Exploring Immersive Micro-Vacations and Their Efficacy on Multiple Biometric Markers and Productivity as A Novel Therapy for Short- and Long-Term Stress and Anxiety Management/Reduction

(Technical Paper)

Evaluation of Healthcare Technology Diffusion Factors to Learn Potential Integration Methods for Virtual Reality Exposure Therapy (VRET) into Clinical Psychology

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignment

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## General Research Problem

*How can healthcare technologies be developed surrounding the needs of society?*

Healthcare is continuously evolving as a result of the abundance of research in the field, development of novel technologies, varying insurance models, constant regulatory changes and institutional rearrangements (Cain, 2002, p.4). Despite the plethora of biomedical innovation, diffusion and adoption of healthcare inventions is not inevitable. There are numerous factors that suggest why medical technologies may fail to infiltrate the American healthcare system. Among them is that novel technologies can be discovered that are neither centered around the goals of the user nor designed to address a pressing issue and thus have little prospective utility or application in medicine (Pearl, 2014, n.p.).

Substantiating the efficacy of medical innovation is not sufficient to guarantee public approval and societal integration because technologies have little value if they do not solve existing problems or improve people's health. While this is a vital primary step in the acceptance process, it is important to identify the factors and societal patterns that encourage, versus prevent, diffusion of medical innovation such that products can be successfully transferred from research laboratories to routine clinical practice.

## Immersive Micro-Vacations for Stress and Anxiety Management

*Is exposure to virtual reality natural environments an effective method to reduce stress and improve productivity in the workplace?*

Due to rising costs of medical and pharmaceutical treatments, employers are seeking innovative ways to manage healthcare expenses for employees and their dependents. Studies indicate that 42% of employees report feeling stressed at work and those employees are linked to 15-30% greater healthcare costs (Black, 2019, n.p.). Further, only 22% of employees feel they are able to cope with stress effectively thus impeding their productivity and overall workplace

satisfaction (Colligan & Higgins, 2006, n.p.). Therefore, a solution that would reduce workplace stress and increase productivity would appeal to both employees and employers.

Traditional treatments for stress and anxiety include medication, cognitive behavioral therapy, and self-care techniques such as meditation. However, these methods are notoriously expensive or time consuming, and are not quick remedies for everyday stressors at work like leading meetings and delivering presentations. Readily accessible digital technologies, such as virtual reality (VR), might be better suited for efficiently improving mental health in a workplace setting. Previous studies report substantial biometric data to support the success of VR environments in reducing anxiety (Gorini & Riva, 2008, n.p.). Attention Restoration Theory (ART), which asserts that individuals concentrate better after spending time in nature, is a validated approach enhancing productivity and mitigating stress and anxiety in the workplace. The technical project will explore the combination of ART and VR technology as a novel therapy for short- and long-term stress reduction and anxiety management.

The team will begin with a comprehensive literature review of prior studies to understand the current state of research and knowledge in the field. This will guide the team in determining the optimal tests and metrics to assess the efficacy of the VR interventions on participants' stress and productivity. Once this information is gathered, an Institutional Review Board (IRB) protocol will be drafted detailing the experimental design and procedure. The study will be conducted in the basement of Olsson Hall at the University of Virginia in January and February 2020. Prior to the experiment, study participants will complete a task such as a puzzle, math problem, or multi-tasking activity to induce minor stress or fatigue. Following task completion, biometric data will be collected through heart rate variability sensors, blood pressure gauges, and galvanic skin response sensors to record participants' initial stress levels. Results from this

preliminary test will serve as baseline data to ultimately measure the impact of the therapy. The participants will then be situated in an enclosed "booth" with a VR headset for 5-8 minutes. They will select a restorative environment from 2-3 given options (i.e. beach, lake, mountaintop) and undergo a guided micro-vacation through a VR program in their chosen natural setting. Patients will be monitored throughout the therapy for physiological responses and biometric indications of change attributed to the immersive experience. Following the micro-vacation, participants' biometric data will be collected again to compare stress levels pre- and post- therapy and a post-stimuli task will be given to measure and compare productivity to baseline data. The project goal is to examine VRET as a prospective mechanism to assuage the rising cost of healthcare through implementation of innovative technologies in the workplace that help individuals build emotional strength and better manage stress and anxiety.

## Possible Diffusion of VRET in Clinical Psychology

*How can we evaluate the diffusion of esteemed healthcare technologies to learn how VRET might be introduced as an alternative to cognitive behavioral therapy?*

### *Introduction*

A pertinent question is whether widespread clinical diffusion of VRET in psychologic practice is possible. To address this question, we can analyze the societal adoption patterns of healthcare inventions similar to VRET and assess the current opinions of psychologists, patients, and the general public on the technology. It will be valuable to investigate the diffusion of comparable healthcare technologies and evaluate the processes that lead to their ultimate societal integration or extinction to understand if a similar course is plausible for VRET. While we cannot predict the future of VRET in healthcare, a case comparison has the potential to reveal significant sociotechnical factors that may shape its adoption.

***Background***

VRET can be understood as an altered form of behavioral therapy in which VR is integrated with "real-time computer graphics, body tracking devices, visual displays, and other sensory input devices to immerse patients in a computer-generated virtual environment" (Krijn et al., 2004, p.259). VRET has demonstrated promise in treating a variety of psychological disorders such as anxiety, phobias, post-traumatic stress disorder (PTSD), depression, bipolar disorder and more (Krijn et al., 2004, p.259; Opriş et al., 2012, p.90). Modifying the need for routine therapy sessions and daily medications could greatly simplify disorder management for patients and providers. From the perspective of clinicians who provide cognitive behavioral therapy and psychiatrists who prescribe medication, VRET has the capacity to alter or reduce the need for their services as patients could schedule sessions at their convenience and discretion. However, there are still many obstacles to clinical adoption and implementation in clinical psychology.

A few issues that impede the common use of VRET in the field include the lack of standardization of VR hardware and software, the inability of providers to customize virtual environments for specific purposes or requirements, the dearth of standardized protocols for the research community, the astronomical costs associated with designing and testing VR technologies in clinical settings, and malfunctioning/nonintuitive user interfaces that require frequent maintenance (Riva, 2009, p.340). Additionally, psychological health providers and patients may be unaware of the technology's existence and effectiveness, unable to afford it, or unwilling to modify their trusted treatment methods to incorporate this modern therapy.

To inform if these problems might be overcome, a case study will be conducted on Invisalign, which serves as an excellent example of a healthcare technology that has successfully

assimilated into standard treatment. Invisalign aligners are clear plastic orthodontic devices that substitute metal braces to adjust teeth (Nedwed & Miethke, 2005, p.163). Once validated by scientific evidence and legitimized as an effective alternative to braces by experts in the community and pertinent regulatory bodies, Invisalign was enthusiastically embraced by the general population. The ease of use, affordable cost, and rapid results generated significant interest among orthodontic patients and individuals who may not otherwise have sought orthodontic care. In addition, orthodontists were eager to provide Invisalign as the product facilitated practice growth by garnering Invisalign candidates as new patients.

It is important to appreciate the similarities between Invisalign and VRET and thus the utility of such a parallel. Both technologies are modern, customizable, cost effective alternatives to conventional methods and are designed to conveniently provide treatment to patients in moderate to mild cases. Since the products target less extreme patient conditions, they also have the capacity to attract patients who may not be interested in traditional care. A comprehensive case study will enable detailed comparisons between Invisalign and VRET with respect to product introduction, attitudes of providers, patients and the general public, and significant societal adoption factors to gauge the possibility of VRET clinical diffusion.

***Evidence and Data Collection***

Preliminary research will consist of reviewing psychological care norms and characterizing classic treatment methods to understand their corresponding costs, feasibility of use, availability through providers, and patient satisfaction in order to compare to VRET. Much of this information can be extracted from documents published by the American Psychological Association (APA) such as Clinical Practice Guidelines for specific diagnoses. Clinical practice

guidelines provide recommendations for the treatment of particular disorders backed by credible scientific evidence (APA, 2019, n.p.).

The Invisalign case study will be conducted around the product's creation, formal approval as a medical treatment device, public introduction, the company's marketing strategy, and the subsequent responses of orthodontic providers and patients. Data collection methods will include investigation of the product's design, research on the company's advertising tactics targeting orthodontal providers, patients, and insurance companies, and a thorough literature review of documents discussing the integration of the technology. The remaining information, specifically the opinions of patients and providers, can be obtained through examination of published personal accounts in the form of product testimonials, patient stories, provider feedback, and more. The purpose of reviewing such sources will be to determine how various groups became aware of the product and their eligibility for use, the appeal of the product, and the feasibility of treatment (availability, price, etc.). Additionally, these documents will reveal the knowledge, experiences and perspectives of different stakeholders with respect to the therapy. If a lack of published opinions are found, direct interviews may be considered with orthodontists who provide the service and individuals who have used and benefited from it.

***Methods***

Acquired data on previously accepted psychological treatment methods will be organized and analyzed to contrast with VRET with a focus on potential application in clinical psychology. Survey data of sentiments of relevant stakeholders will be used to assess their apprehension towards the therapy. The purpose of understanding the establishment and societal adoption process of Invisalign is to inform the future of VRET technology. The ultimate goal is to model

the healthcare technology diffusion process to discern if a similar course for VRET in clinical psychology as a viable alternative to conventional treatment methods is conceivable.

### *Conclusion*

To translate VRET from research and theory to psychological clinical practice, it is vital to learn from the success of products such as Invisalign to understand the adoption patterns of healthcare providers and the general population that lead to the diffusion of medical innovations and ultimately the integration into routine care.

## Conclusion

Although numerous studies have demonstrated the efficacy of VRET in treating a breadth of psychological diagnoses, the therapy has not become regularly prescribed due to technical limitations and hesitation of providers and patients to embrace it. A study in which participants experience VRET micro-vacations will measure the effectiveness of the treatment in mitigating stress to consider potential workplace implementation. Further, analysis of Invisalign as an example of a technology that has successfully assimilated into a healthcare field with rigorously established treatment methods will help identify crucial factors, adoption processes, and societal patterns to determine if VRET may enter clinical psychology as an alternative to cognitive behavioral therapy.

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