	PS_PT - T_PT	Cohen's d	.312
		Hedges' correction	.301
Pair 6	PS_PT - VR_PT	Cohen's d	.390
		Hedges' correction	.376
Pair 7	T_PT - VR_PT	Cohen's d	.526
		Hedges' correction	.507
Pair 8	T_EC - VR_EC	Cohen's d	.378
		Hedges' correction	.365

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

## T-Test

### Notes

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	<b>Cases Used</b>	Statistics for each analysis are based on the cases with no missing or out-of-range data for any variable in the analysis.
<b>Syntax</b>	T-TEST PAIRS=T_FA_Score T_PU_Score T_AE_Score T_RW_Score T_Overall_Score WITH VR_FA_Score VR_PU_Score VR_AE_Score VR_RW_Score VR_Overall_Score (PAIRED) /ES DISPLAY(TRUE) STANDARDIZER(SD) /CRITERIA=CI(.9500) /MISSING=ANALYSIS.	
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	<b>Elapsed Time</b>	<b>00:00:00.00</b>

[DataSet1] /Users/alexiciarichardson/Desktop/ExperimentResults/Post-Survey\_UE.sav

### Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	T_FA_Score	2.8636	22	.73936	.15763
	VR_FA_Score	3.5606	22	1.13802	.24263
Pair 2	T_PU_Score	3.6515	22	.84501	.18016
	VR_PU_Score	3.5758	22	.99300	.21171
Pair 3	T_AE_Score	3.5758	22	.98229	.20942
	VR_AE_Score	4.0606	22	.92374	.19694
Pair 4	T_RW_Score	4.2121	22	.85167	.18158
	VR_RW_Score	4.3485	22	.65447	.13953
Pair 5	T_Overall_Score	3.5758	22	.68521	.14609
	VR_Overall_Score	3.8864	22	.71849	.15318

### Paired Samples Correlations

		N	Correlation	Significance	
				One-Sided p	Two-Sided p
Pair 1	T_FA_Score & VR_FA_Score	22	.328	.068	.136
Pair 2	T_PU_Score & VR_PU_Score	22	.616	.001	.002
Pair 3	T_AE_Score & VR_AE_Score	22	.496	.009	.019
Pair 4	T_RW_Score & VR_RW_Score	22	.459	.016	.032
Pair 5	T_Overall_Score & VR_Overall_Score	22	.444	.019	.038

### Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence ... Lower
Pair 1	T_FA_Score - VR_FA_Score	-.69697	1.13580	.24215	-1.20056
Pair 2	T_PU_Score - VR_PU_Score	.07576	.81605	.17398	-.28606
Pair 3	T_AE_Score - VR_AE_Score	-.48485	.95799	.20424	-.90960
Pair 4	T_RW_Score - VR_RW_Score	-.13636	.80118	.17081	-.49159
Pair 5	T_Overall_Score - VR_Overall_Score	-.31061	.74054	.15788	-.63894

**Paired Samples Test**

		Paired ... 95% Confidence Interval of the ... Upper	t	df	Significance One-Sided p
Pair 1	T_FA_Score - VR_FA_Score	-.19338	-2.878	21	.004
Pair 2	T_PU_Score - VR_PU_Score	.43758	.435	21	.334
Pair 3	T_AE_Score - VR_AE_Score	-.06010	-2.374	21	.014
Pair 4	T_RW_Score - VR_RW_Score	.21886	-.798	21	.217
Pair 5	T_Overall_Score - VR_Overall_Score	.01773	-1.967	21	.031

**Paired Samples Test**

		Significance Two-Sided p
Pair 1	T_FA_Score - VR_FA_Score	.009
Pair 2	T_PU_Score - VR_PU_Score	.668
Pair 3	T_AE_Score - VR_AE_Score	.027
Pair 4	T_RW_Score - VR_RW_Score	.434
Pair 5	T_Overall_Score - VR_Overall_Score	.062

### Paired Samples Effect Sizes

			Standardizer <sup>a</sup>	Point Estimate	95% ... Lower
Pair 1	T_FA_Score - VR_FA_Score	Cohen's d	1.13580	-.614	-1.064
		Hedges' correction	1.17848	-.591	-1.026
Pair 2	T_PU_Score - VR_PU_Score	Cohen's d	.81605	.093	-.327
		Hedges' correction	.84672	.089	-.315
Pair 3	T_AE_Score - VR_AE_Score	Cohen's d	.95799	-.506	-.946
		Hedges' correction	.99399	-.488	-.911
Pair 4	T_RW_Score - VR_RW_Score	Cohen's d	.80118	-.170	-.589
		Hedges' correction	.83129	-.164	-.568
Pair 5	T_Overall_Score - VR_Overall_Score	Cohen's d	.74054	-.419	-.851
		Hedges' correction	.76837	-.404	-.821

### Paired Samples Effect Sizes

			95% ... Upper
Pair 1	T_FA_Score - VR_FA_Score	Cohen's d	-.151
		Hedges' correction	-.145
Pair 2	T_PU_Score - VR_PU_Score	Cohen's d	.511
		Hedges' correction	.492
Pair 3	T_AE_Score - VR_AE_Score	Cohen's d	-.056
		Hedges' correction	-.054
Pair 4	T_RW_Score - VR_RW_Score	Cohen's d	.253
		Hedges' correction	.244
Pair 5	T_Overall_Score - VR_Overall_Score	Cohen's d	.022
		Hedges' correction	.021

a. The denominator used in estimating the effect sizes.

Cohen's d uses the sample standard deviation of the mean difference.

Hedges' correction uses the sample standard deviation of the mean difference, plus a correction factor.

## Correlations

### Notes

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	<b>Cases Used</b>	Statistics for each pair of variables are based on all the cases with valid data for that pair.
<b>Syntax</b>	CORRELATIONS /VARIABLES=T_EC T_PT VR_EC VR_PT T_Attractiveness T_Perspicuity T_Efficiency T_Dependability T_Stimulation T_Novelty VR_Attractiveness VR_Perspicuity VR_Efficiency VR_Dependability VR_Stimulation VR_Novelty /PRINT=TWOTAIL NOSIG FULL /STATISTICS DESCRIPTIVES /MISSING=PAIRWISE.	
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	<b>Elapsed Time</b>	00:00:00.00

### Descriptive Statistics

	Mean	Std. Deviation	N
T_EC	20.23	4.023	22
T_PT	19.00	4.947	22
VR_EC	20.32	4.224	22
VR_PT	18.73	5.444	22
T_Attractiveness	.9173	1.07668	22
T_Perspiciuity	1.8068	1.12051	22
T_Efficiency	1.3636	1.03431	22
T_Dependability	1.1932	.94470	22
T_Stimulation	1.3750	.93780	22
T_Novelty	.6705	.98919	22
VR_Attractiveness	1.4091	1.15887	22
VR_Perspiciuity	1.3977	1.18688	22
VR_Efficiency	.8864	.87874	22
VR_Dependability	1.0000	1.15728	22
VR_Stimulation	1.7273	.96025	22
VR_Novelty	1.4205	.90759	22

### Correlations

		T_EC	T_PT	VR_EC	VR_PT	T_Attractiveness
T_EC	Pearson Correlation	1	.514 <sup>*</sup>	.850 <sup>**</sup>	.455 <sup>*</sup>	.015
	Sig. (2-tailed)		.014	<.001	.033	.948
	N	22	22	22	22	22
T_PT	Pearson Correlation	.514 <sup>*</sup>	1	.419	.886 <sup>**</sup>	.234
	Sig. (2-tailed)	.014		.052	<.001	.295
	N	22	22	22	22	22
VR_EC	Pearson Correlation	.850 <sup>**</sup>	.419	1	.464 <sup>*</sup>	-.030
	Sig. (2-tailed)	<.001	.052		.030	.896
	N	22	22	22	22	22
VR_PT	Pearson Correlation	.455 <sup>*</sup>	.886 <sup>**</sup>	.464 <sup>*</sup>	1	.093
	Sig. (2-tailed)	.033	<.001	.030		.681
	N	22	22	22	22	22
T_Attractiveness	Pearson Correlation	.015	.234	-.030	.093	1
	Sig. (2-tailed)	.948	.295	.896	.681	
	N	22	22	22	22	22
T_Perspiciuity	Pearson Correlation	.066	.002	.139	-.031	.574 <sup>**</sup>
	Sig. (2-tailed)	.772	.992	.536	.893	.005
	N	22	22	22	22	22
T_Efficiency	Pearson Correlation	-.155	-.123	-.129	-.259	.675 <sup>**</sup>
	Sig. (2-tailed)	.490	.585	.569	.245	<.001
	N	22	22	22	22	22

### Correlations

		T_Perspicuity	T_Efficiency	T_Dependability	T_Stimulation
T_EC	Pearson Correlation	.066	-.155	-.053	.222
	Sig. (2-tailed)	.772	.490	.815	.320
	N	22	22	22	22
T_PT	Pearson Correlation	.002	-.123	-.010	.498*
	Sig. (2-tailed)	.992	.585	.964	.018
	N	22	22	22	22
VR_EC	Pearson Correlation	.139	-.129	-.022	.209
	Sig. (2-tailed)	.536	.569	.922	.351
	N	22	22	22	22
VR_PT	Pearson Correlation	-.031	-.259	-.198	.280
	Sig. (2-tailed)	.893	.245	.378	.207
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	.574**	.675**	.733**	.805**
	Sig. (2-tailed)	.005	<.001	<.001	<.001
	N	22	22	22	22
T_Perspicuity	Pearson Correlation	1	.693**	.720**	.375
	Sig. (2-tailed)		<.001	<.001	.085
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.693**	1	.726**	.399
	Sig. (2-tailed)	<.001		<.001	.066
	N	22	22	22	22

### Correlations

		T_Novelty	VR_Attractiveness	VR_Perspicuity	VR_Efficiency
T_EC	Pearson Correlation	.358	.094	-.130	-.056
	Sig. (2-tailed)	.102	.677	.566	.803
	N	22	22	22	22
T_PT	Pearson Correlation	.513 <sup>*</sup>	.254	.114	.101
	Sig. (2-tailed)	.015	.253	.615	.654
	N	22	22	22	22
VR_EC	Pearson Correlation	.286	.113	-.105	-.089
	Sig. (2-tailed)	.198	.618	.643	.693
	N	22	22	22	22
VR_PT	Pearson Correlation	.425 <sup>*</sup>	.076	-.040	.003
	Sig. (2-tailed)	.049	.737	.861	.989
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	.479 <sup>*</sup>	.493 <sup>*</sup>	.323	.315
	Sig. (2-tailed)	.024	.020	.143	.153
	N	22	22	22	22
T_Perspicuity	Pearson Correlation	.055	.519 <sup>*</sup>	.553 <sup>**</sup>	.415
	Sig. (2-tailed)	.807	.013	.008	.055
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.105	.516 <sup>*</sup>	.478 <sup>*</sup>	.552 <sup>**</sup>
	Sig. (2-tailed)	.641	.014	.025	.008
	N	22	22	22	22

### Correlations

		VR_Dependability	VR_Stimulation	VR_Novelty
T_EC	Pearson Correlation	-.199	.112	.364
	Sig. (2-tailed)	.374	.619	.096
	N	22	22	22
T_PT	Pearson Correlation	.177	.393	.278
	Sig. (2-tailed)	.431	.070	.210
	N	22	22	22
VR_EC	Pearson Correlation	-.117	.110	.435*
	Sig. (2-tailed)	.604	.625	.043
	N	22	22	22
VR_PT	Pearson Correlation	.036	.183	.142
	Sig. (2-tailed)	.874	.414	.527
	N	22	22	22
T_Attractiveness	Pearson Correlation	.368	.542**	-.053
	Sig. (2-tailed)	.092	.009	.814
	N	22	22	22
T_Perspicuity	Pearson Correlation	.571**	.416	.195
	Sig. (2-tailed)	.005	.054	.385
	N	22	22	22
T_Efficiency	Pearson Correlation	.507*	.419	.178
	Sig. (2-tailed)	.016	.052	.428
	N	22	22	22

### Correlations

		T_EC	T_PT	VR_EC	VR_PT	T_Attractiveness
T_Dependability	Pearson Correlation	-.053	-.010	-.022	-.198	.733**
	Sig. (2-tailed)	.815	.964	.922	.378	<.001
	N	22	22	22	22	22
T_Stimulation	Pearson Correlation	.222	.498*	.209	.280	.805**
	Sig. (2-tailed)	.320	.018	.351	.207	<.001
	N	22	22	22	22	22
T_Novelty	Pearson Correlation	.358	.513*	.286	.425*	.479*
	Sig. (2-tailed)	.102	.015	.198	.049	.024
	N	22	22	22	22	22
VR_Attractiveness	Pearson Correlation	.094	.254	.113	.076	.493*
	Sig. (2-tailed)	.677	.253	.618	.737	.020
	N	22	22	22	22	22
VR_Perspicuity	Pearson Correlation	-.130	.114	-.105	-.040	.323
	Sig. (2-tailed)	.566	.615	.643	.861	.143
	N	22	22	22	22	22
VR_Efficiency	Pearson Correlation	-.056	.101	-.089	.003	.315
	Sig. (2-tailed)	.803	.654	.693	.989	.153
	N	22	22	22	22	22
VR_Dependability	Pearson Correlation	-.199	.177	-.117	.036	.368
	Sig. (2-tailed)	.374	.431	.604	.874	.092
	N	22	22	22	22	22
VR_Stimulation	Pearson Correlation	.112	.393	.110	.183	.542**
	Sig. (2-tailed)	.619	.070	.625	.414	.009
	N	22	22	22	22	22
VR_Novelty	Pearson Correlation	.364	.278	.435*	.142	-.053
	Sig. (2-tailed)	.096	.210	.043	.527	.814
	N	22	22	22	22	22

### Correlations

		T_Perspicuity	T_Efficiency	T_Dependability	T_Stimulation
T_Dependability	Pearson Correlation	.720**	.726**	1	.613**
	Sig. (2-tailed)	<.001	<.001		.002
	N	22	22	22	22
T_Stimulation	Pearson Correlation	.375	.399	.613**	1
	Sig. (2-tailed)	.085	.066	.002	
	N	22	22	22	22
T_Novelty	Pearson Correlation	.055	.105	.256	.557**
	Sig. (2-tailed)	.807	.641	.250	.007
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.519*	.516*	.490*	.593**
	Sig. (2-tailed)	.013	.014	.021	.004
	N	22	22	22	22
VR_Perspicuity	Pearson Correlation	.553**	.478*	.576**	.333
	Sig. (2-tailed)	.008	.025	.005	.130
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	.415	.552**	.390	.177
	Sig. (2-tailed)	.055	.008	.073	.431
	N	22	22	22	22
VR_Dependability	Pearson Correlation	.571**	.507*	.593**	.472*
	Sig. (2-tailed)	.005	.016	.004	.027
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.416	.419	.527*	.760**
	Sig. (2-tailed)	.054	.052	.012	<.001
	N	22	22	22	22
VR_Novelty	Pearson Correlation	.195	.178	.109	.103
	Sig. (2-tailed)	.385	.428	.629	.648
	N	22	22	22	22

### Correlations

		T_Novelty	VR_Attractiveness	VR_Perspicuity	VR_Efficiency
T_Dependability	Pearson Correlation	.256	.490*	.576**	.390
	Sig. (2-tailed)	.250	.021	.005	.073
	N	22	22	22	22
T_Stimulation	Pearson Correlation	.557**	.593**	.333	.177
	Sig. (2-tailed)	.007	.004	.130	.431
	N	22	22	22	22
T_Novelty	Pearson Correlation	1	.075	-.131	.003
	Sig. (2-tailed)		.740	.560	.990
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.075	1	.784**	.657**
	Sig. (2-tailed)	.740		<.001	<.001
	N	22	22	22	22
VR_Perspicuity	Pearson Correlation	-.131	.784**	1	.707**
	Sig. (2-tailed)	.560	<.001		<.001
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	.003	.657**	.707**	1
	Sig. (2-tailed)	.990	<.001	<.001	
	N	22	22	22	22
VR_Dependability	Pearson Correlation	.205	.743**	.813**	.577**
	Sig. (2-tailed)	.359	<.001	<.001	.005
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.264	.870**	.622**	.519*
	Sig. (2-tailed)	.235	<.001	.002	.013
	N	22	22	22	22
VR_Novelty	Pearson Correlation	.122	.272	.072	.328
	Sig. (2-tailed)	.589	.221	.749	.137
	N	22	22	22	22

### Correlations

		VR_Dependability	VR_Stimulation	VR_Novelty
T_Dependability	Pearson Correlation	.593**	.527*	.109
	Sig. (2-tailed)	.004	.012	.629
	N	22	22	22
T_Stimulation	Pearson Correlation	.472*	.760**	.103
	Sig. (2-tailed)	.027	<.001	.648
	N	22	22	22
T_Novelty	Pearson Correlation	.205	.264	.122
	Sig. (2-tailed)	.359	.235	.589
	N	22	22	22
VR_Attractiveness	Pearson Correlation	.743**	.870**	.272
	Sig. (2-tailed)	<.001	<.001	.221
	N	22	22	22
VR_Perspiciuity	Pearson Correlation	.813**	.622**	.072
	Sig. (2-tailed)	<.001	.002	.749
	N	22	22	22
VR_Efficiency	Pearson Correlation	.577**	.519*	.328
	Sig. (2-tailed)	.005	.013	.137
	N	22	22	22
VR_Dependability	Pearson Correlation	1	.680**	.179
	Sig. (2-tailed)		<.001	.427
	N	22	22	22
VR_Stimulation	Pearson Correlation	.680**	1	.339
	Sig. (2-tailed)	<.001		.122
	N	22	22	22
VR_Novelty	Pearson Correlation	.179	.339	1
	Sig. (2-tailed)	.427	.122	
	N	22	22	22

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

## Correlations

### Notes

<b>Output Created</b>		<b>08-MAR-2023 11:56:51</b>
<b>Comments</b>		
<b>Input</b>	<b>Data</b>	/Users/alexiciarichardson/Desktop/New Results SPSS/Correlations_Data.sav
	<b>Active Dataset</b>	DataSet8
	<b>Filter</b>	<none>
	<b>Weight</b>	<none>
	<b>Split File</b>	<none>
	<b>N of Rows in Working Data File</b>	22
<b>Missing Value Handling</b>	<b>Definition of Missing</b>	User-defined missing values are treated as missing.
	<b>Cases Used</b>	Statistics for each pair of variables are based on all the cases with valid data for that pair.
<b>Syntax</b>		<pre> CORRELATIONS /VARIABLES=T_EC T_PT VR_EC VR_PT T_FA_Score T_PU_Score T_AE_Score T_RW_Score VR_FA_Score VR_PU_Score VR_AE_Score VR_RW_Score /PRINT=TWOTAIL NOSIG FULL /STATISTICS DESCRIPTIVES /MISSING=PAIRWISE. </pre>
<b>Resources</b>	<b>Processor Time</b>	00:00:00.05
	<b>Elapsed Time</b>	00:00:00.00

### Descriptive Statistics

	Mean	Std. Deviation	N
T_EC	20.23	4.023	22
T_PT	19.00	4.947	22
VR_EC	20.32	4.224	22
VR_PT	18.73	5.444	22
T_FA_Score	2.8636	.73936	22
T_PU_Score	3.6515	.84501	22
T_AE_Score	3.5758	.98229	22
T_RW_Score	4.2121	.85167	22
VR_FA_Score	3.5606	1.13802	22
VR_PU_Score	3.5758	.99300	22
VR_AE_Score	4.0606	.92374	22
VR_RW_Score	4.3485	.65447	22

### Correlations

		T_EC	T_PT	VR_EC	VR_PT	T_FA_Score
T_EC	Pearson Correlation	1	.514*	.850**	.455*	.224
	Sig. (2-tailed)		.014	<.001	.033	.315
	N	22	22	22	22	22
T_PT	Pearson Correlation	.514*	1	.419	.886**	.338
	Sig. (2-tailed)	.014		.052	<.001	.123
	N	22	22	22	22	22
VR_EC	Pearson Correlation	.850**	.419	1	.464*	.096
	Sig. (2-tailed)	<.001	.052		.030	.671
	N	22	22	22	22	22
VR_PT	Pearson Correlation	.455*	.886**	.464*	1	.156
	Sig. (2-tailed)	.033	<.001	.030		.488
	N	22	22	22	22	22
T_FA_Score	Pearson Correlation	.224	.338	.096	.156	1
	Sig. (2-tailed)	.315	.123	.671	.488	
	N	22	22	22	22	22
T_PU_Score	Pearson Correlation	.057	.091	-.061	.003	.361
	Sig. (2-tailed)	.801	.687	.788	.991	.099
	N	22	22	22	22	22
T_AE_Score	Pearson Correlation	.082	.327	-.092	.170	.565**
	Sig. (2-tailed)	.717	.138	.683	.449	.006
	N	22	22	22	22	22
T_RW_Score	Pearson Correlation	.161	.218	.174	.092	.477*
	Sig. (2-tailed)	.473	.329	.437	.684	.025
	N	22	22	22	22	22

**Correlations**

		T_PU_Score	T_AE_Score	T_RW_Score	VR_FA_Score
T_EC	Pearson Correlation	.057	.082	.161	.186
	Sig. (2-tailed)	.801	.717	.473	.408
	N	22	22	22	22
T_PT	Pearson Correlation	.091	.327	.218	.121
	Sig. (2-tailed)	.687	.138	.329	.591
	N	22	22	22	22
VR_EC	Pearson Correlation	-.061	-.092	.174	.192
	Sig. (2-tailed)	.788	.683	.437	.391
	N	22	22	22	22
VR_PT	Pearson Correlation	.003	.170	.092	-.010
	Sig. (2-tailed)	.991	.449	.684	.965
	N	22	22	22	22
T_FA_Score	Pearson Correlation	.361	.565 <sup>**</sup>	.477 <sup>*</sup>	.328
	Sig. (2-tailed)	.099	.006	.025	.136
	N	22	22	22	22
T_PU_Score	Pearson Correlation	1	.617 <sup>**</sup>	.446 <sup>*</sup>	.053
	Sig. (2-tailed)		.002	.038	.814
	N	22	22	22	22
T_AE_Score	Pearson Correlation	.617 <sup>**</sup>	1	.612 <sup>**</sup>	.100
	Sig. (2-tailed)	.002		.002	.658
	N	22	22	22	22
T_RW_Score	Pearson Correlation	.446 <sup>*</sup>	.612 <sup>**</sup>	1	-.041
	Sig. (2-tailed)	.038	.002		.856
	N	22	22	22	22

**Correlations**

		VR_PU_Score	VR_AE_Score	VR_RW_Score
T_EC	Pearson Correlation	-.003	.133	.415
	Sig. (2-tailed)	.991	.556	.055
	N	22	22	22
T_PT	Pearson Correlation	.372	.326	.422
	Sig. (2-tailed)	.089	.138	.051
	N	22	22	22
VR_EC	Pearson Correlation	-.171	.068	.297
	Sig. (2-tailed)	.448	.764	.180
	N	22	22	22
VR_PT	Pearson Correlation	.212	.101	.171
	Sig. (2-tailed)	.342	.654	.448
	N	22	22	22
T_FA_Score	Pearson Correlation	.184	.330	.300
	Sig. (2-tailed)	.412	.133	.175
	N	22	22	22
T_PU_Score	Pearson Correlation	.616**	.442*	.297
	Sig. (2-tailed)	.002	.040	.179
	N	22	22	22
T_AE_Score	Pearson Correlation	.333	.496*	.414
	Sig. (2-tailed)	.130	.019	.056
	N	22	22	22
T_RW_Score	Pearson Correlation	.018	.326	.459*
	Sig. (2-tailed)	.938	.139	.032
	N	22	22	22

**Correlations**

		T_EC	T_PT	VR_EC	VR_PT	T_FA_Score
VR_FA_Score	Pearson Correlation	.186	.121	.192	-.010	.328
	Sig. (2-tailed)	.408	.591	.391	.965	.136
	N	22	22	22	22	22
VR_PU_Score	Pearson Correlation	-.003	.372	-.171	.212	.184
	Sig. (2-tailed)	.991	.089	.448	.342	.412
	N	22	22	22	22	22
VR_AE_Score	Pearson Correlation	.133	.326	.068	.101	.330
	Sig. (2-tailed)	.556	.138	.764	.654	.133
	N	22	22	22	22	22
VR_RW_Score	Pearson Correlation	.415	.422	.297	.171	.300
	Sig. (2-tailed)	.055	.051	.180	.448	.175
	N	22	22	22	22	22

### Correlations

		T_PU_Score	T_AE_Score	T_RW_Score	VR_FA_Score
VR_FA_Score	Pearson Correlation	.053	.100	-.041	1
	Sig. (2-tailed)	.814	.658	.856	
	N	22	22	22	22
VR_PU_Score	Pearson Correlation	.616**	.333	.018	.225
	Sig. (2-tailed)	.002	.130	.938	.314
	N	22	22	22	22
VR_AE_Score	Pearson Correlation	.442*	.496*	.326	.555**
	Sig. (2-tailed)	.040	.019	.139	.007
	N	22	22	22	22
VR_RW_Score	Pearson Correlation	.297	.414	.459*	.464*
	Sig. (2-tailed)	.179	.056	.032	.030
	N	22	22	22	22

### Correlations

		VR_PU_Score	VR_AE_Score	VR_RW_Score
VR_FA_Score	Pearson Correlation	.225	.555**	.464*
	Sig. (2-tailed)	.314	.007	.030
	N	22	22	22
VR_PU_Score	Pearson Correlation	1	.497*	.377
	Sig. (2-tailed)		.019	.084
	N	22	22	22
VR_AE_Score	Pearson Correlation	.497*	1	.769**
	Sig. (2-tailed)	.019		<.001
	N	22	22	22
VR_RW_Score	Pearson Correlation	.377	.769**	1
	Sig. (2-tailed)	.084	<.001	
	N	22	22	22

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\*. Correlation is significant at the 0.01 level (2-tailed).

## Correlations

### Notes

<b>Output Created</b>		21-MAR-2023 16:02:47
<b>Comments</b>		
<b>Input</b>	<b>Data</b>	/Users/alexiciarichardson/Desktop/New Results SPSS/Correlations_Data.sav
	<b>Active Dataset</b>	DataSet1
	<b>Filter</b>	<none>
	<b>Weight</b>	<none>
	<b>Split File</b>	<none>
	<b>N of Rows in Working Data File</b>	22
<b>Missing Value Handling</b>	<b>Definition of Missing</b>	User-defined missing values are treated as missing.
	<b>Cases Used</b>	Statistics for each pair of variables are based on all the cases with valid data for that pair.
<b>Syntax</b>	CORRELATIONS /VARIABLES=T_EC T_PT VR_EC VR_PT T_Overall_Score VR_Overall_Score /PRINT=TWOTAIL NOSIG FULL /STATISTICS DESCRIPTIVES /MISSING=PAIRWISE.	
<b>Resources</b>	<b>Processor Time</b>	00:00:00.03
	<b>Elapsed Time</b>	00:00:00.00

### Descriptive Statistics

	Mean	Std. Deviation	N
T_EC	20.23	4.023	22
T_PT	19.00	4.947	22
VR_EC	20.32	4.224	22
VR_PT	18.73	5.444	22
T_Overall_Score	3.5758	.68521	22
VR_Overall_Score	3.8864	.71849	22

**Correlations**

		T_EC	T_PT	VR_EC	VR_PT	T_Overall_Score
T_EC	Pearson Correlation	1	.514*	.850**	.455*	.158
	Sig. (2-tailed)		.014	<.001	.033	.484
	N	22	22	22	22	22
T_PT	Pearson Correlation	.514*	1	.419	.886**	.304
	Sig. (2-tailed)	.014		.052	<.001	.168
	N	22	22	22	22	22
VR_EC	Pearson Correlation	.850**	.419	1	.464*	.028
	Sig. (2-tailed)	<.001	.052		.030	.901
	N	22	22	22	22	22
VR_PT	Pearson Correlation	.455*	.886**	.464*	1	.132
	Sig. (2-tailed)	.033	<.001	.030		.557
	N	22	22	22	22	22
T_Overall_Score	Pearson Correlation	.158	.304	.028	.132	1
	Sig. (2-tailed)	.484	.168	.901	.557	
	N	22	22	22	22	22
VR_Overall_Score	Pearson Correlation	.210	.377	.107	.141	.444*
	Sig. (2-tailed)	.349	.083	.637	.532	.038
	N	22	22	22	22	22

**Correlations**

		VR_Overall_Score
T_EC	Pearson Correlation	.210
	Sig. (2-tailed)	.349
	N	22
T_PT	Pearson Correlation	.377
	Sig. (2-tailed)	.083
	N	22
VR_EC	Pearson Correlation	.107
	Sig. (2-tailed)	.637
	N	22
VR_PT	Pearson Correlation	.141
	Sig. (2-tailed)	.532
	N	22
T_Overall_Score	Pearson Correlation	.444*
	Sig. (2-tailed)	.038
	N	22
VR_Overall_Score	Pearson Correlation	1
	Sig. (2-tailed)	
	N	22

- \*. Correlation is significant at the 0.05 level (2-tailed).
- \*\* . Correlation is significant at the 0.01 level (2-tailed).

## Correlations

### Notes

<b>Output Created</b>		29-MAR-2023 09:48:47
<b>Comments</b>		
<b>Input</b>	<b>Data</b>	/Users/alexiciarichardson/Desktop/New Results SPSS/Correlations_Data.sav
	<b>Active Dataset</b>	DataSet1
	<b>Filter</b>	<none>
	<b>Weight</b>	<none>
	<b>Split File</b>	<none>
	<b>N of Rows in Working Data File</b>	22
<b>Missing Value Handling</b>	<b>Definition of Missing</b>	User-defined missing values are treated as missing.
	<b>Cases Used</b>	Statistics for each pair of variables are based on all the cases with valid data for that pair.
<b>Syntax</b>	<p>CORRELATIONS</p> <p>/VARIABLES=T_PS_EC_SU            B T_PS_PT_SUB            VR_PS_EC_SUB            VR_PS_PT_SUB            T_Attractiveness            T_Perspiciuity              T_Efficiency            T_Dependability            T_Stimulation T_Novelty            VR_Attractiveness            VR_Perspiciuity            VR_Efficiency              VR_Dependability            VR_Stimulation            VR_Novelty T_FA_Score            T_PU_Score T_AE_Score            T_RW_Score VR_FA_Score              VR_PU_Score            VR_AE_Score            VR_RW_Score            VR_Overall_Score            T_Overall_Score            /PRINT=TWOTAIL            NOSIG FULL            /STATISTICS            DESCRIPTIVES            /MISSING=PAIRWISE.</p>	
<b>Resources</b>	<b>Processor Time</b>	00:00:00.16
	<b>Elapsed Time</b>	00:00:00.00

### Descriptive Statistics

	Mean	Std. Deviation	N
T_PS_EC_SUB	-.23	1.998	22
T_PS_PT_SUB	.36	3.360	22
VR_PS_EC_SUB	-.14	1.910	22
VR_PS_PT_SUB	.09	3.191	22
T_Attractiveness	.9173	1.07668	22
T_Perspicuity	1.8068	1.12051	22
T_Efficiency	1.3636	1.03431	22
T_Dependability	1.1932	.94470	22
T_Stimulation	1.3750	.93780	22
T_Novelty	.6705	.98919	22
VR_Attractiveness	1.4091	1.15887	22
VR_Perspicuity	1.3977	1.18688	22
VR_Efficiency	.8864	.87874	22
VR_Dependability	1.0000	1.15728	22
VR_Stimulation	1.7273	.96025	22
VR_Novelty	1.4205	.90759	22
T_FA_Score	2.8636	.73936	22
T_PU_Score	3.6515	.84501	22
T_AE_Score	3.5758	.98229	22
T_RW_Score	4.2121	.85167	22
VR_FA_Score	3.5606	1.13802	22
VR_PU_Score	3.5758	.99300	22
VR_AE_Score	4.0606	.92374	22
VR_RW_Score	4.3485	.65447	22
VR_Overall_Score	3.8864	.71849	22
T_Overall_Score	3.5758	.68521	22

### Correlations

		T_PS_EC_SUB	T_PS_PT_SUB	VR_PS_EC_SUB	VR_PS_PT_SUB
T_PS_EC_SUB	Pearson Correlation	1	.360	.328	.123
	Sig. (2-tailed)		.099	.136	.586
	N	22	22	22	22
T_PS_PT_SUB	Pearson Correlation	.360	1	-.207	.703 <sup>**</sup>
	Sig. (2-tailed)	.099		.355	<.001
	N	22	22	22	22
VR_PS_EC_SUB	Pearson Correlation	.328	-.207	1	-.131
	Sig. (2-tailed)	.136	.355		.562
	N	22	22	22	22
VR_PS_PT_SUB	Pearson Correlation	.123	.703 <sup>**</sup>	-.131	1
	Sig. (2-tailed)	.586	<.001	.562	
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	.297	.235	.214	.044
	Sig. (2-tailed)	.179	.292	.338	.847
	N	22	22	22	22
T_Perspicuity	Pearson Correlation	-.047	-.072	.121	-.131
	Sig. (2-tailed)	.835	.750	.593	.560
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.169	.183	.219	-.057
	Sig. (2-tailed)	.453	.416	.327	.800
	N	22	22	22	22
T_Dependability	Pearson Correlation	-.001	.082	.061	-.235
	Sig. (2-tailed)	.997	.717	.786	.292
	N	22	22	22	22
T_Stimulation	Pearson Correlation	.340	.087	.349	-.203
	Sig. (2-tailed)	.122	.701	.111	.365
	N	22	22	22	22
T_Novelty	Pearson Correlation	.454 <sup>*</sup>	.324	.353	.270
	Sig. (2-tailed)	.034	.141	.107	.224
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.121	.140	.177	-.117
	Sig. (2-tailed)	.590	.533	.430	.603
	N	22	22	22	22
VR_Perspicuity	Pearson Correlation	-.070	.037	-.033	-.205
	Sig. (2-tailed)	.755	.871	.885	.360
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	.154	.196	.083	.055
	Sig. (2-tailed)	.494	.382	.715	.809
	N	22	22	22	22

### Correlations

		T_Attractiveness	T_Perspiciuity	T_Efficiency	T_Dependability
T_PS_EC_SUB	Pearson Correlation	.297	-.047	.169	-.001
	Sig. (2-tailed)	.179	.835	.453	.997
	N	22	22	22	22
T_PS_PT_SUB	Pearson Correlation	.235	-.072	.183	.082
	Sig. (2-tailed)	.292	.750	.416	.717
	N	22	22	22	22
VR_PS_EC_SUB	Pearson Correlation	.214	.121	.219	.061
	Sig. (2-tailed)	.338	.593	.327	.786
	N	22	22	22	22
VR_PS_PT_SUB	Pearson Correlation	.044	-.131	-.057	-.235
	Sig. (2-tailed)	.847	.560	.800	.292
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	1	.574**	.675**	.733**
	Sig. (2-tailed)		.005	<.001	<.001
	N	22	22	22	22
T_Perspiciuity	Pearson Correlation	.574**	1	.693**	.720**
	Sig. (2-tailed)	.005		<.001	<.001
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.675**	.693**	1	.726**
	Sig. (2-tailed)	<.001	<.001		<.001
	N	22	22	22	22
T_Dependability	Pearson Correlation	.733**	.720**	.726**	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	22	22	22	22
T_Stimulation	Pearson Correlation	.805**	.375	.399	.613**
	Sig. (2-tailed)	<.001	.085	.066	.002
	N	22	22	22	22
T_Novelty	Pearson Correlation	.479*	.055	.105	.256
	Sig. (2-tailed)	.024	.807	.641	.250
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.493*	.519*	.516*	.490*
	Sig. (2-tailed)	.020	.013	.014	.021
	N	22	22	22	22
VR_Perspiciuity	Pearson Correlation	.323	.553**	.478*	.576**
	Sig. (2-tailed)	.143	.008	.025	.005
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	.315	.415	.552**	.390
	Sig. (2-tailed)	.153	.055	.008	.073
	N	22	22	22	22

### Correlations

		T_Stimulation	T_Novelty	VR_Attractiveness	VR_Perspiciuity
T_PS_EC_SUB	Pearson Correlation	.340	.454*	.121	-.070
	Sig. (2-tailed)	.122	.034	.590	.755
	N	22	22	22	22
T_PS_PT_SUB	Pearson Correlation	.087	.324	.140	.037
	Sig. (2-tailed)	.701	.141	.533	.871
	N	22	22	22	22
VR_PS_EC_SUB	Pearson Correlation	.349	.353	.177	-.033
	Sig. (2-tailed)	.111	.107	.430	.885
	N	22	22	22	22
VR_PS_PT_SUB	Pearson Correlation	-.203	.270	-.117	-.205
	Sig. (2-tailed)	.365	.224	.603	.360
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	.805**	.479*	.493*	.323
	Sig. (2-tailed)	<.001	.024	.020	.143
	N	22	22	22	22
T_Perspiciuity	Pearson Correlation	.375	.055	.519*	.553**
	Sig. (2-tailed)	.085	.807	.013	.008
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.399	.105	.516*	.478*
	Sig. (2-tailed)	.066	.641	.014	.025
	N	22	22	22	22
T_Dependability	Pearson Correlation	.613**	.256	.490*	.576**
	Sig. (2-tailed)	.002	.250	.021	.005
	N	22	22	22	22
T_Stimulation	Pearson Correlation	1	.557**	.593**	.333
	Sig. (2-tailed)		.007	.004	.130
	N	22	22	22	22
T_Novelty	Pearson Correlation	.557**	1	.075	-.131
	Sig. (2-tailed)	.007		.740	.560
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.593**	.075	1	.784**
	Sig. (2-tailed)	.004	.740		<.001
	N	22	22	22	22
VR_Perspiciuity	Pearson Correlation	.333	-.131	.784**	1
	Sig. (2-tailed)	.130	.560	<.001	
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	.177	.003	.657**	.707**
	Sig. (2-tailed)	.431	.990	<.001	<.001
	N	22	22	22	22

### Correlations

		VR_Efficiency	VR_Dependability	VR_Stimulation	VR_Novelty
T_PS_EC_SUB	Pearson Correlation	.154	.134	.171	.003
	Sig. (2-tailed)	.494	.553	.447	.991
	N	22	22	22	22
T_PS_PT_SUB	Pearson Correlation	.196	.037	.169	.314
	Sig. (2-tailed)	.382	.871	.453	.154
	N	22	22	22	22
VR_PS_EC_SUB	Pearson Correlation	.083	.302	.186	.199
	Sig. (2-tailed)	.715	.172	.406	.373
	N	22	22	22	22
VR_PS_PT_SUB	Pearson Correlation	.055	-.174	-.120	.142
	Sig. (2-tailed)	.809	.438	.596	.527
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	.315	.368	.542**	-.053
	Sig. (2-tailed)	.153	.092	.009	.814
	N	22	22	22	22
T_Perspicuity	Pearson Correlation	.415	.571**	.416	.195
	Sig. (2-tailed)	.055	.005	.054	.385
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.552**	.507*	.419	.178
	Sig. (2-tailed)	.008	.016	.052	.428
	N	22	22	22	22
T_Dependability	Pearson Correlation	.390	.593**	.527*	.109
	Sig. (2-tailed)	.073	.004	.012	.629
	N	22	22	22	22
T_Stimulation	Pearson Correlation	.177	.472*	.760**	.103
	Sig. (2-tailed)	.431	.027	<.001	.648
	N	22	22	22	22
T_Novelty	Pearson Correlation	.003	.205	.264	.122
	Sig. (2-tailed)	.990	.359	.235	.589
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.657**	.743**	.870**	.272
	Sig. (2-tailed)	<.001	<.001	<.001	.221
	N	22	22	22	22
VR_Perspicuity	Pearson Correlation	.707**	.813**	.622**	.072
	Sig. (2-tailed)	<.001	<.001	.002	.749
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	1	.577**	.519*	.328
	Sig. (2-tailed)		.005	.013	.137
	N	22	22	22	22

### Correlations

		T_FA_Score	T_PU_Score	T_AE_Score	T_RW_Score
T_PS_EC_SUB	Pearson Correlation	.343	.336	.345	.104
	Sig. (2-tailed)	.118	.126	.116	.644
	N	22	22	22	22
T_PS_PT_SUB	Pearson Correlation	.353	.310	.597**	.160
	Sig. (2-tailed)	.107	.161	.003	.476
	N	22	22	22	22
VR_PS_EC_SUB	Pearson Correlation	.099	.097	-.015	.155
	Sig. (2-tailed)	.662	.668	.946	.490
	N	22	22	22	22
VR_PS_PT_SUB	Pearson Correlation	.113	.189	.413	-.013
	Sig. (2-tailed)	.616	.400	.056	.953
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	.653**	.705**	.708**	.478*
	Sig. (2-tailed)	<.001	<.001	<.001	.024
	N	22	22	22	22
T_Perspiciuity	Pearson Correlation	.307	.483*	.293	.128
	Sig. (2-tailed)	.165	.023	.185	.570
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.234	.651**	.397	.282
	Sig. (2-tailed)	.295	.001	.067	.203
	N	22	22	22	22
T_Dependability	Pearson Correlation	.432*	.426*	.430*	.420
	Sig. (2-tailed)	.045	.048	.046	.052
	N	22	22	22	22
T_Stimulation	Pearson Correlation	.701**	.388	.482*	.472*
	Sig. (2-tailed)	<.001	.074	.023	.027
	N	22	22	22	22
T_Novelty	Pearson Correlation	.636**	.369	.499*	.582**
	Sig. (2-tailed)	.001	.091	.018	.005
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.236	.388	.239	-.030
	Sig. (2-tailed)	.291	.074	.283	.893
	N	22	22	22	22
VR_Perspiciuity	Pearson Correlation	-.003	.323	.067	-.080
	Sig. (2-tailed)	.989	.143	.769	.725
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	-.165	.473*	.277	.044
	Sig. (2-tailed)	.462	.026	.212	.845
	N	22	22	22	22

### Correlations

		VR_FA_Score	VR_PU_Score	VR_AE_Score	VR_RW_Score
T_PS_EC_SUB	Pearson Correlation	.205	.197	.352	.306
	Sig. (2-tailed)	.359	.379	.108	.166
	N	22	22	22	22
T_PS_PT_SUB	Pearson Correlation	.177	.458 <sup>*</sup>	.397	.308
	Sig. (2-tailed)	.432	.032	.068	.164
	N	22	22	22	22
VR_PS_EC_SUB	Pearson Correlation	.249	-.166	.239	.103
	Sig. (2-tailed)	.264	.461	.284	.647
	N	22	22	22	22
VR_PS_PT_SUB	Pearson Correlation	-.019	.268	.084	-.039
	Sig. (2-tailed)	.933	.227	.709	.864
	N	22	22	22	22
T_Attractiveness	Pearson Correlation	.105	.332	.447 <sup>*</sup>	.193
	Sig. (2-tailed)	.640	.131	.037	.389
	N	22	22	22	22
T_Perspiciuity	Pearson Correlation	.266	.219	.303	.134
	Sig. (2-tailed)	.231	.328	.170	.552
	N	22	22	22	22
T_Efficiency	Pearson Correlation	.301	.347	.503 <sup>*</sup>	.226
	Sig. (2-tailed)	.174	.114	.017	.312
	N	22	22	22	22
T_Dependability	Pearson Correlation	.179	.138	.336	.226
	Sig. (2-tailed)	.426	.540	.126	.312
	N	22	22	22	22
T_Stimulation	Pearson Correlation	.236	.260	.563 <sup>**</sup>	.462 <sup>*</sup>
	Sig. (2-tailed)	.290	.243	.006	.030
	N	22	22	22	22
T_Novelty	Pearson Correlation	.091	.126	.353	.308
	Sig. (2-tailed)	.688	.578	.107	.163
	N	22	22	22	22
VR_Attractiveness	Pearson Correlation	.430 <sup>*</sup>	.643 <sup>**</sup>	.658 <sup>**</sup>	.525 <sup>*</sup>
	Sig. (2-tailed)	.046	.001	<.001	.012
	N	22	22	22	22
VR_Perspiciuity	Pearson Correlation	.200	.631 <sup>**</sup>	.339	.268
	Sig. (2-tailed)	.372	.002	.123	.228
	N	22	22	22	22
VR_Efficiency	Pearson Correlation	.317	.588 <sup>**</sup>	.561 <sup>**</sup>	.431 <sup>*</sup>
	Sig. (2-tailed)	.151	.004	.007	.045
	N	22	22	22	22

**Correlations**

		VR_Overall_Score	T_Overall_Score
T_PS_EC_SUB	Pearson Correlation	.332	.352
	Sig. (2-tailed)	.131	.108
	N	22	22
T_PS_PT_SUB	Pearson Correlation	.426 <sup>*</sup>	.455 <sup>*</sup>
	Sig. (2-tailed)	.048	.034
	N	22	22
VR_PS_EC_SUB	Pearson Correlation	.141	.099
	Sig. (2-tailed)	.530	.660
	N	22	22
VR_PS_PT_SUB	Pearson Correlation	.103	.233
	Sig. (2-tailed)	.647	.297
	N	22	22
T_Attractiveness	Pearson Correlation	.344	.796 <sup>**</sup>
	Sig. (2-tailed)	.117	<.001
	N	22	22
T_Perspiciuity	Pearson Correlation	.309	.377
	Sig. (2-tailed)	.162	.084
	N	22	22
T_Efficiency	Pearson Correlation	.452 <sup>*</sup>	.494 <sup>*</sup>
	Sig. (2-tailed)	.035	.019
	N	22	22
T_Dependability	Pearson Correlation	.278	.533 <sup>*</sup>
	Sig. (2-tailed)	.210	.011
	N	22	22
T_Stimulation	Pearson Correlation	.470 <sup>*</sup>	.628 <sup>**</sup>
	Sig. (2-tailed)	.027	.002
	N	22	22
T_Novelty	Pearson Correlation	.263	.645 <sup>**</sup>
	Sig. (2-tailed)	.237	.001
	N	22	22
VR_Attractiveness	Pearson Correlation	.724 <sup>**</sup>	.260
	Sig. (2-tailed)	<.001	.243
	N	22	22
VR_Perspiciuity	Pearson Correlation	.467 <sup>*</sup>	.098
	Sig. (2-tailed)	.028	.665
	N	22	22
VR_Efficiency	Pearson Correlation	.607 <sup>**</sup>	.214
	Sig. (2-tailed)	.003	.338
	N	22	22

### Correlations

		T_PS_EC_SUB	T_PS_PT_SUB	VR_PS_EC_SUB	VR_PS_PT_SUB
VR_Dependability	Pearson Correlation	.134	.037	.302	-.174
	Sig. (2-tailed)	.553	.871	.172	.438
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.171	.169	.186	-.120
	Sig. (2-tailed)	.447	.453	.406	.596
	N	22	22	22	22
VR_Novelty	Pearson Correlation	.003	.314	.199	.142
	Sig. (2-tailed)	.991	.154	.373	.527
	N	22	22	22	22
T_FA_Score	Pearson Correlation	.343	.353	.099	.113
	Sig. (2-tailed)	.118	.107	.662	.616
	N	22	22	22	22
T_PU_Score	Pearson Correlation	.336	.310	.097	.189
	Sig. (2-tailed)	.126	.161	.668	.400
	N	22	22	22	22
T_AE_Score	Pearson Correlation	.345	.597**	-.015	.413
	Sig. (2-tailed)	.116	.003	.946	.056
	N	22	22	22	22
T_RW_Score	Pearson Correlation	.104	.160	.155	-.013
	Sig. (2-tailed)	.644	.476	.490	.953
	N	22	22	22	22
VR_FA_Score	Pearson Correlation	.205	.177	.249	-.019
	Sig. (2-tailed)	.359	.432	.264	.933
	N	22	22	22	22
VR_PU_Score	Pearson Correlation	.197	.458*	-.166	.268
	Sig. (2-tailed)	.379	.032	.461	.227
	N	22	22	22	22
VR_AE_Score	Pearson Correlation	.352	.397	.239	.084
	Sig. (2-tailed)	.108	.068	.284	.709
	N	22	22	22	22
VR_RW_Score	Pearson Correlation	.306	.308	.103	-.039
	Sig. (2-tailed)	.166	.164	.647	.864
	N	22	22	22	22
VR_Overall_Score	Pearson Correlation	.332	.426*	.141	.103
	Sig. (2-tailed)	.131	.048	.530	.647
	N	22	22	22	22
T_Overall_Score	Pearson Correlation	.352	.455*	.099	.233
	Sig. (2-tailed)	.108	.034	.660	.297
	N	22	22	22	22

**Correlations**

		T_Attractiveness	T_Perspicuity	T_Efficiency	T_Dependability
VR_Dependability	Pearson Correlation	.368	.571**	.507*	.593**
	Sig. (2-tailed)	.092	.005	.016	.004
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.542**	.416	.419	.527*
	Sig. (2-tailed)	.009	.054	.052	.012
	N	22	22	22	22
VR_Novelty	Pearson Correlation	-.053	.195	.178	.109
	Sig. (2-tailed)	.814	.385	.428	.629
	N	22	22	22	22
T_FA_Score	Pearson Correlation	.653**	.307	.234	.432*
	Sig. (2-tailed)	<.001	.165	.295	.045
	N	22	22	22	22
T_PU_Score	Pearson Correlation	.705**	.483*	.651**	.426*
	Sig. (2-tailed)	<.001	.023	.001	.048
	N	22	22	22	22
T_AE_Score	Pearson Correlation	.708**	.293	.397	.430*
	Sig. (2-tailed)	<.001	.185	.067	.046
	N	22	22	22	22
T_RW_Score	Pearson Correlation	.478*	.128	.282	.420
	Sig. (2-tailed)	.024	.570	.203	.052
	N	22	22	22	22
VR_FA_Score	Pearson Correlation	.105	.266	.301	.179
	Sig. (2-tailed)	.640	.231	.174	.426
	N	22	22	22	22
VR_PU_Score	Pearson Correlation	.332	.219	.347	.138
	Sig. (2-tailed)	.131	.328	.114	.540
	N	22	22	22	22
VR_AE_Score	Pearson Correlation	.447*	.303	.503*	.336
	Sig. (2-tailed)	.037	.170	.017	.126
	N	22	22	22	22
VR_RW_Score	Pearson Correlation	.193	.134	.226	.226
	Sig. (2-tailed)	.389	.552	.312	.312
	N	22	22	22	22
VR_Overall_Score	Pearson Correlation	.344	.309	.452*	.278
	Sig. (2-tailed)	.117	.162	.035	.210
	N	22	22	22	22
T_Overall_Score	Pearson Correlation	.796**	.377	.494*	.533*
	Sig. (2-tailed)	<.001	.084	.019	.011
	N	22	22	22	22

### Correlations

		T_Stimulation	T_Novelty	VR_Attractiveness	VR_Perspicuity
VR_Dependability	Pearson Correlation	.472 <sup>*</sup>	.205	.743 <sup>**</sup>	.813 <sup>**</sup>
	Sig. (2-tailed)	.027	.359	<.001	<.001
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.760 <sup>**</sup>	.264	.870 <sup>**</sup>	.622 <sup>**</sup>
	Sig. (2-tailed)	<.001	.235	<.001	.002
	N	22	22	22	22
VR_Novelty	Pearson Correlation	.103	.122	.272	.072
	Sig. (2-tailed)	.648	.589	.221	.749
	N	22	22	22	22
T_FA_Score	Pearson Correlation	.701 <sup>**</sup>	.636 <sup>**</sup>	.236	-.003
	Sig. (2-tailed)	<.001	.001	.291	.989
	N	22	22	22	22
T_PU_Score	Pearson Correlation	.388	.369	.388	.323
	Sig. (2-tailed)	.074	.091	.074	.143
	N	22	22	22	22
T_AE_Score	Pearson Correlation	.482 <sup>*</sup>	.499 <sup>*</sup>	.239	.067
	Sig. (2-tailed)	.023	.018	.283	.769
	N	22	22	22	22
T_RW_Score	Pearson Correlation	.472 <sup>*</sup>	.582 <sup>**</sup>	-.030	-.080
	Sig. (2-tailed)	.027	.005	.893	.725
	N	22	22	22	22
VR_FA_Score	Pearson Correlation	.236	.091	.430 <sup>*</sup>	.200
	Sig. (2-tailed)	.290	.688	.046	.372
	N	22	22	22	22
VR_PU_Score	Pearson Correlation	.260	.126	.643 <sup>**</sup>	.631 <sup>**</sup>
	Sig. (2-tailed)	.243	.578	.001	.002
	N	22	22	22	22
VR_AE_Score	Pearson Correlation	.563 <sup>**</sup>	.353	.658 <sup>**</sup>	.339
	Sig. (2-tailed)	.006	.107	<.001	.123
	N	22	22	22	22
VR_RW_Score	Pearson Correlation	.462 <sup>*</sup>	.308	.525 <sup>*</sup>	.268
	Sig. (2-tailed)	.030	.163	.012	.228
	N	22	22	22	22
VR_Overall_Score	Pearson Correlation	.470 <sup>*</sup>	.263	.724 <sup>**</sup>	.467 <sup>*</sup>
	Sig. (2-tailed)	.027	.237	<.001	.028
	N	22	22	22	22
T_Overall_Score	Pearson Correlation	.628 <sup>**</sup>	.645 <sup>**</sup>	.260	.098
	Sig. (2-tailed)	.002	.001	.243	.665
	N	22	22	22	22

### Correlations

		VR_Efficiency	VR_Dependability	VR_Stimulation	VR_Novelty
VR_Dependability	Pearson Correlation	.577**	1	.680**	.179
	Sig. (2-tailed)	.005		<.001	.427
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.519*	.680**	1	.339
	Sig. (2-tailed)	.013	<.001		.122
	N	22	22	22	22
VR_Novelty	Pearson Correlation	.328	.179	.339	1
	Sig. (2-tailed)	.137	.427	.122	
	N	22	22	22	22
T_FA_Score	Pearson Correlation	-.165	.190	.381	-.047
	Sig. (2-tailed)	.462	.397	.080	.837
	N	22	22	22	22
T_PU_Score	Pearson Correlation	.473*	.243	.288	-.172
	Sig. (2-tailed)	.026	.275	.194	.443
	N	22	22	22	22
T_AE_Score	Pearson Correlation	.277	.147	.288	.072
	Sig. (2-tailed)	.212	.515	.194	.751
	N	22	22	22	22
T_RW_Score	Pearson Correlation	.044	.064	.113	.054
	Sig. (2-tailed)	.845	.776	.617	.812
	N	22	22	22	22
VR_FA_Score	Pearson Correlation	.317	.280	.481*	.414
	Sig. (2-tailed)	.151	.207	.024	.055
	N	22	22	22	22
VR_PU_Score	Pearson Correlation	.588**	.449*	.489*	-.030
	Sig. (2-tailed)	.004	.036	.021	.893
	N	22	22	22	22
VR_AE_Score	Pearson Correlation	.561**	.486*	.789**	.503*
	Sig. (2-tailed)	.007	.022	<.001	.017
	N	22	22	22	22
VR_RW_Score	Pearson Correlation	.431*	.335	.588**	.463*
	Sig. (2-tailed)	.045	.127	.004	.030
	N	22	22	22	22
VR_Overall_Score	Pearson Correlation	.607**	.499*	.747**	.421
	Sig. (2-tailed)	.003	.018	<.001	.051
	N	22	22	22	22
T_Overall_Score	Pearson Correlation	.214	.199	.330	-.023
	Sig. (2-tailed)	.338	.375	.134	.918
	N	22	22	22	22

### Correlations

		T_FA_Score	T_PU_Score	T_AE_Score	T_RW_Score
VR_Dependability	Pearson Correlation	.190	.243	.147	.064
	Sig. (2-tailed)	.397	.275	.515	.776
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.381	.288	.288	.113
	Sig. (2-tailed)	.080	.194	.194	.617
	N	22	22	22	22
VR_Novelty	Pearson Correlation	-.047	-.172	.072	.054
	Sig. (2-tailed)	.837	.443	.751	.812
	N	22	22	22	22
T_FA_Score	Pearson Correlation	1	.361	.565**	.477*
	Sig. (2-tailed)		.099	.006	.025
	N	22	22	22	22
T_PU_Score	Pearson Correlation	.361	1	.617**	.446*
	Sig. (2-tailed)	.099		.002	.038
	N	22	22	22	22
T_AE_Score	Pearson Correlation	.565**	.617**	1	.612**
	Sig. (2-tailed)	.006	.002		.002
	N	22	22	22	22
T_RW_Score	Pearson Correlation	.477*	.446*	.612**	1
	Sig. (2-tailed)	.025	.038	.002	
	N	22	22	22	22
VR_FA_Score	Pearson Correlation	.328	.053	.100	-.041
	Sig. (2-tailed)	.136	.814	.658	.856
	N	22	22	22	22
VR_PU_Score	Pearson Correlation	.184	.616**	.333	.018
	Sig. (2-tailed)	.412	.002	.130	.938
	N	22	22	22	22
VR_AE_Score	Pearson Correlation	.330	.442*	.496*	.326
	Sig. (2-tailed)	.133	.040	.019	.139
	N	22	22	22	22
VR_RW_Score	Pearson Correlation	.300	.297	.414	.459*
	Sig. (2-tailed)	.175	.179	.056	.032
	N	22	22	22	22
VR_Overall_Score	Pearson Correlation	.368	.444*	.408	.199
	Sig. (2-tailed)	.092	.039	.059	.374
	N	22	22	22	22
T_Overall_Score	Pearson Correlation	.732**	.765**	.891**	.796**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	22	22	22	22

### Correlations

		VR_FA_Score	VR_PU_Score	VR_AE_Score	VR_RW_Score
VR_Dependability	Pearson Correlation	.280	.449*	.486*	.335
	Sig. (2-tailed)	.207	.036	.022	.127
	N	22	22	22	22
VR_Stimulation	Pearson Correlation	.481*	.489*	.789**	.588**
	Sig. (2-tailed)	.024	.021	<.001	.004
	N	22	22	22	22
VR_Novelty	Pearson Correlation	.414	-.030	.503*	.463*
	Sig. (2-tailed)	.055	.893	.017	.030
	N	22	22	22	22
T_FA_Score	Pearson Correlation	.328	.184	.330	.300
	Sig. (2-tailed)	.136	.412	.133	.175
	N	22	22	22	22
T_PU_Score	Pearson Correlation	.053	.616**	.442*	.297
	Sig. (2-tailed)	.814	.002	.040	.179
	N	22	22	22	22
T_AE_Score	Pearson Correlation	.100	.333	.496*	.414
	Sig. (2-tailed)	.658	.130	.019	.056
	N	22	22	22	22
T_RW_Score	Pearson Correlation	-.041	.018	.326	.459*
	Sig. (2-tailed)	.856	.938	.139	.032
	N	22	22	22	22
VR_FA_Score	Pearson Correlation	1	.225	.555**	.464*
	Sig. (2-tailed)		.314	.007	.030
	N	22	22	22	22
VR_PU_Score	Pearson Correlation	.225	1	.497*	.377
	Sig. (2-tailed)	.314		.019	.084
	N	22	22	22	22
VR_AE_Score	Pearson Correlation	.555**	.497*	1	.769**
	Sig. (2-tailed)	.007	.019		<.001
	N	22	22	22	22
VR_RW_Score	Pearson Correlation	.464*	.377	.769**	1
	Sig. (2-tailed)	.030	.084	<.001	
	N	22	22	22	22
VR_Overall_Score	Pearson Correlation	.758**	.680**	.888**	.789**
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	22	22	22	22
T_Overall_Score	Pearson Correlation	.128	.364	.504*	.463*
	Sig. (2-tailed)	.571	.095	.017	.030
	N	22	22	22	22

### Correlations

		VR_Overall_Score	T_Overall_Score
VR_Dependability	Pearson Correlation	.499 <sup>*</sup>	.199
	Sig. (2-tailed)	.018	.375
	N	22	22
VR_Stimulation	Pearson Correlation	.747 <sup>**</sup>	.330
	Sig. (2-tailed)	<.001	.134
	N	22	22
VR_Novelty	Pearson Correlation	.421	-.023
	Sig. (2-tailed)	.051	.918
	N	22	22
T_FA_Score	Pearson Correlation	.368	.732 <sup>**</sup>
	Sig. (2-tailed)	.092	<.001
	N	22	22
T_PU_Score	Pearson Correlation	.444 <sup>*</sup>	.765 <sup>**</sup>
	Sig. (2-tailed)	.039	<.001
	N	22	22
T_AE_Score	Pearson Correlation	.408	.891 <sup>**</sup>
	Sig. (2-tailed)	.059	<.001
	N	22	22
T_RW_Score	Pearson Correlation	.199	.796 <sup>**</sup>
	Sig. (2-tailed)	.374	<.001
	N	22	22
VR_FA_Score	Pearson Correlation	.758 <sup>**</sup>	.128
	Sig. (2-tailed)	<.001	.571
	N	22	22
VR_PU_Score	Pearson Correlation	.680 <sup>**</sup>	.364
	Sig. (2-tailed)	<.001	.095
	N	22	22
VR_AE_Score	Pearson Correlation	.888 <sup>**</sup>	.504 <sup>*</sup>
	Sig. (2-tailed)	<.001	.017
	N	22	22
VR_RW_Score	Pearson Correlation	.789 <sup>**</sup>	.463 <sup>*</sup>
	Sig. (2-tailed)	<.001	.030
	N	22	22
VR_Overall_Score	Pearson Correlation	1	.444 <sup>*</sup>
	Sig. (2-tailed)		.038
	N	22	22
T_Overall_Score	Pearson Correlation	.444 <sup>*</sup>	1
	Sig. (2-tailed)	.038	
	N	22	22

- \*. Correlation is significant at the 0.05 level (2-tailed).
- \*\* . Correlation is significant at the 0.01 level (2-tailed).