# A TRIP TO THE BEACH: EXPERIMENTAL INVESTIGATION OF MOOD, THE BODY, AND PRESENCE IN VIRTUAL REALITY MEDITATION

by

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THESIS ABSTRACT

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Title: A Trip to the Beach: Experimental Investigation of Mood, the Body, and Presence in Virtual Reality Meditation

This study sought to explore the effects of virtual reality (VR) as a technology that can potentially improve guided meditation practices; VR guided meditation sessions and audio guided meditation sessions were compared. Specifically, this study investigated VR's impact on an individual's self-perception of psychological factors that reflect mood or emotion; it also examined VR's impact on an individual's self-perception of presence and relaxation. After examination, VR guided meditation had no significant impact on an individual's self-perception of mood and emotion or self-reported feelings of relaxation. However, guided VR meditation had a significant impact on an individual's self-reported perception of presence; participants who meditated with VR felt "as if they were at the beach." Although this study demonstrated that a fairly inexpensive VR system can enhance feelings of presence, that sense of presence did not enhance feelings of well-being and relaxation; this could be attributed to the novelty effect.

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# CHAPTER I

# INTRODUCTION

Technology and human life are inseparable; this relationship, one that is nearly 2.5 million years old, is extremely complex due to technology's ability to shape society and vice-versa (Ramey, 2012). Humans use and depend on technology in our daily lives, and as society's needs and demands for technology keeps rising, we continue to make ground-breaking technological innovations. For most, it is hard to imagine a world without technology. As you read this, have a look around. Do you see technology, devices, and a variety of computers? Our modern lives are surrounded by gadgets and technological appliances. The personal computer at a desk, the cell phone on a night stand, the blue tooth speaker on the counter, and even the thermostat, are examples of how technology has transformed nearly every aspect of the modern world.

The overall development of technology and, more specifically, information technologies, has had a substantial impact on society in recent years (Mazuryk & Gervautz 1999). Information technologies, ones that use computers to manipulate, transmit, retrieve, and store data (Daintith, 2009), have revolutionized nearly every aspect of society; without information technologies and their ability to compute, extraordinarily complex endeavors like space travel or simply going through the self-checkout at the grocery store would not be possible.

While the first large-scale digital computer, IBM's Automatic Sequence Controlled Calculator (ASCC), was a colossal piece of equipment, stretching 50 feet in length, today, most smart phones "have more computing power than all of NASA back in 1969, when it placed two astronauts on the moon" (Kaku, 2011, p2). Modern machines and information technologies, now more easily accessible at more affordable prices, are increasingly equipped with better technologies. Therefore, using computers for different activities has become second nature in our society (Mazuryk & Gervautz, 1999). These technological developments have not only altered the way individuals live and the way society works, but they have also allowed individuals to explore new "worlds" (Mazuryk & Gervautz 1996). One type of technology that has the potential to cross such borders is virtual reality (VR).

The following is a definition of VR presented by Sherman and Craig (2003): "Virtual reality is a medium composed of interactive computer simulations that sense the participant's position and actions and replace or augment the feedback to one or more senses, giving the feeling of being mentally immersed or present in the simulation (a virtual world)" (p.13). VR has foundations that existed long before "VR" was a buzzword. In 1935, author Stanley G. Weinbaum somewhat predicted VR with his short story *Pygmalion's Spectacles* (Norman, nd). Weinbaum's protagonist meets a professor who developed a pair of glasses that allowed "a movie that gives one sight and sound…taste, smell, and touch… You are in the story, you speak to the shadows (characters) and they reply, and instead of being on a screen, the story is all about you, and you are in it" (Weinbaum, 2007, para. 21). VR, a technology that used to be something out of science fiction, is slowly becoming accessible to the everyday consumer; it is amazing to think that nearly a century ago, innovators were already thinking about creating simulated experiences using technology.

According to Burdea and Coiffet (2003), VR historically focused on simulating embodiment even from its beginnings. Morton Heilig, an early innovator of VR technology and the head-mounted display, focused on creating immersive experiences that stimulated a user's multiple senses. His visual arcade "Sensorama," featured, "motion, color, stereo sound, aromas, wind effects (using small fans placed near the user's head), and a seat that vibrated" (Burdea & Coffiet, 2003 p. 2).

Ivan Sutherland's work (1965; 1968) focused on computer-generated 3D graphics and simulations as opposed to visuals from video; users were now able to experience worlds that do not otherwise exist. Also, advances in computer graphics gave VR developers the ability to create progressively realistic, three-dimensional simulations not only of the "real" world, but to create and design worlds only limited by the imagination. Later developments "in tracking technology continued to advance the evolution of VR when it "liberated the user from maintaining a fixed position in front of a display and, to an increasing extent, allowed the user to explore and interact with the virtual worlds using their own body (through head rotation, changes in posture, and natural locomotion)" (Grechkin, 2012, p.3).

The 1980s might be most commonly remembered for the decades' affinity for neon, synthesizers, and questionable hair choices, but the 80s was also "a decade where science and technology reached groundbreaking strides…that introduced us to such high-tech innovations as 8-bit gaming consoles, compact audio systems, mobile phones, portable listening devices," and personal computers (Bracetti, 2013, para. 1). Nearly 20 years after Sutherland, the concept of VR was being explored from a tiny cottage in the Silicon Valley. A 24-year-old named Jaron Lanier, founder of "VPL Research helped make VR a buzzword in the mid-to-late 80s and earned substantial investment, before filing for bankruptcy at the decade's end" (Kim, 2015, para. 1).

“Thirty years have passed since then, and the landscape has finally shifted in virtual reality’s favor;” by 2020, it is projected that the VR market could surpass US $40 billion (Kim, 2015, para. 2; “Global Virtual Reality Market”, 2017). Quite a commotion was made when social media giant Facebook purchased the VR system Oculus Rift in 2014 for $2 billion, and Mark Zuckerberg, Facebook CEO, “made it clear that the company” was truly invested in VR technology: “One day, we believe this kind of immersive, augmented reality will become a part of daily life for billions of people” (Kim, 2015, para. 2). According to some experts, the future is likely to be saturated with VR technology, “and according to Zuckerberg et al., the potential applications are beyond count: ‘One could have breakfast at the Louvre beside the Winged Victory of Samothrace, followed by a lunchtime spelunk through Thailand’s water caves’” (Kim, 2015, para. 3).

In addition to Facebook’s monumental investment, there have been a few important driving forces behind the VR market in recent years. Some of these forces include: a substantial surge of head-mounted devices (HMDs) usage in the video game and entertainment sectors, an increasing use of VR for training purposes, and a decline in prices for VR technologies (“Global Virtual Reality (VR),” 2017). Furthermore, built-in VR capabilities are becoming a standard in newer communication and information technologies like smartphones and tablets; such technologies “have become an important tool in the workplace to enhance smooth business workflows and operations” (“Global Virtual Reality (VR),” 2017, para. 3). The gaming and entertainment sectors are not the only industries that have begun exploring and integrating VR technologies into their business models; areas like sports and sports science, and education have started using VR technologies.

The worlds of sports and education have also begun using VR technologies to enhance their respective fields. VR technologies are utilized by professional athletes, sports scientists, and sports psychologists to analyze technique and measure performance (Ramgopal, 2017). By using VR, “sports psychologists can simulate situations, completely control the athlete’s environment, and replay simulations so the athlete can observe their reactions first hand” (“3 Ways Virtual Reality,” 2017, para. 6). Analysts then have the ability to examine “kinematic and dynamic data to help optimize particular movements or adopt new techniques through strength-and-conditioning training programs” (Bideau, Kulpa, Vignais, Brault, Multon, & Craig, 2010, p.14). VR use for teaching and learning purposes extends beyond athletic training. VR allows large groups of students to interact with each other in a 3D environment. These environments can present difficult information to students in an understandable, experiential way that is both fun and easy to learn in. (Wadhwa, 2018).

The military and the healthcare field are two additional early of the adopters of VR use. The United States’ military has begun using VR technologies for several purposes. One such purpose is for training. VR technologies allow soldiers to prepare for combat situations or other dangerous settings by immersing them in training situations, helping them learn how to react in an appropriate manner (Nye, 2017). Also, there are examples of the military using VR as a sort of exposure therapy for soldiers and individuals suffering from Post-Traumatic Stress Disorder (PTSD) (Rothbaum, Hodges, Ready, Graap, & Alarcon, R., 2001). This type of therapy offers an interesting overlap to the healthcare field where VR is also used to enhance things like skills training and surgery simulation. The use of VR in the healthcare field offers many advantages, allowing professionals and students to refresh their skills while learning new ones in a safe environment without causing any danger to patients (Lee, 2017). More recently, the healthcare field has been exploring the use of VR technology to treat mental illnesses through simulation (Fink, 2017).

**Historical Relevance**

Josh Sackman, President of Applied VR, is determined to integrate VR into the mental health field. His company uses Samsung GearVR to help hospital patients suffering from ailments like anxiety, varying levels and types of pain, and memory loss; the VR content developed by Applied VR ranges from educational games to guided relaxation practices. Sackman's data shows that VR games are popular with children. One study demonstrated that "Bear Blast" reduces pain in young patients by 24 percent. "Pain distraction is often hard to achieve in a hospital," says Sackman, who believes VR can fulfill such unmet needs. "VR is completely immersive and transportive, an extraordinary experience for patients with little or no mobility." (Fink, 2017, para. 7).

There are other researchers and medical professionals that believe VR has therapeutic benefits. Dr. Brennan Spiegel, professor of medicine, has stated that VR experiences can distract patients from focusing on pain. Spiegel says, "It doesn't work on everybody, but when it works, it really, really works" (Fink, 2017, para. 10). Also, according to Dr. Sonya Kim, "there are over 100 clinical research papers that are already published that show proven positive clinical outcomes using VR in managing chronic pain, anxiety, and depression" (Fink, 2017, para. 17). Although VR systems have been around for several decades, completely immersive VR systems are fairly new and research on their therapeutic effect on the brain is young. With its ability to enhance exposure therapy, a type of treatment where "psychologists create a safe environment in which to 'expose' individuals to the things they fear and avoid" ("What is Exposure," nd, para.1), some clinicians and researchers predict that VR use will not only be important to pain management and therapy, but its broader use in the mental healthcare field is bound to increase. (Fink, 2017). One population in particular that may benefit from VR therapy is college students suffering from mental health issues (Reilly, 2018).

In recent years, mental health has become recognized as a serious issue for college students in the United States (Brown, 2016). In 2015, the Association for University and College Counseling Center Directors stated that over 70 percent of mental health and "counseling center directors reported an increase in the severity of student mental health concerns and related behavior on their campuses" (Brown, 2016, para. 6). "It is neither an exaggeration nor is it alarmist to claim that there is a mental health crisis today facing America's college students. Evidence suggests that this group has greater levels of stress and psychopathology than any time in the nation's history," says Gregg Henriques, a psychology professor at James Madison University (Henriques, 2014, para. 1).

In the past, research has shown that many college students sought counseling to combat depression, but "over the last decade, anxiety has overtaken depression as the most common reason college students seek counseling services" (Denizet-Lewis, 2017. para. 8). In 2016, the American College Health Association stated 62 percent of undergraduates reported feeling "overwhelming anxiety" during the school year; this is a substantial increase from 50 percent of students in 2011. Data focusing on anxiety related symptoms is also significant. In 2017, Higher Education Research Institute at U.C.L.A. stated that 41 percent of "incoming college freshmen…felt overwhelmed by all [they] had to do" (Denizet-Lewis, 2017, para. 8). This number is shocking seeing as 29 percent of students disclosed such feelings in 2010, up from only 18 percent of students in 1985 (Denizet-Lewis, 2017). With evidence suggesting that VR technology can be an effective part of treatment for phobias and mental health conditions like PTSD (Carlin, Hoffman, & Weghorst, 1997; Rothbaum et al., 2001), it is important and extremely relevant to explore such effectiveness among a vulnerable population like college students suffering from mental health issues.

At the Columbia University Clinic for Anxiety and Related Disorders (CUCARD), researchers are already using VR to help college students combat things like anxiety and depression (Reilly, 2018). At CUCARD,

> patients in their teens and early 20s can slip on a virtual reality headset and come face-to-face with a variety of anxiety-inducing simulations — from a professor unwilling to budge on a deadline to a roommate who has littered their dorm room with stacks of empty pizza boxes and piles of dirty clothes. Virtual reality takes the common treatment of exposure therapy a step further by allowing patients to interact with realistic situations and overcome their anxiety (Reilly, 2018, para. 25).

Researchers, developers, and mental health experts have also begun exploring a combination of VR and meditation to combat negative emotions (Navarro-Haro, López-Del-Hoyo, Campos, Linehan, Hoffman, García-Palacios, Modrego-Alarcón, Borao, García-Campayo, 2017). Meditation's benefits include, but are not limited to: increased well-being, stress reduction, anxiety reduction, pain management, increased focus, more effective leadership, and clarity of thinking (Baer, 2013; Carroll, 2013; Dolman & Bond, 2011; MacDonald, Walsh, & Shapiro, 2013; Mayo Clinic Staff, n.d.; Sedlmeier et al., 2012; Suchday, Hagemann, Fruchter, & Frankel, 2014). However, research involving VR and meditation is young. With a large number of college students facing more mental health issues than ever before (Henriques, 2014), it is important to explore VR meditation as a possible remedy for such issues.

This study attempts to explore the effects of VR as a technology that can potentially augment or improve meditation practices. The researcher expects to determine whether the experience of an immersive environment will increase positive mood after exposure in VR meditation versus a non-VR condition. Whether the feeling of "being there" when immersed in guided VR meditation may also have implications for therapeutic use of VR for stress reduction.

# CHAPTER II

# LITERATURE REVIEW

This research focuses on meditation and VR. In regard to meditation, the history, integration, and popularization of the practice is discussed; meditation's benefits to well-being are discussed as well. Also, the history, technical specifications, and uses of VR are discussed; the differences between immersive environments like VR, augmented reality, mixed reality, and extended reality are examined as well. Lastly, this research focuses on media studies scholarship, building on early research and foundational theories of presence and immersion.

## Meditation

### Meditation History

Meditation, a several-thousand-year-old concentration practice focused on well-being, has become a contemporary sensation (Plaza, Demarzo, Herrera-Mercadal, & García-Campayo, 2013; Suchday et al., 2014). The ancient practice, typically done while sitting and shutting ones' eyes in a tranquil location, may also be used to reduce negative moods and emotions (Goyal, Singh, Sibinga, Gould, Rowland-Seymour, Sharma, Berger, Sleicher, Maron, Shihab, Ranasinghe, Linn, Saha, Bass, Haythornthwaite, 2014). Studies indicate the number of Americans meditating is somewhere near 10 million and growing. As the practice began to receive more interest, many different people from many different aspects of life began supporting and practicing meditation; this included the scientific community, leadership programs, various branches of the military, the healthcare system, and education (Suchday et al., 2014).

For many who traditionally practice meditation, it is a lifestyle and a method for achieving and maintaining optimal well-being (Suchday et al., 2014). Western scientists, medical personnel, psychologists, and researchers have embraced meditation as a viable wellness activity and have praised the physical and psychological benefits of meditation (Baer, 2013; Carroll, 2013; Dolman & Bond, 2011; Eberth & Sedlmeier, 2012; Ho, 2011; MacDonald et al., 2013; Mayo Clinic Staff, n.d.; Sedlmeier, Eberth, Schwarz, Zimmermann, Haarig, Jaeger, & Kunze, 2012). According to research, benefits include, but are not limited to: increased well-being, stress reduction, anxiety reduction, pain management, increased focus, more effective leadership, and clarity of thinking (Baer, 2013; Carroll, 2013; Dolman & Bond, 2011; MacDonald et al., 2013; Mayo Clinic Staff, n.d.; Sedlmeier et al., 2012; Suchday et al., 2014).

As more and more individuals turn toward meditation to enhance their well-being, some scholars seek to understand how ancient wellness practices, including meditation, can be better incorporated into today's society to address physical and psychological well-being (Suchday et al. 2004). One way this is done is by using different technologies and techniques to support meditation (Buie & Blythe, 2013a; Buie & Blythe, 2013b; Pickert, 2014). Despite the positive impacts of technology on many different fields of life, increased well-being is not among its current benefits (Calvo & Peters, 2013, 2014). However, a yearning exists among researchers and developers to create technology in new ways to improve happiness; meditation may be a natural and powerful opportunity to achieve that goal (Calvo & Peters, 2014).

Researchers and industry have begun to investigate how technology can be combined with meditation and other well-being activities to benefit humans (Botella, Riva, Gaggioli, Wiederhold, Alcaniz, & Baños, 2012; Coyle, Thieme, Linehan, Balaam, Wallace, & Lindley, 2014; & Vidyarthi & Riecke, 2014). Before one can investigate how technology, and specifically in the capacity of this thesis, VR, can be combined with meditation and other well-being activities to benefit humans, it is important to understand the history of meditation, the West's acceptance of meditation, and how technology has been used in meditation throughout the years.

**Antiquity.** As previously mentioned, meditation is an ancient practice with some of the oldest documented archives of meditation are dated around 1500 BCE; these writings discuss the meditative customs of ancient India and Hindu traditions (Everly & Lating, 2002). The exact establishment of Buddhist meditation is debated among scholars (Wynne, 2004). Some early written records arguably related to meditation in Buddhism philosophy can be found in the teachings of the Pāli Canon. The Pali Canon, which dates to 1st century BCE, describes a formula to achieve salvation by observing the rules of morality and seeking knowledge and liberation. It also discusses contemplative concentration, potentially inserting meditation as a component to the formula of achieving salvation (Dumoulin, Heisig, & Knitter, 2005). Some of the earliest accounts of meditation in the West are dated around 20 BCE; Philo of Alexandria, also known as Philo Judaeus, had developed some form of "spiritual exercises." These exercises involved extreme concentration and attention (Hadot, Pierre, & Davidson, 1995).

**Modern Meditation and the West.** Western intellectuals began discussing and academically studying Buddhism and meditation by the 18$^{th}$ century as translations of the ancient teaching began to travel to scholars from the East; philosophers like Schopenhauer contemplated the topics while Voltaire pleaded for toleration toward

Buddhists (Abelson, 1993; Beales, 2005). Although meditation has a long, extensive history in the East, Western society did not adopt the practice for thousands of years eventually gaining popularity in the mid-20th century. By the 1960s and 70s, the benefits of meditation were being tested by professors and researchers (Keng, Smoski, and Robins, 2013).

One individual who, thanks to his research at Harvard University in the early 1970s, is considered a pioneer in studying the effects and benefits of meditation is Dr. Herbert Benson. Benson's publication of articles and studies provided evidence that meditation acts as a remedy to stress. In 1967, Benson led an experiment that revealed "people meditating used 17% less oxygen, experienced lowered heart rates, and produced increased brain waves that could help with sleep" (Ross, 2016, para. 7). "All I've done," Benson told TIME, "is put a biological explanation on techniques that people have been utilizing for thousands of years." (Ross, 2016, para. 7).

The 1970s also gave meditation the buzz "that it needed to bring attention to the science: celebrity status (Ross, 2016, para. 9). In 1975, *TIME* magazine wrote a story on Transcendental Meditation (TM), a specific form of meditation, in which the story called the technique a "drugless high" (Ross, 2016, para. 9). Many popular musical artists at the time like The Beatles used TM as a way to handle their fame; some even traveled to India to practice with Maharishi, a man nicknamed "the groovy guru" (Ross, 2016, para. 9).

The "celebrity sides" of popular meditation and the scientific community finally "met in the middle" during the 1990s (Ross, 2016). *Ageless Body, Timeless Mind,* written by Deepak Chopra, sold nearly 150,000 copies of his book in one day after appearing on Oprah; superstars like George Harrison and Michael Jackson touted "Chopra as a guru"

(Ross, 2016, para. 11). Professional athletes similarly championed meditation in the 90s; "legendary NBA coach Phil Jackson published *Sacred Hoops: Spiritual Lessons of a Hardwood Warrior*, in 1995" (Ross, 2016, para. 11). Fast forward 20 years and you'll find that the NBA's 2015 MVP, Stephen Curry, practices meditation exercises (Ross, 2016). Today, research in meditation continues to expand; the practice is academically studied by psychologists, neurologists, media studies scholars, and individuals in many different fields (Keng et al., 2013).

**Meditation & technology.** Over the course of time, meditation in the West has experienced success when using media to deliver and teach well-being practices. One reason for this is due to the popularization of yoga (Deslippe, 2017). According to:

> the sage Patanjali, yoga is 'Chitta Vriti Nirodhah', promoting the unison of body and mind and envisages wellness of human beings as physical, mental and spiritual. The eight steps of yoga are yama, niyama, aasana, pranayama, pratyahar, dhyana, dharana and Samadhi. Meditation is a part of yoga, which deals with mental relaxation and concentration (Singh, 2005, para.1-3).

Here, both meditation and yoga will be discussed concerning their relationship with media technologies.

***Mail-order lessons (early 20th century).*** Mail-order meditation courses are one of the first examples of meditation being delivered and taught through media in the United States. William Walker Atkinson, more popularly known by his pseudonym "Yogi Ramachakra," was one of the first Americans to author mail-order yoga courses. Atkinson's writing, delivered as a series of monthly lessons through the mail, was first published in 1903; these lessons were later bound and distrusted as books. Also, in 1910, Sakharam Ganesh Pandit offered weekly mail-order lessons called "Yoga and Metaphysics" (Deslippe, 2017). Other teachers like "Rishi Singh Gherwal, A.K. Mozumdar, and Yogananda offered instruction through the post as well" (Deslippe, 2017, para. 4).

***The phonograph (1920s–1970s).*** Another wave of meditation being delivered and taught through media came in the form of the phonograph and vinyl records. One of the first teachers to release a meditation in the United States was Wassan Singh. A small record label in Kansas City named "Flexo" produced and distributed a small number of Singh's "Healing Chant" in 1927 (Deslippe, 2017). "The short record begins with Yogi Wassan bellowing out the 'seven holy chants' of his Soroda System of Yoga and then humming and improvising his way through the next two minutes to fill up the rest of the space" (Deslippe, 2017, para. 5). The 12-inch-long-playing record, or LP, that could play for over 20 minutes on each side began replacing the 78-rpm record by the 1950s. The LP was utilized for several decades by many meditation teachers like: Indra Devi, Swami Vishnu Devananda, and Swami Satchidananda (Deslippe, 2017).

***Television (1970s and 1980s).*** In 1961, Richard Hittleman became the first yoga teacher in American with his own television program; the program, *Yoga for Health,* continued for decades after first airing in Los Angeles in 1961 (Deslippe, 2017). Hittleman inspired others like Lilias Folan, "who started her own show *Yoga and You* in 1970 through a local public television station in Cincinnati that eventually saw 500 episodes aired nationally on PBS stations for almost three decades" (Deslippe, 2017, para. 7). The visibility of television programs made yoga and meditation accessible and approachable for many American (Deslippe, 2017).

***VHS tapes and dvds (1980s–Today).*** One of the most important aspect of pre-recorded yoga classes, first on VHS tapes and later DVDs, is that allowed many instructors the ability to create carefully produced and planned classes. VHS tapes and DVDs not only allowed individuals to practice meditation in the privacy of their homes like television, but also at their own convenience. It also allowed individuals to select a style or teacher that fit their personal preferences (Deslippe, 2017). It can be argued that VHS tapes and DVDs "normalized the practice of yoga [and meditation] through video" (Deslippe, 2017, para. 10).

***Digital technology and social media (today).*** In our current technologically saturated society, it is somewhat challenging to find aspects of yoga and meditation that are not impacted by the Internet and digital technologies (Deslippe, 2017). While technology was essential for the growth of meditative practices in the West, some believe that media has made yoga and meditation a popularity contest focused on which teacher has the most Instagram follows or which brand ambassador has the most likes on their selfie; however, things of this nature are not new seeing as "yoga teachers have crafted their public images through advertising, celebrity endorsements, and credentialing since the nineteenth-century" (Deslippe, 2017, para. 11). Meditation practices have experienced success when using media to deliver and teach well-being practice, but how will such practices be affected by new media such as VR?

Companies like Cubicle Ninjas, Owen Harris LL, m ss ng sp c s (missing letters and spaces are intended), and Transport VR – which is backed by Deepak Chopra – believe that VR guided meditation will have a significant impact on meditative practice (Ackerman, 2017; Ong, 2017; Wevr Transport, 2017). Chopra, a "pioneer in integrative medicine and personal transformation," has said that he believes "the biggest application for VR in the future will be for healing. [Chopra] think[s] that even in less than five years you will go to a really good medical center and a physician might prescribe a VR session instead of pharmaceuticals" (Wevr Transport, 2017, About section, para. 3). Contrarily, others like Dan Harris, an ABC News anchor that has played a crucial role in popularizing technology-assisted forms of meditation, feel that VR-assisted meditation may be one step too far (Ackerman, 2017). Harris has said that he's "done some thinking about using VR for meditation," and he believes developers and engineers have been unable to "harness what the technology is capable of to truly augment your meditation experience." (Ackerman, 2017, para. 8)

According to traditional meditation purists, the thought of placing a device on one's head that transports them to a virtual environment in order to relax is quite preposterous; the goal of meditation is to create a peaceful environment that supports well-being by yourself. Harris says using VR for meditation:

> seems obvious on the one hand, because there are all these elaborate, particularly in the Tibetan tradition, visualization techniques. But if the VR is doing it for you, then you're not actually doing it. You're supposed to be closing your eyes and creating it on your own, that's a mental exercise (Ackerman, 2017, para. 9).

Josh Farkus, founder of the extremely immersive VR guided meditation system Cubicle Ninjas, disagrees. Farkas views VR meditation as a perfect tool for "Type-A, very process-oriented, very analytical" individuals that "have the worst time just sitting there with their eyes closed" (Ackerman, 2017, para. 10). VR's ability to create lush, virtual environments helps such individuals "get distracted by this environment, and then they learn how to turn off those processes in their mind" (Ackerman, 2017, para. 10). Also, VR essentially hijacks all the audio and visual senses, effectively shutting out all external distractions – of which there are many in today's media-saturated distracted culture (LaValle, 2017). Before one can understand how VR has the potential to improve a user's well-being, understanding the history of VR will offer important perspective.

**Virtual Reality**

One of the most discussed and exposed technological buzzwords of the last decade has been the word "virtual." Today, there are virtual universities, offices, pets, museums, and just about anything an individual can think of thanks to VR systems and technologies. VR itself was a buzzword in the 1980s, spawning scholarly and social debates about the meaning of reality then and for years to come (Vince, 1998). The Oxford Dictionary defines the word virtual as "almost or nearly as described, but not completely or according to strict definition" ("Virtual," 2018) The word reality, for as much as it can be defined, is listed as "the state of things as they actually exist" ("Reality," 2018). The way humans interpret and discuss reality is based upon what individuals experience in the "real" physical world. Therefore, a "virtual reality" seems to "suggest a reality that is believable, and yet does not physically exist" (Vince, 1998, p. 4).

VR technology immerses users into a virtual world; other types of media technologies cannot provide such an experience. VR also has the ability to stimulate multiple senses including hearing, touch, and vision; it is predicted that smell will also be incorporated into VR experiences. With such abilities, VR systems can immerse users into a simulated experience with ease. However, cost and availability are two major problems facing the spread of fully immersive VR systems. While high quality VR systems, including a powerful computer and HMD, can cost users hundreds to thousands of dollars, things like Google Cardboard and other fairly inexpensive HMDs have hit the market to combat such problems (Mulis, 2016). Scholars, researchers, and industry analysists believe that the future is bright for VR; as VR systems become less expensive over time, “it will not be long before high quality content is readily available” (Mulis, 2016, para. 2). Before understanding how an ancient practice like meditation has been integrated into VR technologies, it is important to understand VR’s history.

**Virtual Reality History**

***1838 – Stereoscopic photos & viewers.*** In 1838, Sir Charles Wheatstone invented the stereoscope; the device gives users a sense of depth and immersion when looking at two side by side photographs (Welling, 1978). The View-Master stereoscope, patented in 1939, promoted “virtual tourism” (Welling, 1978, p. 4).

***1950s – Morton Heilig’s Sensorama.*** The Sensorama was introduced by cinematographer Morton Heilig in the 1950s. Featuring a 3D, “stereoscopic color display, fans to provide wind, odor emitters, stereo-sound system, and a moving chair to simulate motion,” the Sensorama attempted to induce immerse by stimulating multiple senses of viewer (Srivastava, Das, & Chaduray, 2014, p. 83; Srivastava, Das, & Chaduray, 2014).

***1968 – Sword of Damocles.*** Three years after publishing "The Ultimate Display" in 1965, Sutherland developed a head-mounted display, known as the Sword of Damocles, that presented the wearers with views of a computer-generated 3D scene. The images, simple drawings, did not move when users moved their heads left or right, but the stereoscopic nature of the images made it appear as if they were a solid 3D object.

Affordable and fast computer systems unfortunately did not exist in the 1960s and 70s, so VR remained dormant for years to come (Vince, 1998).

***HMD chaos.*** It is said that American teenager Palmer Luckey ushered in the current age of VR when he created the first prototype of a VR head-mounted display (HMD) or headset named the Oculus Rift in 2010.

**How Virtual Reality Works**

While there are high-quality, fairly expensive HMDs like the Oculus Rift and the HTC Vive that offer high-end VR experiences, lower-end HMDs like Google Cardboard still have the ability to get users somewhat immersed in a virtual world (Charara, 2017). High-end systems create virtual environments by sending content from the "console or computer to the headset via a HDMI cable in the case of headsets" (Charara, 2017, para. 8). These high-end systems typically offer greater audio fidelity, graphic quality, and a more robust field of view (Dredge, 2016). To operate low-end headsets like Samsung Gear VR and Google Cardboard, a smartphone containing the appropriate data, applications, or videos, is placed into the headset. HMDs are often called goggles due to the lenses housed in the HMD between the user's eye and the displayed content. These lenses can be focused and reshape the picture, creating stereoscopic, 3D images (Charara, 2017). Two other very important components to how VR works are head tracking and eye tracking.

**Head tracking.** Head tracking is crucial to the overall success of a VR experience; it allows users to freely look around the simulated environment. As users wearing HMDs move their heads up, down, and side to side, the picture in front of them shifts with the corresponding movement. A "6DoF" (six degrees of freedom) system tracks users' "head(s) in terms of an X, Y and Z axis to measure head movements" (Charara, 2017, para. 13). Other internal components used in a head-tracking system are: gyroscopes, accelerometers, and magnetometers (Charara, 2017).

**Eye tracking.** Eye tracking has to do with an HMD's ability to blur and focus on certain objects, simulating things like a user's eyes looking at an object in the distance and, in this case, blurring the foreground. (Charara, 2017). Also, HMDs need high-resolution displays to "avoid the effect of looking through a grid" (Charara, 2017, para. 28). Additionally, graphics and virtual environments need to feel as life-like as possible, meaning the head and eye-tracking need to mimic the human anatomical experience of movement and eye gaze (Charara, 2017). Without eye tracking, "simulation sickness is more likely. Your brain knows that something doesn't match up" (Charara, 2017, para. 28).

Simulation and motion sickness is a major deterrent to the popularization of VR technologies; the most common symptom of simulation or motion sickness is nausea. (Samit, 2018). An imbalance of inputs to a user's vestibular and visual systems typically cause such sickness; the latter systems do not feel the motion that the former systems see (Munster, 2017). While there are some unproven cures for VR motion sickness "such as wristbands, soaking their feet in ice water, and chewing ginger" (Samit, 2018, para. 5), developers have recently found that adding virtual hands or a nose helps alleviate motion sickness (Samit, 2018). They have also found that when a system imitates "the natural way people tilt their heads down when moving forward to walk or run (Samit, 2018, para. 7)," motion simulation and motion sickness decreases (Samit, 2018)

### The Differences Between Immersive Environments

As VR and other immersive environment technologies become more popular and easily accessible, it is important to know the differences between them, and more specifically, the differences between VR and augmented reality. In 2016, the mobile augmented reality (AR) application Pokémon Go became an international sensation; the game shattered iPhone and Android download records by accumulating 30 million worldwide downloads, faster than any other mobile application ever while generating $35 million in revenue (Molina, 2016). After years of technological progression, AR technology, defined as a technology that blends the physical, real environment in real-time with interactive and virtual, three-dimensional images (Azuma, 1997), has transformed the gaming world by turning familiar, physical realities into alternate, fantasy universes. While AR's overwhelming popularity is in the gaming world, its functions and benefits are not limited to entertainment (Malik, 2016).

AR heightens a user's perception of the real world by creating a computer-generated layer of images and information. AR is characterized by three properties: digitally simulated and real objects displayed in the real environment, real and computer-generated objects that align with one another, and technology that runs interactively in real time (Azuma, 1997). Typically, AR technologies are divided into two categories, location-based systems and image-based systems. Location-based AR systems use the position of a device determined by the device's Global Positioning System (GPS). This allows users to move around the real environment with their devices and observe three-dimensional, computer-generated images or information on their device screens; the information superimposed on the real environment relies on the position of the user.

Image-based AR systems rely on image recognition technologies that use images or markers in the real environment, or physical objects and natural features of the real environment itself, to determine the appropriate position of images or information related to the physical environment (Di Serio, Ibáñez, & Kloos, 2013). Essentially, AR allows users to interact with the real world while digital content is added to it and VR immerses users in a completely simulated digital environment.

Mixed reality (MR) is an additional new media worth discussing. In MR, physical objects of the real world and digitally simulated objects exist and interact in real time. In this experience, new digital images are added to the “real world” and the the simulated content can react and interact with the real world (Ohta & Tamura, 2014). In order to prevent confusion between AR, VR, and MR, some have started using the term extended reality (XR); XR is an umbrella term used to describe all forms of AR, VR, and MR. Basically, MR is combination of the physical world and virtual reality, creating simulations that can interact with the physical world and XR brings all three technologies together under one term (Somasegar and Lian, 2017). This study focuses on VR and the potential effects of immersing users in a fully artificial digital environment to enhance meditative practices.

**Immersion**

One of the most important characteristics of VR experiences is immersion (Biocca, 1995). Immersion is the term given to describe the extent of a VR system’s ability to deliver experiences that are: “extensive, surrounding, inclusive, vivid, and matching” (Miller and Bugnariu, 2016, p. 247). Immersion deals with the technical aspects of virtual environments (Slater and Wilbur, 1997) while presence, another important characteristic of VR experiences, is described as the psychological feeling of "being there" (Slater, Linakis, Usoh, & Kooper, 1996). VR systems rely on immersion to influence user experience and presence. There are several different types of VR technologies that typically grouped into the following categories: non-immersive, semi-immersive, or fully immersive (Gutiérrez, Vexo, & Thalmann, 2008).

Fully immersive systems typically involve the use of an HMD that completely isolates users' vision and hearing to the virtual world, thus eliminating physical world distractions in hopes to increase the feeling of immersion. Semi-immersive systems surround the user with projectors and screens. These systems provide opportunities for multi-user interactivity. Lastly, non-immersive systems are typically desktop or laptop based. (Gutiérrez et al., 2008).

From this perspective, immersion is associated with an attempt to replicate human characteristics (Mestre, 2015). Such characteristics include but are not limited to: "size of the human visual field, stereoscopic aspects of the simulation, [and] the 'surround' aspects of the sound" (Mestre, 2015, p. 2) Therefore, displays that stimulate multiple senses and tracking that preserves fidelity determine how immersive a VR system is (Slater & Wilbur, 1997).

Immersion, by hijacking a user's senses, attempts to trick the minds of individuals into believing that they are "present" in a simulated world. It is not hard to understand why the notion of "being present" in a virtual world is crucial to a VR system's success (Minsky, 1980). While immersion is a "technology-related" theory and aspect behind VR, presence, another important characteristic and theory related to VR, is a "psychological, perceptual, and cognitive consequence of immersion" (Mestre, 2015, p2). Presence describes the mental perception of "being in" or "existing in" a virtual world (Heeter, 1992).

In this project, immersion is manipulated with the use of wireless VR Gear headsets and a 3D, VR guided meditation mobile application; this application guides users to a remote beach. Research exists arguing the beach may be the premier destination for relaxation; evidence suggests that proximity to the beach or coast can significantly increase general health and mental health (White, Alcock, Wheeler, & Depledge, 2013). It is expected that immersion in the 3D VR environment could potentially be more impactful because individuals will be more likely to feel present on the beach where they are visually immersed in the 360-degree paradise environment; this potentially may have a more positive impact on psychological and physiological states than less immersive meditation apps on the market.

**Presence**

Another important concept and theory in VR is presence. “Telepresence” is the phenomenon resulting from the sense of being physically present at a remote location through interaction with a medium based on an action and the perceptual feedback resulting from those actions (Minsky, 1980). Heeter (1992) later proposed that presence has the possibility to be established in either a personal, social, or environmental sense. Personal and environmental presence are fundamental to VR experiences; personal presence represents the phenomenon of a person believing they are actually inside a virtual or remote environment. Environmental presence represents how effectively the environment itself is able to acknowledge and interact with the user in the environment. As VR technology becomes more photorealistic and incorporates high fidelity sound, especially in an HMD (head-mounted device) that removes outside stimuli thus completely immersing the user in the environment, it would be expected that the experience of presence might also be enhanced.

When presence is felt and achieved, the brain is tricked into believing that the displayed environment is “real” by stimulating multiple human senses. When the brain interprets the simulated environment as “real,” users react to the VR on a more emotional level (Steuer, 1992; Cheong, 1995; Lee, 2004). Kim (2005), provides a simpler definition of presence than Heeter, assuming there are two different types of presence: spatial and non-spatial presence. The former describes physiological aspects while the latter refers to psychological aspects; immersion has commonly replaced the term spatial presence in recent years.

Research has provided evidence that human feelings and emotions such as anxiety, sadness, and happiness, can be influenced when presence is felt in an immersive VR environment (Gutiérrez, Pierce, Vergara, Coulter, Saland, Caudell, Goldsmith, & Alverson, 2007). Seeing as emotions can be influenced by presence, VR is starting to become a common application in therapy; it is being used to treat phobias and other mental health issues (Gutiérrez et al., 2008; Munster, Clinton, Jakel, & Murphy, 2015). As VR technology becomes more photorealistic and incorporates high fidelity sound, especially in an HMD that removes outside stimuli thus completely immersing the user in the environment, it would be expected that the experience of presence might also be enhanced.

**Virtual Reality Uses**

One common way VR is used in the mental health field is to help treat individuals suffering from posttraumatic stress disorder (PTSD) (Rothbaum et al, 2001). An example of this is found in a specific “clinical trial using VR exposure to treat Vietnam combat veterans suffering from posttraumatic stress disorder (PTSD)” (Rothbaum et al, 2001, p. 617). Ten male patients who averaged 51 years of age, all Vietnam combat veterans suffering from PTSD, were exposed to 2 virtual environments for eight to 16 sessions. The first environment simulated a helicopter flying over Vietnam while the second environment simulated a helicopter flying over a clearing in the jungle: VR exposure therapy sessions were compared to typical imaginal exposure therapy. After the participants were interviewed after six months, reports found “reductions in PTSD symptoms ranging from 15–67%. Significant decreases were seen in all 3 symptom clusters” (Rothbaum et al., 2001, p. 617).

While VR use is becoming an evidence-supported form of exposure therapy for individuals suffering from PTSD, other researchers have explored the option of VR use to cure several different types of phobias; one specific case study deals with the treatment of arachnophobia (Carlin et al., 1997). One subject, a 37-yr-old female with incapacitating arachnophobia, underwent 12 weekly one-hour sessions over the course of a three month period; in the experiment, she wore a HMD that displayed spiders crawling over her hand; a glove with haptic capabilities was also worn to simulate the feeling of a spider crawling over her hand. Results showed that the VR exposure was successful in reducing the participant’s fear of spiders; measures of decreased anxiety and avoidance of spiders were also found (Carlin et al., 1997).

Not only has VR been used as a means to combat mental health issues like PTSD and different phobias, it has also been used to alter emotional states like environmental awareness, embodiment, and empathy (Ahn, Bostick, Ogle, Nowak, McGillicuddy, & Bailenson, 2016). One academic study tested such abilities by developing a VR system that allowed participants to inhabit the body of animals. The researchers found that the immersive environment demonstrated greater feelings of presence, embodiment, and interconnection between the self and nature compared to participants that watched such experiences on video. For one week, participants that experienced the said VR system felt more environmentally aware and connected with nature; such findings suggest VR may be an effective instrument in promoting environmental awareness (Ahn et al., 2016).

VR, and especially VR in journalism and storytelling, has been called "The Empathy Machine (Constine, 2015). Some scholars like Nonny de la Pena believe VR can enhance mankind's feelings of compassion (de la Peña, Weil, Pomes, Spanlang, Friedman, Sanchez-Vives, & Slater, 2010). One such study conducted by Slater and Sanchez-Vives (2016) involved participants watching a documentary featuring a young girl living in a refugee camp; half of the participants viewed the documentary in 2D, video format while others viewed the documentary in VR via an HMD. Results indicated that the VR documentary experience resulted in higher levels of empathy for the refugee girl when compared to the 2D, video experience.

Not only does VR have the ability to impact human emotion, it can also produce physiological effects. One interesting study to test such effects used VR in a bicycling exercise (Plante, Aldridge, Bogden, and Hanelin, 2003). In this study, participants were:

> randomly assigned to one of three 30-minute conditions including: (1) bicycling at a moderate intensity (60–70% maximum heart rate) on a stationary bicycle, (2) playing a VR computer bicycle game, or (3) an interactive VR bicycle experience

on a computer while exercising on a stationary bike at moderate intensity (60–70% maximum heart rate) (Plante et al., 2003, p. 495).

Results showed that those who exercised with VR exhibited enhanced levels of enjoyment, energy, and reduced levels of tiredness; those who exercised without VR reported increased levels of tension, tiredness, and low energy. Evidence from this study suggests that the combination of VR and exercise can produce psychological and physiological benefits (Plante et al., 2003).

Although research and literature involving VR as a tool to facilitate meditation is fairly young, some studies do exist; however, most of these studies involve expensive VR systems that cost thousands of dollars to develop and distribute. One such system is RelaWorld. RelaWorld, developed by scholars and engineers at the University of Helsinki in Finland, is a neuroadaptive VR meditation system that combines immersive meditation practices and physiological, neurofeedback. Users, wearing an HMD, practice various meditation exercises in order to levitate in the virtual world; if users do not steady their breathing or lower their heart rate – goals of the meditative experience – they do not levitate. Data was gathered using EEG to measure user's brain activity; the measures used estimated levels of concentration and relaxation. When compared to a similar setup without HMDs or neurofeedback, evidence suggested that the RelaWorld VR system produced greater feelings of relaxation, a greater feeling of presence, and deeper levels of meditation (Kosunen, Salminen, Jarvela, Ruonala, Ravaja, & Jacucci, 2016).

While most experiments conducted involving VR and meditation include high quality, very expensive computer based systems like RelaWorld VR, the Oculus Rift, or the HTC Vive, this experiment uses a phone-driven VR system and a 99-cents app available for all smartphones; users need a smartphone, headphones, and an HMD. Therefore, this experiment was conducted to see if less expensive, more readily available VR guided meditation systems had the ability to create an immersive environment that prompted greater feelings of relaxation, a greater feeling of presence, and deeper levels of meditation when compared to audio guided meditation sessions. In accordance with previous research, the following is hypothesized:

H1: Individuals who meditate with VR technology will experience greater levels of self-reported well-being than those who meditate without the technology.

H2: Individuals who meditate with VR technology will report higher levels of self-reported relaxation after meditation than those who meditate without the technology.

H3: Individuals who meditate with VR technology will report higher levels of self-reported presence during meditation than those who meditate without the technology.

# CHAPTER III

# METHOD

## Participants

The participants in this study, 62 in total, were student volunteers at large public university in the Pacific Northwest. The majority of the participants were enrolled in a School of Journalism and Communication; this is a result of a general journalism course offering extra credit to students who participated in the study. Participants were recruited via email and course announcements. The principal investigator also gave a recruitment pitch in the said course (Appendix List 1). Participants signed up by clicking a link distributed by the principal instructor. The link took participants to a sign-up sheet where they anonymously picked a date and time to participate in the project.

## Design

This study used an experimental method to assess whether VR can potentially augment or improve guided meditation practices: does the sense of presence or "being there" created through immersion resulting from the use of VR improve a user's mood and sense of relaxation? The treatment group used VR technologies to facilitate the guided meditation, while the control group was presented with an audio track facilitating the guided meditation. The VR treatment group utilized mobile phones, Samsung VR gear, and the Guided Meditation VR app, a free application developed by nDreams. Data collection began in December of 2017 and ended in April of 2018.

## Procedure

Approval from the Internal Review Board (IRB) was granted by the principal investigator's university before data collection was started. First, the participants were welcomed to a computer lab owned by a large public university in the Pacific Northwest and told that they will be involved in an experiment, for extra credit, to determine how different styles of meditation impact psychological factors like stress, depression, and anxiety. They were asked to show their student ID, and the principal instructor typed their name on a sign-in sheet – an electronic Excel spreadsheet. The principal instructor used this sign-in sheet to inform the course instructor which students participated in the study for extra credit. The principal investigator obtained documentation of permissions from the instructor to recruit from their class and to offer extra credit.

Once permissions were acquired, the principal investigator handed the participant an index card. The index card had a random number on it that the participant used on the surveys throughout the experiment. The participants were told that their number was to simply link their answers to the surveys with their experience and that their names would not be used in the data collection; the data collection and results were anonymous. The number also served to randomly assign the participant to either the control or experimental group.

After participants were welcomed and informed consent forms were read aloud, signed, and collected, the participants took an online pre-meditation survey/questionnaire containing two different surveys sections (**Pre-Meditation Info Survey & Profile of Moods States (POMS) Survey**) (Appendix List 2 and 3). The first section of the survey (**Pre-Meditation Info Survey)** gathered information regarding demographics, prior meditation practices, and prior use of VR technologies. A full list of the demographic survey can be found in the Appendix as List 2. The second section, the **POMS Survey**, is a reliable scale used to evaluate mood states (McNair, Droppleman, & Lorr, 1992). This survey took participants five to seven minutes on average to complete. A full list of this survey can be found in the Appendix as List 3. Higher TMD (Total Mood Disturbance) scores "indicate a greater degree of mood disturbance" and lower scores reflect a more positive mood and state of well-being (Yoshihara, Hiramoto, Sudo, & Kubo, 2011, p. 3).

After the pre-meditation surveys were completed, the principal investigator divided participants into two groups; participants with odd numbers on their index cards were told they were group one and those with an even number were told they were group two. The principal investigator then led each group to two separate rooms where they would be meditating. These rooms are extremely similar in appearance and are arranged in a seminar layout. Participants in group two were let into one room where the principal investigator asked them to have a seat and relax, and the principal investigator played a previously downloaded guided meditation audio track from his computer. The track was played on an iTunes media player and was loud enough that participants did not need headphones.

Once the track was played, participants in group one then entered the second room where the principal investigator asked them to have a seat in front of a HMD. Next, the instructor explained how to adjust the focus on the HMD, how to access the guided meditation session on the app, and directed participants to explore the setting of the virtual environment before starting the session. After two minutes were taken to allow participants to acclimate to the VR technology and environment, the instructor asked participants to start the guided meditation session.

The participants then meditated for 10 minutes. This time was chosen because the audio track used was 10 minutes in length. Participants in the control group meditated with a digital audio guide and participants in the experimental condition group meditated using VR technology (HMD and headphones) supplied by principal investigator. Specifically, participants randomly selected for the VR condition used Samsung VR gear and the Perfect Beach VR app, a free application developed by nDreams; the control group listened to a guided meditation session focused on “going to the beach” developed by Jon Kabat-Zinn, PhD, who has studied mindfulness for more than 35 years. The audio guide and the VR technology guided participants through the same meditation process; both were guided to a beach. The control group had a voice guiding them to a beach and the experimental VR condition group was guided to a beach by a voice while experiencing sounds and sights of a beach in an immersive, digitally generated 360-degree video. After meditation was complete, the instructor lead participants back to the welcome area where they took a survey containing three sections: **Post-Meditation POMS Survey, Post-Meditation Presence Survey,** and **Post-Meditation Relaxation Survey.**

The **Post-Meditation POMS Survey** is the same survey as the **Pre-Meditation POMS.** The scores and means of both surveys were compared with statistical *t*-tests to determine if immersive meditation creates a more relaxed experience or reduces stress than a non-immersive experience. Examples from the said survey are as follows:

1= Not at all / 2= A little / 3= Moderately / 4= Quite a lot / 5= Extremely

In the past week I have felt:

| | | | | | |
|---|---|---|---|---|---|
| Tense | 1 | 2 | 3 | 4 | 5 |
| Angry | 1 | 2 | 3 | 4 | 5 |
| Worn Out | 1 | 2 | 3 | 4 | 5 |

Unhappy 1 2 3 4 5

The full survey is found in the Appendix as List 3.

**The Post-Meditation Presence Survey (**Appendix List 4) used sections from the Temple Presence Inventory (Lombard, Ditton, & Weinstein, 2009) and was also compared to determine how presence is experienced in immersive and non-immersive meditation; the scores and means of the survey were compared with statistical *t* tests. Examples from the said survey are as follows:

> How much did it seem as if the objects and people you saw/heard had come to the place you were?
> Not at all 1 2 3 4 5 6 7 Very much
>
> How often when an object seemed to be headed toward you did you want to move to get out of its way?
> Never 1 2 3 4 5 6 7 Always
>
> To what extent did it seem that sounds came from specific, different locations?
> Not at all 1 2 3 4 5 6 7 Very much

The full survey is found in the Appendix as List 4.

The **Post-Meditation Relaxation Survey** (Appendix List 5) used the Physical Assessment Scale, a self-report measure scale used to assess the effects of relaxation training; the scores and means of the survey were compared with statistical *t* tests. (Crist, Rickard, Prentice-Dunn, and Barker, 1989). Examples from the said survey are as follows:

> **My muscles feel loose**
>
> 1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree
>
> **I feel very peaceful**
>
> 1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I have a clear mind**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

The full survey is found in the Appendix as List 5.

# CHAPTER IV

## RESULTS & DISCUSSION

Out of the 62 students who participated in the experiment, 30 were randomly assigned to the VR experimental condition group and 32 were assigned to the control group. The average age of participants was 19 and ages ranged from 18 to 63. Sixteen participants reported they practice meditation regularly and three participants meditate on a daily basis; their exposure to meditation did not have a significant impact on the data analyzed. Also, the demographic information survey showed that only 30 participants overall and 18 participants in the VR group have been exposed to some sort of VR technology prior to the experiment; the lack of VR exposure may have had an impact on the data collected. Lastly, it should be noted that 91 volunteers participated in the study, but the data from 29 participants were removed from the data analysis for several reasons. Eleven participants skipped too many questions on several surveys, leading to their exclusion from the data analysis. Also, the TMD scores of both groups before meditation were significantly different; therefore, the principal investigator removed an additional 18 outliers from the data analysis in order to have significantly similar groups.

*H1: Individuals who meditate with VR technology will experience greater levels of self-reported well-being than those who meditate without the technology.*

Prior to the experiment, the VR experimental condition group had a mean Total Mood Disturbance (TMD) score of 32.4 and the condition group had a score of 30.34. As previously mentioned, higher TMD scores indicate a greater degree of mood disturbance and lower scores reflect a more positive mood and state of well-being (Yoshihara et al., 2011). After the meditation sessions, the VR experimental condition group had a TMD of

26.47 and the condition group had a score of 25.84. An independent-samples *t* test comparing the mean scores of the VR experimental condition and the control groups indicated no significant difference between the means of the two groups ($t(60) = 0.135$, $p > 0.05$). These results, displayed on Table 1, indicate that self-reported perceptions of mood were similar between the VR guided meditation session and the audio guided meditation session. However, it should be noted that participants that meditated with VR did have improved feelings mood and emotion by the end of the experiment, but this improvement was not statistically significant or greater than the improvement demonstrated by participants that meditated without VR.

*H2: Individuals who meditate with VR technology will report higher levels of self-reported relaxation after meditation than those who meditate without the technology.*

The minimum and maximum scores of the Physical Assessment Scale are 20 and 100 respectively; there are 20 questions on the survey and the response scale ranged from 1 to 5. The total scores in the VR experimental condition group ranged from 20 to 100 and the scores in control group ranged from 23 to 97. An independent-samples *t* test comparing the mean scores of the VR experimental condition and the control groups indicated no significant difference between the means of the two groups ($t(60) = 0.107$, $p < 0.05$). The mean of the VR experimental condition group was nearly identical ($M$=70.03) with the mean of the control group ($M$=69.53). These results, displayed on Table 2, indicate that relaxation levels were similar between the VR guided meditation session and the audio guided meditation session.

*H3: Individuals who meditate with VR technology will report higher levels of self-reported presence during meditation than those who meditate without the technology.*

The minimum and maximum scores of the Temple Presence Inventory are 17 and 119 respectively; there are 17 questions on the survey and the response scale ranged from 1 to 7. The total scores in the VR experimental condition group ranged from 46 to 105 and the scores in control group ranged from 23 to 100. An independent-samples *t* test comparing the mean scores of the VR experimental condition and the control groups indicated a significant difference between the means of the two groups ($t(60) = 2.21$, $p < 0.031$). The mean of the VR experimental condition group was significantly higher ($M$=67.43) than the mean of the control group ($M$=56.75). These results, seen on Table 3, indicate that participants in the VR condition experienced a greater feeling of presence – feeling as if they were at the beach in this experiment – than those who meditated without VR. See Table 3.

**Discussion**

Virtual reality (VR) technology is becoming more established with time; however, its uses in the health field need to be studied more extensively. The principal investigator hypothesized that due to the immersive effect of VR, the already discovered positive effects of meditation would be enhanced. The experimental results did not support this. Failure to find significant differences in results could be due to the novelty effect of the VR technology (Rupp, Kozachuk, Michaelis, Odette, Smither, & McConnell, 2016). The novelty effect is felt when there is an increase interest and “newness or freshness of the innovation in the eyes of the adopter” prematurely increases performance (Wells, Campbell, Valacich, & Featherman, 2010, p. 813).

This study’s findings may suggest that individuals were focusing on the novelty of the VR experience, distracting them from the content of the application. Similar findings were found for individuals who experienced enhanced presence during the experiment; greater presence did not lead to lower TMD levels and higher relaxation levels (Rupp et al., 2016). As participants were leaving one particular session, the principal investigator overheard a participant say, “that was really cool but it wasn’t that relaxing.” Perhaps the content or the experience of “being there,” in this case, was simply too distracting (Rupp et al., 2016).

Also, this was many participants first time using VR technologies and perhaps this experience was too new and exciting. This potentially diverted users’ mental effort and attention away from relaxing or focusing (Rupp et al., 2016). As previously mentioned (Ackerman, 2017), VR meditation is not for everyone and does not fit all personality types, so it may be naïve to think one VR immersive experience would augment or enhance meditative practice. Overall, VR guided meditation had the opposite effect that principal investigator anticipated, most likely due to novelty of the technology (Rupp et al., 2016).

Another potential reason why the anticipated results were not found could be due to VR technology’s placement on the Gartner Hype Cycle. In 2017, Gartner’s Hype Cycle placed VR on the “Slope of Enlightenment” (Lomas, 2017). Gartner's Hype Cycles offer an overview of the maturity of emerging technologies. This cycle is used by businesses interpret the reality behind the hype of a technology, ultimately informing businesses on when they should adapt a new technology. Gartner's Hype Cycle is also useful because it describes the typical development of an emerging technology. The Hype Cycle contains the following stages: Technology Trigger, On the Rise, At the Peak of Inflated Expectations, Sliding Into the Trough of Disillusionment, Climbing the Slope of Enlightenment, Entering the Plateau of Productivity, and Post-Plateau (Linden and Fenn, 2003)

Perhaps the hypothesized expectations were not achieved and the VR system failed to deliver an enhanced meditative experience because VR technology has yet to climb all that far out of the "Trough of Disillusionment" (Kahn, 2017). The "trough" is a section on Gartner's Hype Cycle where a technology is quickly discredited if it does not live up to lofty expectations. (Linden and Fenn, 2003). While there has been an increase of research and studies on how VR technology can benefit businesses and society (Rothbaum et al, 2001; de la Peña et al, 2010; Plante et al., 2003; Kosunen et al., 2016), this could have been an influx of hype. This influx could have influenced the principal investigator, thus assuming and hypothesizing that VR technologies would be effective for meditation. This could also potentially explain why participants did not react significantly to the VR system as predicted. While many readily available technologies offer high-definition visuals, perhaps the VR system used, one far less immersive and high-quality when compared to systems like the Oculus Rift and the HTC Vive, simply could not captivate users and provide them with the fidelity they have become accustomed to on high-definition televisions, cellphone screens, computers, and tablets.

VR made its first appearance on "Gartner's annual hype cycle chart in 2013, one year after Oculus VR founder Palmer Luckey and CTO John Carmack showed off a ducttaped set of ski goggles to a small group of journalists at the game industry's annual trade event, E3" (Gilbert, 2015, para. 5). Today, Gartner's research predicts that VR will achieve mainstream adoption in two to five years (Panetta, 2017). However, some veteran game developers disagree. In an interview with *TechCrunch,* a respected designer who works for a successful games publisher expressed his skepticism regarding VR's mainstream acceptance:

> The harsh truth is you really need $1,000 of kit to deliver modern AAA experiences in VR, and people don't want to spend that, they don't want to wear it, and they hate the cables and the clunkiness. We are not only seeing low hardware sales, but attach rates are terrible. Even owners of VR hardware are not buying software (at least not in the quantities needed to fund large games), and this is further limiting how it is growing (Lomas, 2017, para. 45-46).

Despite the precarious nature of emerging information and media technologies, the VR market is predicted to grow exponentially with reports foreseeing to be worth over $40 billion across all platforms by the year 2020. The massive adoptions of VR HMDs like the Samsung Gear, HTC Vive, Oculus Rift (and the less expensive Oculus Go, and Google Cardboard (and now Google Daydream) shows the increasing interest and acceptance of VR in the business landscape and consumer space; these products are steadily growing across many sectors like healthcare, retail, military, and education ("Global Virtual Reality (VR)," 2017). By listing VR on the "Slope of Enlightenment" on the Gartner Hype Cycle, it is expected that the adoption rate will increase in the next few years bringing in a new era of customer experience and engagement (Lomas, 2017). Perhaps there will be an increasing interest and acceptance of VR in meditation as well.

While there are some who do not agree with mixing VR and meditation (Ackerman, 2017), there are some who believe the combination has a strong future (Kosunen et al., 2016; Wevr Transport, 2017). A vast market is expanding, and individuals like Chopra hopes for a simulation which mixes "insights, contemplation and entertainment" (Carrol, 2016, para. 10). Although ancient practices of contemplation never included wearing a headset or staring at a screen, Chopra does not see a problem with starting now. "I've never been too attached to tradition. We're an evolving species. If you don't keep up with technology you're not in touch with the zeitgeist and you may as well pack it in." (Carrol, 2016, para. 20). Studies exist indicating VR use can positively impact levels of well-being while mitigating negative emotional states (Davis and Calitz, 2014). These results provide groundwork and encouraging evidence of the practicality and appropriateness of using VR to practice meditation and mindfulness practices (Kosunen et al., 2016). As technology and society advances, VR undoubtedly has the ability to advance as well; these advancements may help the technology become more accepted and applicable for meditation enhancement.

**Limitations**

Although the experiment was carefully prepared, the author is aware of the study's limitations. The population of the experimental group is somewhat small; 62 students from one undergraduate class at a west coast university cannot represent all students. Another limitation deals with the VR technology used; the application participants used is efficient, but not necessarily "cutting edge." Perhaps levels of well-being and would vary in different, more high-quality VR meditation environments. Lastly, the principal investigator did not include a control group containing participants practicing traditional meditation; meaning, meditating without any type of media. This decision was made because the principal investigator does not have any experience conducting meditation sessions; therefore, guided meditation sessions were chosen as the focus of this study. However, it would be beneficial to include such a control group in future studies.

**Conclusion and Future Work**

The quantitative results of this research study showed that the use of virtual reality (VR) technology in a guided meditation session had a positive effect on an individual's self-reported sense of presence; the effect has been analyzed in comparison with traditional audio guided meditation sessions. The mean presence level scores obtained were $M = 67.43$ for the VR guided meditation session and $M = 56.75$ for the audio guided meditation session; a clear enhancement on the sense of presence for the individual's using VR technology compared to a more traditional meditation environment was noticed. However, the increased sense of presence did not make users feel more relaxed or mentally and emotionally at peace.

The analyzed data results of this research study showed that the use of VR technology in a guided meditation session did not have a significant positive effect on an individual's self-reported sense of well-being. The mean TMD level scores obtained from the POMS survey post-test were $M = 26.47$ for the VR guided meditation session and $M = 25.84$ for the audio guided meditation session; although meditation seemed to have small effect on both groups, no clear enhancement of well-being for the individual's using VR technology compared to a more traditional meditation environment was noticed.

Lastly, the quantitative data results of this research study showed that the use of

VR technology in a guided meditation session did not a statistically significant positive effect on an individual's self-reported sense of relaxation. The mean TMD level scores obtained from the Physical Assessment Scale survey were $M = 70.03$ for the VR guided meditation session and $M = 69.53$ for the audio guided meditation session; no clear enhancement of relaxation for the individual's using VR technology compared to a more traditional meditation environment was noticed.

Given the results obtained from this specific research study and studies like (Kosunen, et al., 2016), it is clear that the quality of current VR systems has an impact on the system's ability to enhance meditation practices. It would be interesting if this specific study could add an experimental group of participants meditating in a high-quality VR system like the previously mentioned RelaWorld or Chopra's meditation simulation on an HTC Vive or Oculus Rift and a control group containing participants practicing traditional meditation; data would be gathered and analyzed using the same scales used in this specific study.

It would also be interesting to see how physiological factors are affected by the various meditation conditions. Factors such as heart-rate, blood pressure, and skin galvanization levels could be gathered and analyzed to see VR systems have a physical effect on users. Also, it would be interesting to measure brain activity with EEG devices during the different experimental and control groups. Such data could provide greater insight than self-reported effects as it would provide evidence on how the brain is neurologically affected during VR use as well as during meditation in general.

Nevertheless, high-end, multi-sensory, VR wellness experiences involving biofeedback and haptic technology are beginning to enhance meditative practices. If the technology continues to follow the stages on the Gartner Hype Cycle, and as VR improves and become less expensive and more accessible, the technology will evolve from being "new" to the "norm." It will be interesting to see how VR will improve applications and systems focused on meditative practices.

APPENDIX:

TABLES AND LISTS

Table 1

Profile of Mood States (POMS) Survey Results – Total Mood Disturbance (TMD)*

| Pre-Experiment | N | Low | High | Mean |
|---|---|---|---|---|
| VR Experimental Group | 30 | 8 | 56 | 32.4 |
| Condition Group | 32 | 13 | 57 | 30.34 |
| Post-Experiment | | | | |
| VR Experimental Group | 30 | 3 | 81 | 26.47 |
| Condition Group | 32 | 5 | 64 | 25.84 |

* Higher TMD scores indicate a greater degree of mood disturbance and lower scores reflect a more positive mood and state of well-being (Yoshihara, Hiramoto, Sudo, & Kubo, 2011).

Table 2

Physical Assessment Scale Survey Results

| Post-Experiment | N | Low | High | Mean |
|---|---|---|---|---|
| VR Experimental Group | 30 | 20 | 100 | 70.03 |
| Condition Group | 32 | 23 | 97 | 69.53 |

Table 3

Temple Presence Inventory (TPI) Survey Results

| Post-Experiment | N | Low | High | Mean |
|---|---|---|---|---|
| VR Experimental Group | 30 | 46 | 105 | 67.43 |
| Condition Group | 32 | 23 | 100 | 56.75 |

List 1

**Classroom Pitch**

- Hello.
- My name is
- I am a Graduate Employee at the School of Journalism and Communication who is running a study focusing on different types of meditation and their impact on well-being.
- I am looking for participants, at max 100, who are:
  - 18 years of age or older
  - that are willing to partake in an experiment involving emerging media technologies and meditation.
- If you choose to participate, you will have a 1 in 10 chance of winning a $10 gift card to Starbucks.
- This study should take no longer than 35 minutes.
- If you wish to participate in the study or receive more information on it, please email me at (email) or see me at the end of class to sign up.
-The only risk that might apply to this study is a case where participants might react negatively to the virtual reality condition. For example, they might become dizzy or nauseous. However, the chances of this happening are very small.
- Also, your participation in this study will be worth extra credit points for this class. The extra credit assignment is worth five points. The five points can be added to any assignment throughout the term. For example, if a student received a 75% on a quiz and completed the extra credit assignment, whether it be the essay or participating in my experiment, they can use the five points to turn their grade into an 80%. Remember, you also have an opportunity to gain extra credit by completing an essay assigned by professor Parker. For that, you will have to write a 2-page essay focused new media (like augmented reality, virtual reality, artificial intelligence, etc.)
- Your participation is voluntary. If you choose not to participate, it will not affect your current or future relations with the University of School of Journalism and Communication. You are free to withdraw at any time for whatever reason. There is no penalty or loss of benefits for not taking part or for stopping your participation. For students, withdrawal from the study does not jeopardize grades nor risk loss of present or future faculty, school, or University relationships. However, you will not be entered to win a gift card or receive extra credit due to early withdrawal.
- I will write my email address on a board of some sorts to make sure that students can contact me.
- Thank you for your time!

List 2

**Pre-Meditation Info Survey**

Participation Number:

Gender: Male / Female / Other / Prefer not to Answer

Age:

Academic Rank: Undergraduate / Graduate

**Do you meditate?**

Yes or No

**Do you meditate on a daily basis?**

Yes or No

**Do you meditate throughout the week?**

Yes or No

**Do you use guided meditation sessions?**

Yes or No or Unsure

**How important is meditation to you?**

1 – Not important 2 – Slightly important 3 – Moderately important 4 – Mostly important 5 – Very important

**Have you ever used virtual reality technologies?**

Yes or No or Unsure

**Have you ever used virtual reality technologies in guided meditation sessions?**

Yes or No or Unsure

**How familiar are you with virtual reality technologies?**

1 – Not familiar 2 – Slightly familiar 3 – Moderately familiar 4 – Mostly familiar 5 – Very familiar

**How likely are you to use media technology devices to help with meditation?**

1 – Not likely 2 – Slightly likely 3 – Moderately likely 4 – Mostly likely 5 – Very likely

**How important is utilizing emerging media technologies to you?**

1 – Not important 2 – Slightly important 3 – Moderately important 4 – Mostly important 5 – Very important

List 3

**Profile of Mood States Survey (Pre-Test & Post Test)**

1= Not at all / 2= A little / 3= Moderately / 4= Quite a lot / 5= Extremely

| | | | | | |
|---|---|---|---|---|---|
| Tense | 1 | 2 | 3 | 4 | 5 |
| Angry | 1 | 2 | 3 | 4 | 5 |
| Worn out | 1 | 2 | 3 | 4 | 5 |
| Unhappy | 1 | 2 | 3 | 4 | 5 |
| Proud | 1 | 2 | 3 | 4 | 5 |
| Lively | 1 | 2 | 3 | 4 | 5 |
| Confused | 1 | 2 | 3 | 4 | 5 |
| Sad | 1 | 2 | 3 | 4 | 5 |
| Active | 1 | 2 | 3 | 4 | 5 |
| On-edge | 1 | 2 | 3 | 4 | 5 |
| Grouchy | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| Ashamed | 1 | 2 | 3 | 4 | 5 |
| Energetic | 1 | 2 | 3 | 4 | 5 |
| Hopeless | 1 | 2 | 3 | 4 | 5 |
| Uneasy | 1 | 2 | 3 | 4 | 5 |
| Restless | 1 | 2 | 3 | 4 | 5 |
| Unable to concentrate | 1 | 2 | 3 | 4 | 5 |
| Fatigued | 1 | 2 | 3 | 4 | 5 |
| Competent | 1 | 2 | 3 | 4 | 5 |
| Annoyed | 1 | 2 | 3 | 4 | 5 |
| Discouraged | 1 | 2 | 3 | 4 | 5 |
| Resentful | 1 | 2 | 3 | 4 | 5 |
| Nervous | 1 | 2 | 3 | 4 | 5 |
| Miserable | 1 | 2 | 3 | 4 | 5 |
| Confident | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| Bitter | 1 | 2 | 3 | 4 | 5 |
| Exhausted | 1 | 2 | 3 | 4 | 5 |
| Anxious | 1 | 2 | 3 | 4 | 5 |
| Helpless | 1 | 2 | 3 | 4 | 5 |
| Weary | 1 | 2 | 3 | 4 | 5 |
| Satisfied | 1 | 2 | 3 | 4 | 5 |
| Bewildered | 1 | 2 | 3 | 4 | 5 |
| Furious | 1 | 2 | 3 | 4 | 5 |
| Full of pep | 1 | 2 | 3 | 4 | 5 |
| Worthless | 1 | 2 | 3 | 4 | 5 |
| Forgetful | 1 | 2 | 3 | 4 | 5 |
| Vigorous | 1 | 2 | 3 | 4 | 5 |
| Uncertain about things | 1 | 2 | 3 | 4 | 5 |
| Drained | 1 | 2 | 3 | 4 | 5 |

| | | | | | |
|---|---|---|---|---|---|
| Embarrassed | 1 | 2 | 3 | 4 | 5 |

List 4

**Temple Presence Inventory (TPI)**

How much did it seem as if the objects and people you saw/heard had come to the place you were?

Not at all 1 2 3 4 5 6 7 Very much

How much did it seem as if you could reach out and touch the objects or people you saw/heard?

Not at all 1 2 3 4 5 6 7 Very much

How often when an object seemed to be headed toward you did you want to move to get out of its way?

Never 1 2 3 4 5 6 7 Always

To what extent did you experience a sense of 'being there' inside the environment you saw/heard?

Not at all 1 2 3 4 5 6 7 Very much

To what extent did it seem that sounds came from specific, different locations?

Not at all 1 2 3 4 5 6 7 Very much

How often did you want to or try to touch something you saw/heard?

Never 1 2 3 4 5 6 7 Always

Did the experience seem more like looking at the events/people on a movie screen or more like looking at the events/people through a window?

Like a movie screen 1 2 3 4 5 6 7 Like a window

How often did you have the sensation that people you saw/heard could also see/hear you?

Never 1 2 3 4 5 6 7 Always

To what extent did you feel you could interact with the person or people you saw/heard?

None 1 2 3 4 5 6 7 Very much

How much did it seem as if you and the people you saw/heard both left the places where you were and went to a new place?

Not at all 1 2 3 4 5 6 7 Very much

How much did it seem as if you and the people you saw/heard were together in the same place?

Not at all 1 2 3 4 5 6 7 Very much

How often did it feel as if someone you saw/heard in the environment was talking directly to you?

Never 1 2 3 4 5 6 7 Always

To what extent did you feel mentally immersed in the experience?

Not at all 1 2 3 4 5 6 7 Very much

How involving was the media experience?

Not at all 1 2 3 4 5 6 7 Very much

How completely were your senses engaged?

Not at all 1 2 3 4 5 6 7 Very much

To what extent did you experience a sensation of reality?

Not at all 1 2 3 4 5 6 7 Very much

How relaxing or exciting was the experience?

Very relaxing 1 2 3 4 5 6 7 Very exciting

List 5

**Post-Meditation Relaxation Survey (Physical Assessment Scale)**

**My muscles feel loose**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**My whole body is at rest**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel content**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel very peaceful**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**My body feels loose**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel a kind of peacefulness**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**My muscles feel relaxed**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel really easy going right now**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel very calm**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel a sense of tranquility throughout my body**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel very relaxed**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel serene**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel really laid back**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel extremely comfortable**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel limber**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I have a clear mind**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**My muscles are at rest**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**Very few things would bother me now**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel no tension in my muscles at all**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

**I feel refreshed**

1 = Strongly Disagree / 2 = Disagree / 3 = Neutral / 4 = Agree / 5 = Strongly Agree

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