

YOUR MIND MATTERS

Patrick Hanna

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Abstract

This practice-based project prototypes a virtual reality platform-based mindfulness experience. This experience is framed within therapeutic immersive environment design. Created in response to an ever stressful and demanding contemporary life providing a mindfulness meditation located within a serene New Zealand environment. *Your Mind Matters* is the intersection of technologically driven immersive experiences and mindfulness. The practice speculates, through iterative experimentation, on the potential of these devices when they are combined with contemplative meditative practices.

This paper aims to provide an insight into the complex design process covering various stages of the production pipeline covering the methodological, contextual and technical aspects of the project. Examining research on mindfulness and VR as therapeutic tools and the quality of immersion. Covering methodology regarding user experience such as User Experience Design and Human Computer Interaction Design discussing how these informed the practice. Providing an overview of the iterative journey and the thinking behind the making of this research project.

Declaration

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning

A handwritten signature in black ink, appearing to read 'A. H.', is positioned above the date.

18/05/2018

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Contents

Copyright Notice	ii
Abstract	iii
Declaration	iv
Acknowledgements	v
Figures List	vii
Introduction	1
Chapter One: Contextual Review	4
Mindfulness	5
Immersion	11
VR	18
Chapter Two: Methodology	25
Technical Design of Project & Iterative Testing	29
Chapter Three: Final Design Platform	35
Conclusion	42
Bibliography	46
Appendices	
Appendix One: Other Research Artefacts	53

Figures List

Introduction

- Figure 1: VR game played using the HTC Vive. From <http://www.indiedb.com>. Retrieved from <http://www.indiedb.com/news/htcs-first-vive-vr-game-front-defense-is-a-world-war-ii-shooter>. Copyright 2016 by DBolical Pty Ltd. 4

Chapter One:Contextual Review

- Figure 2: Floatation tank. From Medium. Retrieved from <https://medium.com/@olivercheng/float-tanks-are-the-best-meditation-tool-6e993ddd68aa>. Copyright 2017 by A Medium Corporation. 15
- Figure 3. Anechoic Chamber, University of Salford. [Photograph]. From Acoustic Engineering. Retrieved from <https://acousticengineering.wordpress.com/2013/07/22/does-an-anechoic-chamber-cause-hallucinations/>.Copyright 2013 by Trevor Cox 16
- Figure 4. Room projection.[Photograph]. From Broomx Technologies. Retrieved from <http://www.broomx.com/mk-player360.php>. Copyright 2017 by Broomx Technologies. 17
- Figure 5. Augmented Reality and Mixed Reality difference illustration.[Photograph]. From UXPlanet. Retrieved from <https://uxplanet.org/the-differences-between-vr-ar-mr-27012ea1c5>. Copyright 2017 by Avi Barel. 18
- Figure 6.How the HTC Vive works. [Diagram]. From How To Geek. Retrieved from <https://www.howtogeek.com/246333/oculus-rift-vs.-htc-vive-which-vr-headset-is-right-for-you/>Copyright 2017 by How-To Geek LLC. 19

Chapter Two:Methodology

- Figure 7. Patrick Hanna.[Video] Samsung 360° Cityscape at Night. Auckland, New Zealand. (2017). 30
- Figure 8. Patrick Hanna.[Video] Kodak Pix Pro 360° Cityscape at Night. Auckland, New Zealand. (2017) 31
- Figure 9. Patrick Hanna.[Video] 360° Sunrise with Guided Audio & Music. Whitford, New Zealand. (2017). 31
- Figure 10. Patrick Hanna.[Video] 360° Noon. Te Pahi Sand Dunes, New Zealand. (2017). 31
- Figure 11. Patrick Hanna.[Video] 360° Sunset Bucklands Beach, Auckland,New Zealand. (2017). 31
- Figure 12. Patrick Hanna.[Photograph] Four DSLR rig. New Zealand. (2017). 32
- Figure 13. Patrick Hanna.[Photograph] One Camera’s perspective in Rig. New Zealand. (2017). 32
- Figure 14. Patrick Hanna.[Image] Terragen Equirectangular Night Sky. (2017). 33
- Figure 15. Patrick Hanna.[Image] Terragen Equirectangular Sunset. (2017). 33
-
-

Chapter Three: Final Design Platform

- Figure 16. Patrick Hanna.[Video] Ground Layer And Foliage Process in UE4 (2018). 36
- Figure 17. Patrick Hanna.[Image] Megascans Ground Texture Dead Leaves On The Forest Floor(2018).
- Figure 18. Patrick Hanna.[Image] Landscape Material (2018). 37
- Figure 19. Patrick Hanna.[Video] Player Selection of Location With Dynamic Lighting (2018). 38
- Figure 20. Patrick Hanna.[Video] Sunny Forest Environment (2018). 38
- Figure 21. Patrick Hanna.[Video] Beach Sunrise Test (2018). 38
- Figure 22. Patrick Hanna.[Image] NZ Dicksonia Squarrosa Fern 3D Model Made By Cliff Chen (2018). 40
- Figure 23. Patrick Hanna.[Video] Final Your Mind Matters (2018). 41

Appendix One: Other Research Artefacts

- Figure 24. Patrick Hanna.[Photograph] Time Lapse Star Trail. Auckland, New Zealand. (2017) 53
- Figure 25. Patrick Hanna.[Video] Star Trail. With Binaural Beats. Auckland, New Zealand. (2017) 54
- Figure 26. Patrick Hanna.[Video] Star Trail. With Sheaprd Tone. Auckland, New Zealand. (2017) 54
- Figure 27. Patrick Hanna.[Video] Unity Sound Proximity (2017) 55
- Figure 28. Patrick Hanna.[Video] White Noise Audio & Visual(2017) 55
- Figure 29. Patrick Hanna.[Short Film] Layers Of The World; Serenity (2017) 56
- Figure 30. Patrick Hanna.[Video] Reflections On The Water At Night (2017) 56

Introduction

“You can’t stop the waves, but you can learn to surf.”¹

Your Mind Matters is the intersection of immersive experiences and mindfulness, created in response to an ever stressful and demanding contemporary life. The busy lives we lead often results in insufficient time to look within and take time for our inner world. This wellbeing of finding ourselves and how we move through this life is left as a task we overlook too often. The connection humans have to the cosmos, nature, and its inhabitants are integral to our own wellbeing. This research is concerned with our collective quest for meaning in modern life and our reconnection with nature as an integral part of human wellbeing.

With this contemporary burden, unhealthy habits can manifest both physically and mentally. While the world has made significant strides in the right direction, the great progress made has resulted in trouble spots having a light shone on them. For example, unbalanced mental health is a problem that has always beleaguered society, however contemporary inventions such as social media, can often exacerbate this. These problems have occurred in combination with the progress we have made.

Increasing the availability and understanding of coping mechanisms could be a useful way to achieve a healthier society. A toolkit for modern life could potentially help build a foundation with wellbeing at the forefront. Within this toolkit is mindfulness - a practice that concerns the mind’s wellbeing and leads the practitioner to examine the way in which they respond to an ever-active mind and the stresses of life. The practice is used to relax and unwind, but its impact goes beyond the duration of the meditation, influencing the way in which the body and mind react to situations throughout the waking day. When practiced regularly, mindfulness can improve emotional regularity and provide relief from stress. Jon Kabat-Zinn, the godfather of modern Western mindfulness meditation, states that the ultimate power of mindfulness and meditation generally is the impact it has on a person’s daily life, fostering the practitioner to fully experience their life.

¹ Jon Kabat-Zinn, *Wherever You Go, There You Are: Mindfulness Meditation in Everyday Life* (Hachette Books, 2009).

“The real mindfulness practice is how you live your life moment to moment.”²

The goal of my research is not to study mindfulness, but to examine how technology, specifically virtual reality (VR) might interface when paired with the contemplative practice of mindfulness, and how the practice of mindfulness; an immersive experience, might interface with a technologically-driven immersive experience; VR. The goal is not to shun technology but to explore the symbiotic relationship of the two immersive experiences. The research aims to bring the natural environment to the living room, but is not meant to replace the real experience of enjoying the beauty of the natural world, an intrinsically human experience. The prototype is not intended as a substitute for going outdoors, nor is the meditation meant to replace the usual method of mindfulness without technology. The research prototypes what this virtual experience might entail and provides a learned environment for the concepts of mindfulness. This VR mindfulness meditation experience explores the relationship between the virtual world and the inner workings of the mind. This historically meditative tool has been transformed to a post-cinematic tool of the body, rather than solely of the mind.

This thesis presents a range of contextualising theoretical and critical investigations that have influenced the direction of the research and the outcomes of practice. By limiting the scope of these diverse topics to several key areas of interest, I discuss the areas of interest of most relevance to the research.

Chapter One establishes the important role various topics have supplied the foundations which contributed to and linked my thoughts and creations throughout this exercise. I began with unpacking what mindfulness is and investigated the research pertaining to therapeutic applications of this contemplative practice. Continuing this therapeutic thread, the latter half of the chapter concentrates on the qualities of an immersive experience- both analogue and technology driven. These lead into the potential therapeutic benefits of these immersive experiences in connection to emerging technology, specifically VR, and culminate in a review of the research surrounding VR’s therapeutic applications, and the combination of the virtual platform with mindfulness.

² Jon Kabat-Zinn and Thich Nhat Hanh, *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain, and Illness* (Delta, 2009).

I inquire into critically evaluating these works in relation to my research, while providing a clear description and summary of each topic. Investigating this collective pool of knowledge has helped inform and create a foundation for my research, in turn locating where this research is situated.

Chapter Two dives into the deep end, with discussion regarding the methodology and approaches utilised to investigate my research question. I examine the design decisions, and how they informed the practice and the relevance of these conclusions to my research. I highlight the methodological frameworks which informed the practice, specifically Human Computer-Interaction and User Experience Design. This chapter defines abstract concepts raised through this research.

Additionally it examines the technical design of the project and probes how the project was assembled throughout the design process. Significant milestones resulting from the iterative cyclical nature of the design process and my methodology are discussed. These provide context to relevant technical details, informing the reader of how each iteration led into the next. Working within an exploratory environment results in several iterations which all carry knowledge onto the next iteration. This reflective journey highlights the thinking behind the making providing context to design decisions made.

Chapter Three discusses the final design platform choice of the game engine 'Unreal Engine 4', used to create the VR experience and the working processes behind these iterations. This final design platform is an important discourse and is the focus of this chapter as it is the main body of work which has been created as the artefact of this research expedition.

Concluding the thesis, I provide a brief discussion of the overall project and the findings and dialogue surrounding future development potential of the research.

To aid the content discussed, this thesis is paired with relevant audio and visual files throughout.

Chapter One: Contextual Review of Knowledge

Key Words

- Mindfulness: a meditative practice used for relaxation and contemplation. A goal of mindfulness is to become aware of all thoughts, emotions, and physical sensations as they are without judgement
- Virtual Reality (VR): Computer generated content which gives users the ability to look and move around in the virtual environment. Often seen as the most immersive form of virtual realities because it has no real world visual component

This contextual review chapter explores the contemplative practice of mindfulness³ and presents ways in which it might interface with emergent immersive technologies, specifically VR experiences. It is a review of mindfulness; its history and applied therapeutic uses today and investigates vital qualities of the immersive experience. Finally, it surveys VR's role in therapeutic and discusses and presents a range of significant projects.⁴ This review of practice and knowledge informed the thinking behind the practice regarding exploring the potential combination of VR and mindfulness into a technology-based immersive experience.

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Figure 1: VR Game Played Using the HTC Vive. From <http://www.indiedb.com>. Retrieved from <http://www.indiedb.com/news/htcs-first-vive-vr-game-front-defense-is-a-world-war-ii-shooter>. Copyright 2016 by DBolical Pty Ltd.

3 A technique for relaxing and centring your thoughts.

4 VR meditation projects specifically.

Mindfulness: Historical and Contemporary Practices

Mindfulness is an approach of orienting one's awareness to the self, which encompasses a broad set of tools and definitions, ranging from traditional Buddhist teachings to contemporary articulations of Mindfulness-based cognitive therapy. The latter was introduced to the Western World, circa 1970's, most notably from John Kabat Zin. Zin was a pioneer for western implementations of mindfulness for use in stress reduction⁵ and management of chronic pain.⁶ There has been a recent expansion of these concepts and applications, especially in multiple domains within health care and general wellness. Recent studies connect the practice of mindfulness to both applied and theoretical therapeutic uses. In general, these studies have demonstrated positive measurable outcomes for participants.

As a designer and a practitioner of mindfulness, I've contemplated how these thinking-making-being actions might be engaged with, in an alternate delivery system, through the intersection of traditional modes of mindfulness lensed through a VR experience. To that end, the project aims have explored how VR can augment a mindfulness experience of emotional regulation and shift patterns of thinking or behaviour to combat difficulties facing the person's mental wellbeing. The research outlined here, asks how the immersive qualities of VR might potentially bring another layer of haptic connection within discursive acts of contemplative practice. The practice investigates and tests meaningful ways they might interface with each other, investigating what role technology can play in facilitating a learning environment for these concepts. Through the course of this research, I have considered whether technology might hinder the practice and add unforeseen barriers for meditative states, which are commonly used without any external non-human interventions.

A wide range of approaches and broader meanings surrounding mindfulness is due to the increase in research and interest pertaining to the exercise. The root word 'mindful' is defined in the Oxford English Dictionary as "conscious or aware of

5 Jon Kabat-Zinn and Ann Chapman-Waldrop, "Compliance with an Outpatient Stress Reduction Program: Rates and Predictors of Program Completion," *Journal of behavioral medicine* 11, no. 4 (1988); *ibid.*; *ibid.*

6 Jon Kabat-Zinn, Leslie Lipworth, and Robert Burney, "The Clinical Use of Mindfulness Meditation for the Self-Regulation of Chronic Pain," *Journal of behavioral medicine* 8, no. 2 (1985).

something” or “focusing one’s awareness on the present moment”⁷ these are both interwoven when talking about the act of being mindful. One method of attaining a ‘mindful’ state of being is reached through mindfulness meditation.⁸ So, it can be said that MM refers to the exercise of focussing on the present moment by always directing attention back to the present moment when the mind wanders. The exercise highlights the sensations of the passing moment, inducing blissful relaxation for the duration and afterwards. Repetition of this technique helps reinforce the model of thinking leading to a lasting beneficial impact as ‘*cognitive and psychological benefits that persist throughout the day*’.⁹ Helping change one’s psychological wellbeing through meditation has been proven with changes in brainstem grey matter.¹⁰ This grey matter is a major component of the central nervous system involved in muscle control, sensory perception, emotion, memory, self-control. Regular mindfulness practice has been shown to increase grey matter involvement and volume as well as the activity in the amygdala.¹¹ These findings have shown the structural changes the brain undergoes when consistent meditation is practiced.

Exercises of meditation have been passed by word of mouth through time, which has meant the practice required ease of communication and teaching. Recent practices of mindfulness utilise audio aids along with a guided experience through audio or physical participation.¹² The preferred mindfulness method comes down to the individual.

A guided experience is usually best for those beginning their journey. This is because

7 Stevenson, Angus. ‘Oxford Dictionary of English (3 ed.) ‘Mindful’ definition. Oxford University Press. England. 2015.

8 Mindfulness, a form of meditation, as defined by the Oxford English Dictionary relates to “the state or quality of being mindful” or alternatively “A mental state achieved by focusing one’s awareness on the present moment, while calmly acknowledging and accepting one’s feelings, thoughts, and bodily sensations, used as a therapeutic technique.”

9 Britta K Hölzel et al., “Mindfulness Practice Leads to Increases in Regional Brain Gray Matter Density,” *Psychiatry Research: Neuroimaging* 191, no. 1 (2011).

10 Sara Lazar, “Change in Brainstem Gray Matter Concentration Following a Mindfulness-Based Intervention Is Correlated with Improvement in Psychological Well-Being,” *Frontiers in Human Neuroscience* 8 (2014).

11 A part of the brain related to memory, decision-making, and emotional responses. Rinske A Gotink et al., “8-Week Mindfulness Based Stress Reduction Induces Brain Changes Similar to Traditional Long-Term Meditation Practice—a Systematic Review,” *Brain and cognition* 108 (2016).

12 Guided audio mindfulness files are readily available online. Physical participation relates to VR mindfulness experiences. Some users find mindfulness is most effective without external influences or aids. Usually these are experienced practitioners of mindfulness, who have mastered the technique in a traditional way.

the guide provides timely reminders of the basics of mindfulness and the concepts within the practice.¹³

The benefits of the mindfulness exercise help the user pay attention and live a healthier life. The 2014 paper ‘*Mindfulness in Education at the Intersection of Science, Religion, and Healing*’ written by Oren Ergas points to mindfulness as a commonality between the different sectors of the metaphysical, science and education, showing a unique standing in society with merits backed by scientific findings. One definition Ergas suggests is that “very roughly, it could be thought of as a practice that teaches us to ‘pay attention’ by simply ‘paying attention’ to our bodies, breath, actions, speech, and every aspect of our lives.”¹⁴ The combination demonstrates both historical efficacy and its relevance to society today; demonstrating that meditation and mindfulness can be understood of as components of a toolkit that is associated with wellbeing.¹⁵

By understanding how your body and mind work during the present moment, you can choose to whether to respond to all the different threads of thinking you experience when removing physical distractions and focussing inwards.¹⁶ This act fosters your conscious ability to regulate your emotions, behaviours and reactions to events in a more mindful manner in everyday life. The lasting impact of challenging your modes of being and making changes accordingly is called ‘recalibration’.¹⁷ It is this effect which I find most interesting about these therapeutic techniques and the potential for long-term benefits that they can have on individual’s lives.

Mindfulness belongs to the broader framework which many refer to as ‘contemplative practice.’¹⁸ These practices are advantageous for wellbeing and are recognised as an effective treatment in various medical applications. A research paper from 2015

13 Of interest to me is this guiding teacher component. Providing the user with an overview of mindfulness and the benefits followed by the practical exercise.

14 Oren Ergas, “Mindfulness in Education at the Intersection of Science, Religion, and Healing,” *Critical Studies in Education* 55, no. 1 (2014).

15 Małgorzata Powietrzyńska and Kenneth Tobin, *Weaving Complementary Knowledge Systems and Mindfulness to Educate a Literate Citizenry for Sustainable and Healthy Lives* (Springer, 2017).

16 Similarly, as a balanced diet and exercise are important to a better-quality life, the same line of thinking can be said for mental exercise such as mindfulness to foster a healthier mentality and psychological lifestyle.

17 Beneficial change attained through the practice that has a lasting impact.

18 Contemplative Practices *are designed to quiet and shift the habitual chatter of the mind to cultivate a capacity for deepened awareness, concentration, and insight...they share a distinct nonlinear consciousness that invites an inner opening of awareness*” – Oren, 3.

conducted a meta-analysis study reviewing the large number of studies involving mindfulness-based therapy (MBT) and the effectiveness in treating an assortment of psychological problems.¹⁹ The paper concludes that “MBT is an effective treatment for a variety of psychological problems, and is especially effective for reducing anxiety, depression, and stress.”²⁰ This reinforces the scientific consensus that this treatment has proven effective for patients and that excitement around the treatment warranted, however it has with it the caveat that further research is needed. A link is drawn between MBT and Cognitive Behavioural Therapy with MBT not differing significantly from common traditional treatments.²¹

Studies have also supported an identified need for alternate rehabilitation methods for depression, anxiety or stress in modern life. Although effective treatments are accessible, approximately one third of patients with depression fail to respond to conventional antidepressant treatments.²² The large number of patients and poor response rate has led to an increase in research focused on finding appropriate treatments for depression and other psychological illnesses and stressors. Addressing these conditions through therapy one patient at a time is an extensive task for health care professionals; however it can be the best form of treatment for enduring results.²³ It is here where a toolkit could be implemented to distribute vital information for the wider public encouraging a healthier mind-set. Group education sessions are also an option to increase delivery efficiency.

Studies have argued extensively for and against the notion that the incidence of mental health problems in the population have increased over the years.²⁴

19 A comprehensive effect-size analysis to evaluate the efficacy of 209 Mindfulness-based therapies (MBT) studies was carried out which accounted for 12,145 participants with a variety of disorders. Bassam Khoury et al., “Mindfulness-Based Stress Reduction for Healthy Individuals: A Meta-Analysis,” *Journal of psychosomatic research* 78, no. 6 (2015).

20 Ibid.

21 CBT is a short-term, goal-oriented psychotherapy treatment that takes a hands-on, practical approach to problem-solving aiming to change patterns of thinking or behaviour to combat difficulties facing the person’s mental wellbeing.

22 Khalid Saad Al-Harbi, “Treatment-Resistant Depression: Therapeutic Trends, Challenges, and Future Directions,” *Patient preference and adherence* 6 (2012).

23 Robert J DeRubeis, Greg J Siegle, and Steven D Hollon, “Cognitive Therapy Versus Medication for Depression: Treatment Outcomes and Neural Mechanisms,” *Nature Reviews Neuroscience* 9, no. 10 (2008).

24 Amanda J Baxter et al., “Challenging the Myth of an “Epidemic” of Common Mental Disorders: Trends in the Global Prevalence of Anxiety and Depression between 1990 and 2010,” *Depression and anxiety* 31, no. 6 (2014).

The 2017 Psychological Medicine research paper indicates the prevalence of depression in the USA has increased significantly from 2005 to 2015, before and after controlling for demographics.²⁵ However, other research does not agree that common mental disorders have become more prevalent over the past two decades.

A 2014 paper set out to analyse the trends in the global prevalence of anxiety and depression between 1990 and 2010. The researchers found “no evidence for an increased prevalence” of either.²⁶ From their analysis they determined that the perceived ‘epidemic’ of common mental disorders could be explained by the increasing numbers of affected patients driven by increasing population sizes along with factors such as symptom checklists, greater public awareness, reduced stigma, and the use of terms such as ‘anxiety’ and ‘depression’ in a context where they do not represent classically-diagnosed clinical disorders. The study did find however, that 8 of the 11 GHQ²⁷ studies found a significant increase in psychological distress over time. This distress is often a general term used to describe unpleasant feelings or emotions that impact a person’s level of functioning making it difficult to cope with ordinary life events. This emotional anguish can be seen in researcher Jean M. Twenge’s 2015 paper which highlights differences of mental health over the decades and changes occurring during this time.²⁸

Throughout the decades, mental health disorders have become widely accepted, resulting in reduced stigma and improving the various treatments available. Some risk factors for mental disorders have been mitigated to some degree²⁹ such as improved living standards leading to, for instance, higher rates of education³⁰ and lower levels of illness due to communicable disease and malnutrition.³¹ These factors show that

25 AH Weinberger et al., “Trends in Depression Prevalence in the USA from 2005 to 2015: Widening Disparities in Vulnerable Groups,” *Psychological medicine* (2017).

26 Baxter et al.

27 General Health Questionnaire

28 Stating that ‘U.S. college students in the 2010s (vs. the 1980s) were more likely to feel overwhelmed and to say they believed their emotional health and physical health was below average...twice as many high school students now seek treatment for mental and emotional issues.’ Jean M Twenge, “Time Period and Birth Cohort Differences in Depressive Symptoms in the Us, 1982–2013,” *Social Indicators Research 121*, no. 2 (2015).

29 Baxter et al.

30 Bank W. World Development Indicators 2013. Washington, DC: World Bank; 2013.

31 Christopher JL Murray et al., “Disability-Adjusted Life Years (Dalys) for 291 Diseases and Injuries in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010,” *The lancet* 380, no. 9859 (2012).

progress and innovation has helped immensely with some causes of mental health distress, showing that tackling wider societal problems can effective way to further reduce these statistics. However, while quality of life has improved for much of the world, mental health problems are present in every society.³²

A toolkit which offers advice for improving lifestyles and ultimately restoring wellness through self-help is pertinent to helping society to progress towards health improvement. This ‘toolkit’ approach is suggested via Kenneth Tobin whose work emphasises emotional regularity, mindfulness, and wellness. In his 2017 book, *Weaving Complementary Knowledge Systems and Mindfulness to Educate a Literate Citizenry for Sustainable and Healthy Lives*, reasons that there is “a strong rationale for educating the public to control emotions, if and as necessary, concerns relationships between health and emotion.”³³ Mindfulness is an “activity that has potential applicability to the quality of social life.”³⁴ Kenneth Tobin raises a valid idea that society at large can benefit from mindfulness, thus increasing the quality of life for many. Tobin believes that teaching concepts like mindfulness to the public is a step in reducing unnecessary suffering.

The association between mindfulness and reduced stress, and an amplified ability to regulate emotions is an area studied by several researchers.³⁵ Research from the University of Iowa found association amongst facets of “mindfulness, present focused attention and non-judgmental acceptance, and the prediction of helping behaviour.”³⁶ The 2014 systematic evaluation and meta-analysis of mediation studies “identified strong, consistent evidence for cognitive and emotional reactivity, and research surrounding mindfulness meditation during stressful situations in immersive virtual reality with results showing overall an increase in mindfulness, decrease in anxiety, decreased heart rate and corrugator muscle activity, reduced arousal and emotional

32 ‘World Health Organisation | Depression.’ WHO. 2017. Accessed February 10, 2018. <http://www.who.int.ezproxy.aut.ac.nz/mediacentre/factsheets/fs369/en/>.

33 Powietrzyńska and Tobin.

34 Ibid.

35 Cristiano Crescentini et al., “Psychological and Physiological Responses to Stressful Situations in Immersive Virtual Reality: Differences between Users Who Practice Mindfulness Meditation and Controls,” *Computers in Human Behavior* 59 (2016).

36 C Daryl Cameron and Barbara L Fredrickson, “Mindfulness Facets Predict Helping Behavior and Distinct Helping-Related Emotions,” *Mindfulness* 6, no. 5 (2015).

deactivation while participants faced stressful experiences in virtual reality.”³⁷ These results illustrate that mindfulness plays a role in addressing significant characteristics of mental health; emotional regulation and stress.

A study examining the role of emotional regulation and cognitive control as possible mediators of the association among mindfulness and perceived displays of stress was conducted.³⁸ The results showed those who exhibited enhanced emotional regulation abilities have “a potential underlying mechanism contributing to the stress-reducing capacity of dispositional mindfulness.” These regulation capabilities account for the greater levels of emotional well-being. The authors conclude that “emotion regulation plays a central role in the relationship between mindfulness and stress.”³⁹

Previous research lends support to this concept of emotional regulation acting as an underlying mechanism of mindfulness.”⁴⁰ This research helps bring new insight into the processes occurring during the mindfulness activity and its effects on related areas of human cognition such as emotion regulation and stress, showing that these aspects are intertwined, adding gravitas to the appeal of mindfulness.

With this research in mind this review will now turn towards a discussion on the immersive experiences and the qualities of immersion.

Immersion

The themes of applied therapeutic uses of mindfulness leads into this section of the chapter, which defines, for the purposes of this project, what an immersive experience (IE) is, and surveys a range of relevant examples to support this discussion.⁴¹

Of particular interest to the practice are those IEs which may have therapeutic or rehabilitative qualities. To that end, I will unpack some of these qualities and draw some

37 Jenny Gu et al., “How Do Mindfulness-Based Cognitive Therapy and Mindfulness-Based Stress Reduction Improve Mental Health and Wellbeing? A Systematic Review and Meta-Analysis of Mediation Studies”: Corrigendum,” (2016).

38 Ruchika Shaurya Prakash, Mariam A Hussain, and Brittney Schirda, “The Role of Emotion Regulation and Cognitive Control in the Association between Mindfulness Disposition and Stress,” *Psychology and aging* 30, no. 1 (2015).

39 A sample size of one hundred participants was given. Fifty older adults and fifty young adults were recruited for the study and completed self-report measures assessing mindfulness disposition, perceived stress, and emotional regulation.

40 Prakash, Hussain, and Schirda.

41 Specifically, a VR experience

comparisons to some of the making choices that are discussed in more detail in the methodology and documentation of practice chapter(s).

IEs actively engage a participant's senses, creating a strong mental connection to the medium.⁴² The degree in which participants are involved with the experience determines how engaged they may feel during the duration, linking the state of immersion with the user's degree of mental concentration or participation in the activity.

During the survey of IE/VR in practice I discovered a range of examples which clearly connect with their users for different reason and in different ways. While the experiences might not all be directly therapeutic in design, the qualities expressed through the encounter demonstrate the soothing features they offer.

While a person can be immersed in a variety of things such as a good book or movie, there is a deeper level underpinning these experiences and the impact they have on the human condition. It is this quality which is of most interest to the practice outlined in this exegesis. Meaningful IEs span across analogue encounters such as yoga, mindful breathing and floatation tanks, to technology-driven interactions such as VR, auditory stimulation and 360-degree wall to wall video projection in a small enclosed space. *Your Mind Matters* is located within this technological realm. This technology- driven IE is a product within the VR domain influenced by analogue IEs. It is a virtual relaxation environment intended for a guided MM exercise in VR, encouraging a positive mind-set and wellbeing.

Before considering the IEs and the qualities surrounding it, I will first define what this project understands as 'immersion'. The experiences listed tap into a mental involvement beyond observation, opening participants up to embracing their present moment. An important characteristic of immersion is this mental involvement, signalling a conscious effort to engage with the experience. The participant gives themselves to the experience without reservation and by being fully aware of the present moment; they are fully engaged and involved within the experience.

⁴² Oxford English Dictionary defines immersion as a 'deep mental involvement in something'. Immersion (2013). In OxfordDictionaries.com. Retrieved from <http://www.oxforddictionaries.com/definition/english/immersion>

This involvement in some cases is balanced with the physical involvement for activities such as yoga, but often less focussed on the physical reality such as the floatation tank. The quality of being immersed has a direct connection to mental activity.

Experiences using this mental connection submerge the user into an experience which helps form a bond between the user and the experience. The connection is amplified as the user settles into the immersion.⁴³ As each person is different, the effect of immersion in whichever medium is always at the whim of the user's physiological and mental state. For example, a person might react to the floatation experience with anxiety which can lead to claustrophobia. This reaction is one of many a person might have, this knowledge lending to the inference that the experiences on their own can be immersive.

The immersive quality behind technologically-dependent experiences like VR has created the need to further expand on the definition of immersion. Researcher Mel Slater helps bridge this into two parts of 'immersion' and 'presence'. Immersion refers to the objective level of sensory fidelity a VR system provides, and presence⁴⁴ refers to a user's subjective psychological response to a VR system⁴⁵. The two concepts are intrinsically linked and, when compounded, allow for VR to create a sensory experience which transcends traditional media.

Mel Slater states that immersion "requires that there is match between the participant's proprioceptive feedback about body movements, and the information generated on the displays" making it so that the users' real-world movements correlate correctly in the virtual world.⁴⁶ Going on to state that "participants who are highly present should experience the VR as more the engaging reality than the surrounding world, and

43 This settling occurs as the mind, body and external experience communicate, shifting the conscious waking reality into an often-blissful state.

44 Researches have theorised three dimensions to presence/immersion.

(1) Sense of Physical Space: a participant's sense of being located in a contiguous spatial environment, determined primarily by aspects of media form;

(2) Ecological Validity (naturalness): the believability and realism of the content – that it is real to the participant; determined by media and content; and

(3) Engagement: a participant's sense of engagement and interest in the content of the mediated environment; determined primarily by content.

J Freeman et al., *Relaxation Island: Virtual, and Really Relaxing, Proceedings of 7th international workshop on presence* (2004).

45 Jason Jerald, *The Vr Book: Human-Centered Design for Virtual Reality* (Morgan & Claypool, 2015).

46 Mel Slater et al., *Immersion, Presence, and Performance in Virtual Environments: An Experiment with Tri-Dimensional Chess*, vol. 163, *ACM virtual reality software and technology (VRST)* (ACM Press New York, NY, 1996).

consider the environment specified by the displays as places visited rather than as images seen.”⁴⁷ When both are executed to a high degree they offer the feelings of ‘being there’, or the ‘realism’ of the virtual environment. This permits the opportunity of greater depth in the experience and allows the user to be more in tune and alert to what they encounter. The two notions are intrinsically linked, and when compounded, allow for VR to create a highly involved sensory experience.

Similarly, author and artist Oliver Grau points to immersion regarding VR to place an emphasis on the connection and inseparable union of the participant, the technology driving it and the experience that arises. Stating that “immersion arises when artwork and technologically advanced apparatus, message and medium, are perceived to merge inseparably. In this moment of calculated “totalization”, the artwork is extinguished as an autonomously perceived aesthetic object.”⁴⁸ Grau goes on to say that product of these melded together creates a functioning conscious display for a period which can bring about the unconscious illusion resulting in immersion.

To this end, I define immersion as the experience one has when normal world sensory inputs of vision and audio are replaced with a virtual version causing isolation in the VR experience, being less aware of the physical world around them. The isolation and convincing replacement of stimuli is a key component of immersion in a virtual experience. Furthermore, the user’s perception shifts from being consciously aware of the VR experience to being temporarily fully enveloped in a new reality.

I now highlight the role immersion plays in the IE. This survey of IEs will cover examples which have in common the above qualities and are linked into the intent of the research aims of this project. This section presents an overview of analogue experiences such as an anechoic chamber (the quietest environment on earth), and floatation tanks (sensory deprivation/isolation tank).⁴⁹ It then compares these with ‘immersive’ experiences driven by technology, such as VR.

Analogue experiences, such as the floatation tank,⁵⁰ immerse in a large tank of salt water

47 Ibid.

48 Oliver Grau, *Virtual Art: From Illusion to Immersion* (MIT press, 2003).

49 These experiences involve shutting off external stimuli.

50 While the floatation tank is aided by technology the experience itself is not a digital one.

in darkness or with minimal lighting. The participant then floats in the water for a period (30 – 90 minutes) during which the body can stay still and the mind can relax.⁵¹ It is like a meditative experience aided through external means. The lack of external stimuli for the user leads to bodily sensations slowly fading from current focus, creating the sensation of weightlessness or having no body entirely. These tanks offer an interesting and unique experience like a meditative state. The experience alters the user's subjective reality by misleading the conscious and subconscious mind into thinking the body is floating or dissolved. This leads to a range of experiences, often best described as 'blissful'. The deep mental involvement of this experience ushers the user into a stillness, over which the bodily sensations might be heightened to begin (thumping heart), but soon these functions cease to be of importance and, as a result, the mind changes user's subjective reality.

Image removed due to copyright restrictions

Figure 2. Floatation tank. From Medium. Retrieved from <https://medium.com/@olivercheng/float-tanks-are-the-best-meditation-tool-6e993ddd68aa>. Copyright 2017 by A Medium Corporation.

An anechoic chamber is a room designed to completely absorb sound waves to stop sound waves reflecting, resulting an uncomfortably silent room. Anechoic (meaning free from echo) creates a disturbing quality for the user when inside the room. Being the quietest places on earth often causes the sounds of ones' physiology to be amplified, like

⁵¹ It is to be noted that meditation is a form of an analogue IE. Meditation involves the deep mental activity which helps bring about the tranquil feelings. The participant is immersed in their mind looking inward and immersed in a state of contentment and clarity which often transcends the duration of the experience.

the floatation tank encounter. However, this experience involves mental activity in a different manner than a tank by focusing on the outward rather than the inward. The user is completely immersed in this silent environment for as long as the user's sanity can cope

Image removed due to copyright restrictions

Figure 3. Anechoic Chamber, University of Salford. [Photograph]. From Acoustic Engineering. Retrieved from <https://acousticengineering.wordpress.com/2013/07/22/does-an-anechoic-chamber-cause-hallucinations/>. Copyright 2013 by Trevor Cox

In contrast, a new domain of IEs has developed in the last several decades; technologically-dependent IEs. The use of technology to induce the state of immersion has become readily available. These IEs have qualities like those analogues, presenting them in a different medium; aiming for the same essence at their core. I will discuss these experiences briefly and compare them to the most relevant example for my research VR.

Room Projection, also known as CAVE, refers to 360-degree video projection in an enclosed space.⁵² Crafting an atmosphere is important to this type of immersion, as users have no interaction with the content, therefore, creating the passive experience to line up with the intended feeling is where each element helps build up the environment.⁵³

These types of installations are in a way doing the opposite to a floatation tank, where

⁵² Cave automatic virtual environment (CAVE) utilise projectors to create the immersive experience. *Sky* developed by IglooVision and *Living Room Projection* developed by Mr.Beam are examples of this type of content.

“Sky.” Igloo Vision. Last Modified 2018. Accessed May 17, 2018. <https://www.igloovision.com/case-studies/sky-tv>; Mr.Beam. “Living Room.” Mr.Beam. Accessed May 17, 2018. <http://mrbeam.com/work/living-room/>.

⁵³ Audio visual components respectively

instead of trying to shut off external sensation, it is embraced and made a part of the environment, helping to ease the user into a relaxed state.

Image removed due to copyright restrictions

Figure 4. Room projection.[Photograph]. From Broomx Technologies. Retrieved from <http://www.broomx.com/mk-player360.php>. Copyright 2017 by Broomx Technologies.

In contrast, auditory IEs rely on no element of an enclosed space. Audio IEs have existed in the form of rhythm and music since the dawn of humankind. In contemporary contexts, highly immersive digitally-aided means of immersion have been developed.⁵⁴ These auditory experiences offer new ways to consume the ancient techniques of storytelling and meditation practices, by presenting them to users in a variety of ways. These audio files are only one part of the equation however; the second is utilising technology in a way which brings ease and comfort to the user, as they can create whatever environment they wish to experience them in.

In this example, combining the external and internal world for the user helps solidify the symbiosis of the body and mind. In *Your Mind Matters* the practice experimented and trialled ways of achieving through experimentation.

⁵⁴ Stimulating audio such as ASMR (Autonomous sensory meridian response), guided sleep aid, guided meditation and audiobooks offer an insight into the stimulation of human senses to create mesmerizing experiences.

VR

Combining the captivating auditory sensations with a visual component is where experiences in the VR/AR range excel, and where the latest immersive experiences are originating from. As my research is focussed on VR, I will present several examples of current uses for VR. VR is the highest form currently of immersive technology when compared to other forms of immersion technology available. This content can be thought of as having a sliding scale for ‘reality’ with each focusing on a different aspect of blending technology and reality.⁵⁵ Immersion is not an all-encompassing definition, but one that scales with varying levels and combinations of multimodal sensory input, allowing audio, haptic, smell and motion to be experienced simultaneously to the graphically rendered environment or objects. These stimuli are seen to increase the user’s sense of engagement in the virtual environment.⁵⁶

Image removed due to copyright restrictions

Fig.5. Augmented Reality and Mixed Reality difference illustration.[Photograph]. From UXPlanet. Retrieved from <https://uxplanet.org/the-differences-between-vr-ar-mr-27012ea1c5>. Copyright 2017 by Avi Barel.

55 AR: Augmented reality is an overlay of content on the real world, but that content is not anchored to or part of it. The real-world content and the CG content are not able to respond to each other.

MR: Mixed reality is an overlay of synthetic content on the real world that is anchored to, and interacts with the real world—for example, picture surgeons overlaying virtual ultrasound images on their patient while performing an operation. The key characteristic of MR is that the synthetic content and the real-world content can react to each other in real time.

VR: Computer generated content which gives users the ability to look and move around in the virtual environment. Often seen as the most immersive form of these because it has no real world visual component. ‘VR? AR? MR? Sorry, I’m confused.’ Foundry.com <https://www.foundry.com/industries/virtual-reality/vr-mr-ar-confused> (accessed 11/04/2018)

56 Christopher J Wilson and Alessandro Soranzo, “The Use of Virtual Reality in Psychology: A Case Study in Visual Perception,” *Computational and mathematical methods in medicine* 2015 (2015).

These two mediums still have a connection visually to the real world. In contrast, VR goes further and replaces the user's vision of the everyday reality with a virtual one, and leads to VR creating an isolating effect with the headset. The current technology used to access VR is made possible with the help of VR headsets.⁵⁷ The goal of VR is to create what appear to be a life size all-encompassing three-dimensional virtual environment without the boundaries other screens such as TV or computer screens have. The head-mounted display screen tracks your movements, permitting you look around freely and the picture in front of you shifts with your movement as you look up, down and side to side or angle your head. Within the virtual environment the user's actions "partially determine what happens in the environment"⁵⁸ with the ability to look around, move and interact with virtual features or items. In conjunction, audio is often played through headphones offering total audio-visual immersion. The symbiotic relationship supports stimulation and reinforces an isolating outcome helping bring these aspects to the forefront. Auditory stimulations⁵⁹ can transport users into a world of imagination, and with VR that world can be visualised and explored.

Image removed due to copyright restrictions

Fig.6.How the HTC Vive works. [Diagram]. From How To Geek. Retrieved from <https://www.howtogeek.com/246333/oculus-rift-vs.-htc-vive-which-vr-headset-is-right-for-you/> Copyright 2017 by How-To Geek LLC.

⁵⁷ Headset consisting of a head-mounted display and a small screen in front of the eyes. Brands: HTC Vive, Oculus Rift, Google Daydream/Cardboard

⁵⁸ "Virtual Reality." Merriam-Webster's collegiate dictionary. Accessed January 5, 2018. [https://www.merriam-webster.com/dictionary/virtual reality](https://www.merriam-webster.com/dictionary/virtual%20reality).

⁵⁹ Spatialized audio provides a sense of where sounds are coming from in 3D space.

The VR environment offers a new landscape for immersive experiences and unlocks areas of inquiry previously unmapped, conceivably accommodating greater communication of ideas. Jason Jerlad wrote that “well-designed VR experiences can be thought of as collaboration between human and machine where both software and hardware work harmoniously together to provide intuitive communication with the human.”⁶⁰

The effectiveness in communicating and solidifying concepts is a key component of VR and has seen great success in providing a new platform to learn on. Examples of the exciting possibilities VR has already shown are the ability to pre-visualise concepts, learning through field trip type experiences such as Stonehenge (celestial alignment) or showcasing solar system movements in VR.⁶¹ The technology helps create a platform that provides a variety of experiences and the ability to communicate information in new ways.

VR is not only an entertainment device as it has been applied in a wide variety of serious uses; the medical field being one of the biggest and best examples. VR and the medical field have been an interesting area of research, with VR supporting in therapeutic settings, notably research around treating pain management,⁶² anxiety issues,⁶³ eating disorders,⁶⁴ PTSD,⁶⁵ and VR MRI experience for children.⁶⁶ These experiences make use of VR as a peripheral tool to aid in treatment or preparation for medical procedures.

60 Jerlad.

61 Previsualise: Creating design mock-ups and viewing in VR to get a feel for the models in 3D space

62 Hunter G Hoffman et al., “Feasibility of Articulated Arm Mounted Oculus Rift Virtual Reality Goggles for Adjunctive Pain Control During Occupational Therapy in Pediatric Burn Patients,” *Cyberpsychology, Behavior, and Social Networking* 17, no. 6 (2014).

63 Max M North, Sarah M North, and Joseph R Coble, “Virtual Reality Therapy: An Effective Treatment for the Fear of Public Speaking,” *International Journal of Virtual Reality (IJVR)* 3, no. 3 (2015).

64 Jose H Marco, Conxa Perpina, and Cristina Botella, “Effectiveness of Cognitive Behavioral Therapy Supported by Virtual Reality in the Treatment of Body Image in Eating Disorders: One Year Follow-Up,” *Psychiatry Research* 209, no. 3 (2013).

65 Cristina Botella et al., “Virtual Reality Exposure-Based Therapy for the Treatment of Post-Traumatic Stress Disorder: A Review of Its Efficacy, the Adequacy of the Treatment Protocol, and Its Acceptability,” *Neuropsychiatric disease and treatment* 11 (2015).

66 Jan Kruse et al., *Virtual Reality Mri Experience for Children, Joint International Conference on Serious Games* (Springer, 2016).

A few studies about the combination of meditation and VR have been conducted with successful results. In one researchers considered the effectiveness of CBT supported by VR in the treatment of body image in eating disorders, concluding that from their results it was revealed that the program “enhanced by a body image specific component using VR techniques was shown to be more efficient than CBT alone. The body image specific component using VR techniques boosts efficiency and accelerates the CBT change process for eating disorders; it results in greater improvement than when body image is not addressed.” In another study, concerning chronic pain patients, researchers established substantial relief in subjective ratings of pain using the VR system. Patients reported relaxation while in the VR session; associated with a lower heart rate.⁶⁷ Similarly patients’ psychological and physiological responses to stressful situations in VR have been studied.⁶⁸ The patients were taught mindfulness and the impact of this was measured in a VR simulated emergency. Results showed that anxiety levels, heart rate and facial muscle activity all decreased with the VR. These changes were attributed to the awareness and acceptance components of mindfulness by the investigators.

These examples are of interest to my project because they establish a connection between VR and the qualities unique to VR, in addition to highlighting the additional impact VR can have when used in therapeutic settings: i.e. the CBT program was more effective when the VR component was included. Although the VR component focussed on body image and not for providing an environment to relax in, the beneficial relationship between a contemplative practice and VR is of significance. Similarly, the significant impact the isolating effect VR has when dealing with pain management provides an advantageous use of this isolation, in addition to the positive physiological changes patients had during its use. This demonstrates that VR has applied therapeutic uses.

This thinking informed the practice in relation to my role in designing a VR environment with the goals of relaxation and ability to concentrate at the forefront.

These studies have confirmed to me that both VR and mindfulness have their uses and

67 Brenda K Wiederhold et al., “Virtual Reality as a Distraction Technique in Chronic Pain Patients,” *Cyberpsychology, Behavior, and Social Networking* 17, no. 6 (2014).

68 Crescentini et al.

benefits and when combined in various arrangements they complement each other. My practice has expanded upon the notion of the interplay between the two and explores this relationship further by having the mindfulness practice entwined with VR.

As research shows, the applied uses of mindfulness and VR together and separately have impacted users significantly in various situations. These examples emphasise the quality of life improvements across the board and offer a look at the possibilities of each respective domain. Subsequently, VR and meditation can be seen together in numerous VR experiences that have been created in the last five years. Although a debate remains around the necessity of VR concerning achieving the goal of meditation,⁶⁹ there have been several high-quality experiences created which I will cover in the following section. These experiences are the closest examples to my own research, and these have informed the thinking behind the practice, giving me a foundation of what is on offer and how my research can add to this conversation. Being able to see what has come before permits the investigation into area where others may not have explored, along with seeing how I can make my VR experience unique; such as the geographical location of NZ informing the visual style.

Further technological advancements are appearing, utilising VR to place users in relaxing areas such as nature or a meditation class, and it is here where my project is situated. Most meditation practices and most practitioners find closing ones' eyes to be helpful when trying to enter a relaxed meditative state, however, a relaxed state can also be attained with eyes open (Zen meditation) the choice is up to the individual. This aspect of meditation raises questions regarding the role VR can have in this goal of relaxation and mindfulness. Keeping this in mind makes the task of creating the right atmosphere and making the individual comfortable through proper VR practices to reduce negative effects- something that brings forth interesting design challenges in which a handful of projects have been created. I will examine some of these examples.

Early practice-based experiments looked at 360° video in VR. Most of these videos are well put together but the lack of depth in consumer level mono

⁶⁹ Debate surrounding VR possibly being counter intuitive to focussing inward,

platforms⁷⁰ leaves the experiences as a very flat viewing experience. They are often good novelty experiences but lack the extra ‘wow’ factor when compared to CG VR. Examples like DotCalm⁷¹ craft an immersive experience that relaxes the viewer and builds a world designed for and around the experience. While 360 videos are the most accessible version of VR content currently, it has many issues that hold it back from being a complete VR experience.

CG VR is the next logical step is to create full immersion as to fix the depth and quality issues 360° video faces currently. ‘Realworld’ is a fully immersive VR experience that combines neuro-feedback that feeds back into VR, producing a computer-assisted meditation system.⁷² The user can “levitate in a virtual world by doing meditation exercises through measuring users” brain activity in real time via EEG computing an estimate for the level of concentration and relaxation.⁷³ These values are then mapped into the VR, providing a feedback loop in which the more the user can concentrate and relax, the higher the higher up they will levitate. The tool aids in providing an experience that engages the participant and tasks the user with a simple challenge for them to aim for. While the project offers a great challenge and helps ease the user into a relaxed state through concentration, it lacks the visual beauty which transports users to another world via VR. In comparison, a project developed by Cubicle Ninjas ‘Guided Meditation VR’

emphasises the visual component as it mimics photorealism and combines it with a guided meditation that helps build up the environment’s story and then into a meditation exercise. This is a full VR project from the ground up, which gives users depth perception, and allows free movement within environments compared to a flat 360 video. Other notable VR meditation examples that take the photorealistic meditation

70 My testing was done using mono platforms which means the recorded video with one perspective. Mono images show the same image to both eyes compared to stereo projection which provide a different image to each eye providing 3D depth perception. This depth perception issue was a main factor in abandoning 360 technology for my research.

71 DotCalm infuses guided ASMR relaxation with a futuristic cityscape in 360°. Maque Ally. DotCalm: Relaxation Program (a futuristic 360° ASMR experience). <https://www.youtube.com/watch?v=IZu1e2TVGjs>

72 Ilkka Kosunen et al., *Relaworld: Neuroadaptive and Immersive Virtual Reality Meditation System*, *Proceedings of the 21st International Conference on Intelligent User Interfaces* (ACM, 2016).

73 Ibid.

route include ‘Perfect’,⁷⁴ ‘Nature Treks VR’⁷⁵ and ‘House of Meditation Inc’⁷⁶, all of which have their own unique way of presenting the meditation. Perfect is a good example of a hands-off approach, where the experience is less geared toward traditional meditation and more focused on providing a quiet place to be alone. Likewise, Nature Treks VR does not have a guided aspect to it either, making these experiences less about a guided journey and more about a quiet time for yourself to explore and collect your thoughts. In contrast, House of Meditation has the guided aspect and gives users control over if they want the voice interaction or not.⁷⁷ These projects capture the essence of my own exploration in this area of VR. The experiences offer a variety of environments for users to explore with a reasonable level of user control. The isolating effect of VR is used to rebuild the users’ sense of reality as they are guided through the audio-visual experience, often pondering on deep philosophical aspects of life and reality along with breathing and relaxing.

Both mindfulness and VR are shown to be effective in applied therapeutic situations. The practice of mindfulness has notable quality of life improvements and VR has proven to be an effective platform when combined with therapeutic intent. The topics discussed provide context to the research I have undertaken. The next chapter discusses the thinking that has informed my project specifically the methodology and methods used.

74 Perfect. Developed by nDreams. 2016. <http://www.ndreams.com/titles/perfectvr/>

75 NatureTreks VR. Developed by Carline, John. <http://greenergames.net>

76 House of Meditation. Developed by Cerevrum. 2017. <https://www.cerevrum.com/house-of-meditation>

77 While Perfect and Nature Treks are focussed heavily on photorealism, House of Meditation is less photorealistic. These all offer a wide range of experiences and the art styles ensures users will like at least one of the environments.

Chapter Two: Methodology

Key Words

- Immersion: the experience one has when normal world sensory inputs of vision and audio are replaced with a virtual version, within VR.
- Interaction: a responsive action that occurs as the result of two or more objects influencing one another.

This chapter of the exegesis presents an overview of the methodological frameworks utilised in the thinking and making processes to produce the research outlined in this document. It steps off from the platform provided by the contextual review of knowledge and key practices, which influenced the research journey and the final outcomes of practice. *Your Mind Matters* prototypes a VR platform-based mindfulness experience that is framed within therapeutic immersive environment design. The project speculates, through iterative experimentation, on the potential of these devices when they are combined with contemplative meditative practices.

Your Mind Matters, applied design principles and methods situated in Human Computer-Interaction (HCI), User Experience Design (UED), Interactive design and Immersive design to provide the frameworks that guide the core of this research project. Underpinning this thinking are three key factors that informed the iterative testing:

1. A comfortable VR experience is critical to a successful experience of the environment that users are immersed within.
2. A relaxed environment activates a successful mindfulness experience.
3. Temporal factors (that is the length of contemplative time spent in the experience) impact on successful immersion in the VR experience.

The design paradigm for this project focused on the potential therapeutic uses of emergent technologies, in relation to a VR meditation experience. The possibilities within the recent wave of VR platforms have provoked interesting ways of thinking with serious real-world outcomes, as discussed in the contextual review chapter. This project is located in finding potential relationships between current VR technology and

the subjective experiences of mindfulness/meditation. This is a nascent space for which there are few examples to refer or respond to. However, this is also what makes it a rich and vibrant territory for experimentation and what ignited the curiosity in the practice.

Crafting an experience intended to promote wellbeing and prompt healthy change aided by technology is an area of study piqued my interests as a designer and a practitioner of meditation. To initiate the project, I drew upon my tacit knowledge as a mindfulness practitioner and as a digital designer. The design principle within the methodologies outlines the aspects of significant importance within the design process. Aiming for comfort and deep immersion these frameworks informed the thinking throughout. These methodologies bring the experience and how it interfaces with the human participant to the forefront, making this artefact an integral aspect of the research.

Human Computer-Interaction (HCI): An interdisciplinary field which investigates the design and implementation of computer technology. Aiming to improve interfaces between the interactive processes, users of the virtual environment and any digital information conveyed within.⁷⁸

User experience design: The interdisciplinary research methodology relates to the experience the product creates for the people who use it in the real world. Developing interactive experiences aims to improve the interactive process. It concerns itself with the experience when the person meets it, and the method designs the product with the user experience as an explicit outcome going beyond just functional or aesthetic and establishes the users' experience as a design priority.⁷⁹

Interaction design: The design approach dealing with effective interactive communication with virtual environments, interfaces and other objects. Tasked with analysing and improving interactivity to figure out the best approaches to communicate and influence the user.⁸⁰

The above methodologies have at their centre real human users, but for the scope of this

78 Alan Dix, "Human-Computer Interaction," in *Encyclopedia of Database Systems* (Springer, 2009).

79 Jesse James Garrett, *The Elements of User Experience: User-Centered Design for the Web and Beyond* (Pearson Education, 2010).

80 Yvonne Rogers, Helen Sharp, and Jenny Preece, *Interaction Design: Beyond Human-Computer Interaction* (John Wiley & Sons, 2011); Dix, in *Encyclopedia of Database Systems*.

project I have made the choice not to engage with a user group, but, rather focus on a highly resolved prototype that could be developed further with user testing and ethics approvals.

These methodologies were surveyed as a way of thinking about how to ease the user slowly into the personal and isolating experience. It is acknowledged that a user might be overwhelmed or uneasy when stepping into VR and experiencing virtual environments. This is where UED is helpful to ensure participant experience is well designed. The outcome of the user's experience should be explicitly tailored towards meeting their preferences, with the beginning of the experience designed to ensure a smoothly introduce the user and give them a small degree of control. I maintain a calming atmosphere through, with ambient music integrated with light binaural beats, providing the non-diegetic soundscape. Furthermore, I recorded natural New Zealand nature sounds to provide diegetic sound. As shown, the methodologies pay careful attention to user experience and the products' overall ability to deliver a comfortable, clear and engaging product.

These methodological frameworks help ground my project in the space concerned with creating a positive IE for the user within VR to facilitate the practice of mindfulness.⁸¹ Utilising these approaches to thinking through the practical design has an impact on the quality of the user experience of the final artefact.

Experience Design is about who is experiencing the final artefact or service, or event; the wider community, with a specific interest in creating the experience for those who might be unfamiliar with VR. With this guiding principle, the artefact discussed here, makes sure not to overwhelm the participant. I did not want to overload the user with complicated control schemes and complex systems, so keeping it simple was core to the design thinking. It is essential that the participant has a certain period of time to acclimatise to the experience, thus easing the user into the mindfulness exercise which formally commences several minutes in. There needed to be a degree of elegance to the outcome for it to be effective. Specific design consideration has been given to the experience when the person meets it.

⁸¹ In this project the learned environment relates to the creation of a quiet relaxing environment that acts as the background to learning through interaction and engagement.

As each design iteration occurred, the control participants had increased.⁸² In addition, immersive design brings the greatest level of immersion as a key design component. The prototype limits that which can hinder the connection between the participant and the experience. Ensuring adequate space for users to move around in the physical world, having a comfortable and clean headset and minimizing influence from the outside world, can help comfortably transition the user from the everyday reality into the virtual world, thus designing both within the virtual experience and outside in the physical world.

The components of presence and immersion underscore the working processes involved within the immersive experience and are responsible for bringing about an experience that

distinguishes itself and transcends from traditional media.⁸³ These central aspects allow for the possibility of greater depth in the experience and allow the user to be more in tune and alert to what they encounter. Negating the common challenges of VR and promoting a smooth experience is the best way to guarantee a positive user experience.

⁸⁴ With the user comfortable in VR, the experience transitions into the mindfulness exercise. To successfully communicate mindfulness through VR, the experience must be designed in every aspect with the user's comfort and immersion in mind.

Design decisions made with UED make sure the artefact is developed with a positive user experience in mind. Elements such as low frame rates can hinder this experience, with a noticeable impact in quality resulting in a bad user experience and an ineffective IE.⁸⁵ These elements pertaining to visual fidelity are conscious design decisions and the

82 The limitations of each iteration were a large part of the overall design platform choice. For example, 360° video meant limited interaction vs CG VR which is built from the ground up and allows for a larger extent of interaction. With UE4 I can implement user control of movement within VR and allowing users to choose which environment they visit.

83 Jason Jerald, *The Vr Book: Human-Centered Design for Virtual Reality* (Morgan & Claypool, 2015).

84 Common negative effects of VR include reports of feeling sick after experiencing VR- suffering nausea, eye strain, headache, vertigo, physical injury (tripping over cables for example) and motion sickness. These adverse effects may never be eliminated; however, the designer of the virtual world should aim to reduce these negative effects and make the experience for the user as comfortable as possible. It is important to work around these current difficulties and allow for a safe environment in the real world for these experiences to take place in.

85 The rate at which consecutive images (frames) appear on display. Applies to TV, Film, Video game or another video sequence. Film for examples is 24 frames per second (FPS). For VR specifically, FPS is important to ensure a smooth and reactive picture as the user turns their head. VR aims for 90 FPS to mitigate the problems of nausea, disorientation and other negative effects which are often exacerbated at lower frame rates. The high frame rate and ideal smooth vision in VR are very demanding on the PC which means conscious design decisions around the VR creation process. Maximising ways to produce

majority can be mitigated through various means throughout the creation process. In combination with HCI and immersive design the interactive elements are made to run on minimal resources for smoother implementation. This meant I could follow with a standard user control scheme with a limited degree of interactivity.⁸⁶

Through practical experimentation, the project drew together, concepts of mindfulness into a range of digital test platforms, which created a significant number of designed artefacts. Next, I will discuss, how my iterative design process led to each significant phase of my project. This iterative process considered the benefits and limitations of each of the technologies as they related to immersive therapies, the best aspects of each taken forward either in thinking or design choices or discarding or improving on that which was not successful. The story of the project's evolution can be seen throughout the documentation of practice, within each artefact and area of research explored; each iterative pass flowing into the next phase of the research.

Technical Design of Project & Iterative Testing

Several design prototypes have been created through the iterative process.

Chronologically documenting the iterations of this project leading into the final design platform of UE4 will be discussed. For further reading of these experiments refer to appendix where a detailed breakdown of each iteration has been provided.

Among the iterations a common thread was revealed: the quest for meaning in contemporary life brought about through immersion among the natural world and a therapeutic activity that conveys the beauty of the human experience. Early iterations explored rejuvenating the connections between humans and nature with latter iterations devoted to relaxation among nature.⁸⁷ The associated therapeutic component that arises is a key element that connected each iteration, from recording real world locations in 360° video, to the final design platform of UE4 which could recreate the natural world

the intended effect with the least processing power required. Thus, minimizing the negative effects VR is often known to induce.

86 Basic control for this VR experience: Teleportation movement and laser pointing for target selection.

87 The contemplative atmosphere that occurs as the world sleeps. Capturing astrophotography time-lapses, recording 360° video scenes, and creating ambient soundscapes were several early influences that informed my thinking when approaching the research project. Later iterations were mindfulness exercise within VR based. Providing relaxation among New Zealand landscapes.

in a computer-generated environment.⁸⁸

Four environments at different times of the day were filmed; sunrise, noon, sunset and night, which were compiled into 360° videos.⁸⁹ While the daytime tests were successful, the technology used in 360 cameras cannot record night time scene effectively.⁹⁰

Changing cameras was an upgrade in resolution, but the main problems remained with 360° technologies in general.⁹¹ The technology remained limited in the immersive quality it could deliver. It was clear the retail consumer-level products could not fulfil the project's requirements.



Figure 7. Patrick Hanna.[Video] Samsung 360° Cityscape At Night. Auckland, New Zealand. (2017).

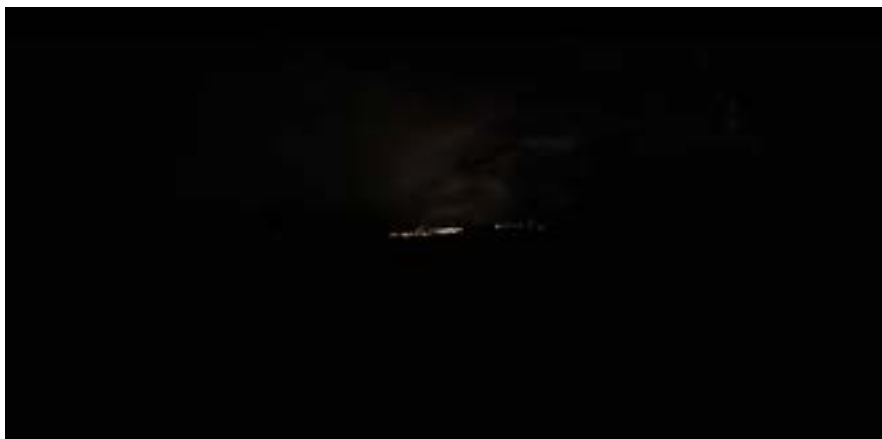


Figure 8. Patrick Hanna.[Video] Kodak Pix Pro 360° Cityscape At Night. Auckland, New Zealand. (2017).

88 To a certain degree of success. CG VR is currently a step below our real-world reality and can be distinguished from the real world we reside in.

89 Filmed using the Samsung Gear 360 and Kodak PixPro4k.

90 Limited user control. No exposure control for example. Resulting in dark grainy footage.

91 Image resolution is the detail an image holds. Higher resolution means more image detail. Samsung Gear 360 was Standard Definition image vs the Kodak Pix Pro 4k which was Ultra HD; a noticeable leap in quality.



Figure 9. Patrick Hanna.[Video] 360° Sunrise With Guided Audio & Music. Whitford, New Zealand. (2017).



Figure 10. Patrick Hanna.[Video] 360° Noon. Te Paki Sand Dunes, New Zealand. (2017).



Figure 11. Patrick Hanna.[Video] 360° Sunset Bucklands Beach, Auckland, New Zealand. (2017).

To provide a night sky 360 video experience meant creating a 360 camera with the help of four DSLR cameras.⁹² However, execution of this idea was a huge challenge, and the results were underwhelming. Camera and other equipment needed were not ideal, resulting in an unsuccessful 360° video. The trial led into the next phase; exploration of virtual world creation.



Figure 12. Patrick Hanna.[Photograph] Four DSLR Rig. New Zealand. (2017).

Figure 13. Patrick Hanna.[Photograph] Single DSLR Perspective. New Zealand. (2017).

Investigating virtual scenery creation led to a program I had previous used; Terragen.⁹³

This offered the option to render equirectangular images that could be compiled to create a video and meant working in 360° VR. I was familiar with creating virtual

⁹² DSLR: digital single-lens reflex camera which means digital camera.

⁹³ Terragen being a photorealistic scenery generator program was suitable to create high quality photo realistic renderings and animations of landscape environments that are highly customisable.



Figure 14. Patrick Hanna.[Image] Terragen Equirectangular Night Sky. (2017).



Figure 15. Patrick Hanna.[Image] Terragen Equirectangular Sunset. (2017).

The limitations of the software became apparent with the best output method being pre-rendered 360° video. As discussed prior, the extra dimension of depth cannot currently be obtained with 360° video. This, coupled with the time-consuming rendering process, led me to seek out alternative ways of creating this virtual environment.

The avenue of 360 videos created through recorded and digital means was an important stepping stone into the world of VR and setting up the project to come. Updating the design parameters meant exploring new ways to communicate the immersive experience.

Designing a strong platform to conceptualize the intersection of mindfulness and VR was made possible through UE4. Having worked with Unity previously, I had experience with game engines and their processes and terminology. This knowledge helped when transitioning to UE4 to create the research artefact. The UE4 platform enables real time simulation which provides user interaction, a feature absent from previous tested platforms, such as 360 VR.⁹⁴ This open source software opens new creative avenues to explore designed VR environments and includes further immersive tools to the design toolkit. The UE4 engine includes elements like photo-realism, interactivity and performance power, which are key aspects in the creation of this experience. Several iterations have occurred throughout this projects UE4 development cycle. In the following section I will be detailing the iterations created in UE4 for this research.

⁹⁴ Panoramic video recordings of a real-world scene from a single point of reference, where the viewer can see usually 360° horizontally though sometimes lesser. When a full 360° horizontal view and 180° vertical view it is referred to as a 360° video. These videos offer a level of immersion however they lack depth (z plane) since they are using pre-filmed real-world content as the central media, recording depth data is a harder task not yet accomplished well at this stage. Resulting in a limited experience that is akin to traditional forms of media like film more so than CG VR.

ChapterThree: Final Design Platform

Key Words

- Unreal Engine 4: UE4 is an open source program used to develop, design and build games, simulations and visualizations. Used in this project to create the VR experience.
- HTC Vive: A brand of virtual reality headset developed by HTC and Valve Corporation on which displays the VR experience.

This chapter chronicles my making processes, techniques learned and applied, and the materials used to produce *Your Mind Matters*. It focuses on the technical side of the project demonstrating how each aspect guided exploration throughout the iterative process of design. In addition, it covers my selection processes around making decisions around the efficacy of the prototypes, supported by a conversation around specific materials and techniques applied to deliver a VR mindfulness experience. The final prototype aims for an elegant integration of technology and relaxation, specifically the technique of mindfulness. Documenting this journey and my thinking behind each step will be supported by visual examples, specifically curating each aspect of the experience, made interaction possible between the content and the user. Designing the experience from the ground upward literally meant creating environments. Utilising free and paid assets (trees, grass etc.), I compiled a library of plants and textures. For landscape environment materials (ground layers, plant materials) I used Megascans.⁹⁵

The creative process is hard to pin down, but a basic blueprint can be found in UE4 is as follows.

Outlined idea > terrain creation > set landscape material > foliage for ground level > adding VR components (camera, interactivity) > fixing any initial VR issues > adding

⁹⁵ Developed by Quixel this software and assets library contains high resolution (2k -8k) scans of nature for game design. The library features assets for a variety of environments and versions of assets such as wet sand, dry sand, sand with shells, etc.

taller denser foliage > lighting & sky dome > particle effects e.g. rain > testing and



Figure 16. Patrick Hanna.[Video] Ground Layer And Foliage Process in UE4 (2018).



Figure 17. Patrick Hanna.[Image] Megascans Ground Texture Dead Leaves On The Forest Floor(2018).

Unreal Engine 4 can simulate a real-time day/night cycle, giving dynamic lighting which made this task much easier than with previous software. Along with these times of day, I could also add various weather elements and bodies of water to my project, and these all played a role in crafting the final project. Performance factors meant that environments could not be too large with the experience being viewed in VR.

Additionally, the context of the environment was localised, meaning the audience would not get to see this larger scale environment and thus negating the need. This influenced the design approach going forward with focus on smaller, more intricate environments.



Figure 18. Patrick Hanna.[Image] Landscape Material (2018).

The first prototype was a combination ambient audio and a mindfulness voice over. I tested these sound devices out within a VR environment I did not create. The landscape examples provided me with a much deeper knowledge of landscape creation; for example, how elements such as wind bring the scene to life. Bringing the ebb and flow of the natural world into the virtual world was a challenge within the practice.

The locations were chosen with relaxation in mind. These environments were: the rainforest at night time seeing the stars above; a summer forest meadow with trees rustling and birds chirping as the sun sets; sunrise on a sandy beach watching the waves flow in and out on the shore, and high up in the mountains clouds surrounding the user overlooking a vast landscape and lake. In addition to these locations, abstract locations of a stellar nebula and an underwater location were created. Connecting previous lines of enquiry with these settings influenced the design, specifically in guiding the user through audio and visual elements into a mindful and relaxed state.

Optimising these assets for VR was paramount to the users' experience, as a slow

system or a crashed simulation is a failure for the experience, and which was a concern throughout the design process. The use of LODS (level of detail) to scale asset details by switching to a less complex and resource-heavy mesh as the player moves away from it to make your level perform better.⁹⁶ Below are some of these specific aspects in each scene to craft a mood and enjoyable experience for the user in VR:



Figure 19. Patrick Hanna.[Video] Player Selection of Location With Dynamic Lighting (2018).

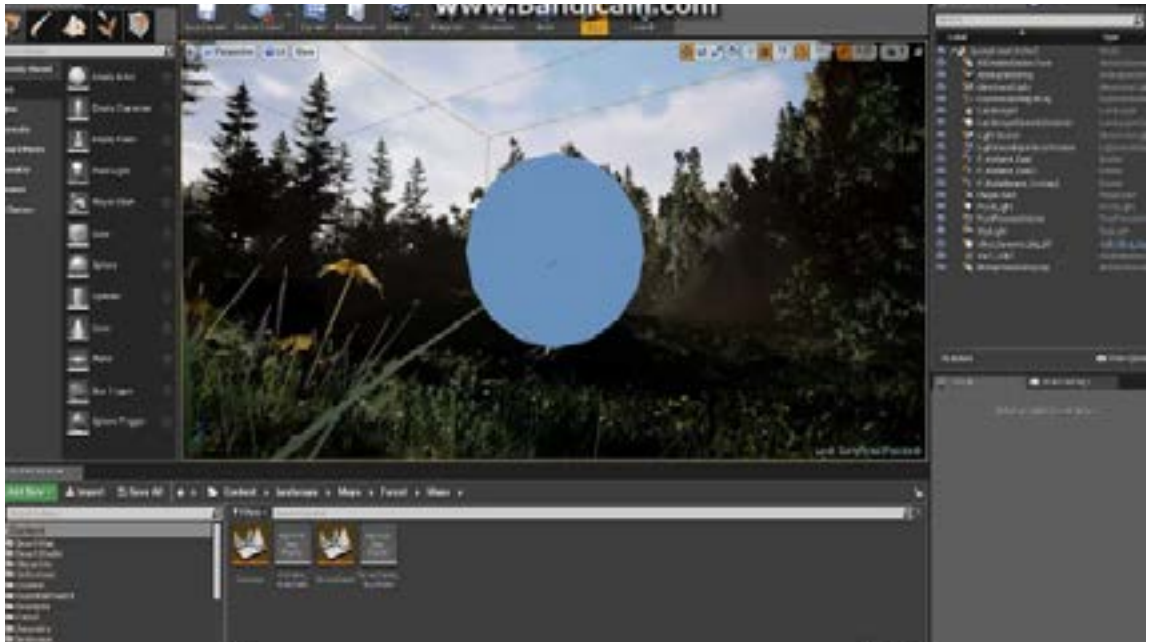


Figure 20. Patrick Hanna.[Video] Sunny Forest Environment (2018).

⁹⁶ Unreal Engine 'Creating and using LODs'. <https://docs.unrealengine.com/en-us/Engine/Content/Types/StaticMeshes/HowTo/LODs>



Figure 21. Patrick Hanna.[Video] Beach Sunrise Test (2018).

Testing these environments in VR highlighted the challenges I still faced in creating a smooth VR experience. The VR field of view along with frame rate issues meant the viewing experience was not of the high quality needed for a successful baseline experience. Ultimately, this resulted in my removing the dynamic lighting which simulated the passage of time and changing to static lighting. This change meant I could create specific lighting, e.g. afternoon sunset, and pre-computing all the lighting data to save resource power.

While these locations were successful and were on track to being completed, they lacked the degree of originality and polish which I desired. Living in New Zealand has given me an appreciation of the native flora and fauna. Showing off the beautiful native plants of NZ and the wider Oceanic region was one of the biggest design pivots in the UE4 iterative process. This pivot was essential in creating an original artefact, which sets itself apart from the current crop of VR meditation experiences. Being able to add an element of myself and my heritage was an important personal aspect of this research.



Figure 22. Patrick Hanna.[Image] NZ Dicksonia Squarrosa Fern 3D Model Made By Cliff Chen (2018).

With user experience design as a focus, testing for interactivity functions occurred.

Exploring this natural environment is made possible through the teleportation function and is a most important aspect of giving the player control over the environment they wish to explore.⁹⁷ These are the basic functional controls usually offered within VR.

Designing with optimisation in mind ensured a smooth experience for the user. The target of 90 fps meant a conscious design for user experience.⁹⁸ Several elements were used in the optimisation of this experience.⁹⁹ Optimisation is essential to a smooth VR experience and this quality facilitates the immersion needed for the mindfulness exercise in VR. Furthermore, it's important for the experience to provide adequate time to acclimatise to VR.

This experience provides a serene New Zealand environment as the backdrop for the participant to practice mindfulness within. This practice is a response to the research concerned with prototyping the integration of mindfulness within VR.

97 Forward movement within VR world controlled by the HTC Vive controllers.

98 Frames per second.

99 The use of LODS for 3D models, billboards for far away aspects of the environment, static lighting and converting blueprints to C++ aided in this performance focus.



Figure 23. Patrick Hanna.[Video] Final Your Mind Matters (2018).

Conclusion

A sound mind in and our connection to nature are integral parts of the human experience and our wellbeing. Today's busy world often leaves people with insufficient time to relax and reflect. The inner wellness of the mind is an important aspect of health. Contemporary life has brought about great innovation which has benefitted humanity greatly, however our cultural blind spots can be seen.¹⁰⁰ The destruction of our natural ecological environments and co-existence, to the stresses of everyday life have had detrimental impacts on the world we live in and on personal health and wellbeing. The relationship we have to ourselves, our community, society at large, the ecosystem and life itself are all impacted when we do not provide adequate time for ourselves.

The qualities within meditation offer us time to examine how we live our lives and how we respond to situations. The practice of mindfulness promotes a focus on the present moment, making the most of this time we have.

Recreating this meditative state through VR particularly the immersive and isolating qualities, prompted me to investigate how mindfulness might interface with this technology. This creative practice models a combination of the natural world within the virtual world, designed to create a calming atmosphere for contemplation through mindfulness. Research coming from various fields' highlights applied therapeutic uses for mindfulness and VR, along with the need to continue to pursue new and innovative ways of solving future and existing problems.

I have personally found meditation alongside an active lifestyle and a reconnection to nature has helped bring clarity, emotion, revitalisation and regularity to my busy mind. The practice can cause a shift of perspective, emphasising that which is of importance in life and that which is not. Developing a greater ability to able control how you act moment to moment is an important aspect of mindfulness. Similarly, healthy habits like setting time aside for my

¹⁰⁰ Mental health struggles have existed in the past however innovation such as social media can amplify the very real negative impacts these can have when unchecked.

own personal care and reflection and to explore and reconnect with nature, are qualities enhanced through meditation.

We are living in a world where technology has transformed every facet of life. Intrigued with the role technology could play in bringing about positive change in this world, I have created an artefact which responds to the technologically-driven society I have grown up in. While I have prototyped what mindfulness might look like when paired with technology, the prototype does not aim to replace traditional means of contemplation, but to explore its potential in aiding this contemplation. *Your Mind Matters* is an experience with user's wellbeing at its core. Further interactive qualities, user interface design and further refinement of the VR experience are features which could be expanded upon with future development.¹⁰¹

The research surrounding prototyping a meditative experience with emerging technology led me to develop *Your Mind Matters* as a way of thinking through how the technology might be harnessed into a mindfulness experience, as an experiment within the current technical options. The refining of the practice brought about some major design decisions, focussed on improving the performance quality of this experience. While changes have been made through each iteration, the core research aim remained the same. Revised Conclusion

The research surrounding prototyping a meditative experience with emerging tech led me to developing *Your Mind Matters*. The refining of the practice brought about some major design decisions namely to improve performance quality of this experience. While changes have been made through each iteration the core research remains the same.

To begin with a number of changes were made to the scope of the project to ensure the experience met the 90 fps benchmark. A major change was redesigning the way in which users get to each environment. Instead of the user walking through the island to

¹⁰¹ Further interactive elements such as user control over audio tracks, environment like opening a gate or picking a flower and user control over the time of day are a few examples of what could be implemented in the future.

each landscape I made a small glass house with four rooms containing their respective environments. Each room would only load when the user enters the connecting corridor. This meant that I could load each area only when needed. This is called Level Streaming. This utility could be used for the island prototype however that required a greater investment to get the same result. The change in layout meant users could easily go between environments. Minimizing non-essential components of this project meant several concepts were not explored due to time constraint and complexity in addition to a refinement of the core components. These components such as an audio manager for various voice overs and music tracks could be implemented in future development.

Additionally, performance was increased by reducing the number of items to render on screen. A clean minimalistic approach to this glass house located high in the clouds was ensuring a steady framerate of 110 – 120. Further refining the performance through engine setting changes specific to VR development and the use of tools such as distance culling, density scalability, and LODS were used in order to keep the desired 90fps. Performance, comfort and ease of use were at the forefront of the practice guided by the design frameworks. Overall these changes were for the better aesthetically and technically resulting in the final version of Your Mind Matters.

Ultimately Your Mind Matters prototypes my ideas onto a digital canvas. In this prototype I explored how the practice of mindfulness could interface with virtual reality. The immersive technology being developed has come a long way and will continue to be refined and developed for many years still to come. These technologies give us a look at what the future could look like and what types of experiences can be had. The core concepts contained within Your Mind Matters can be developed further. Exploring these topics further led me to believe that this research going forward would be best suited for another emerging technology; mixed reality. A big hinderance of VR is the headset and the clash this has with comfort within the meditative state whereby removing this would be of great benefit. Mixed reality does not have this discomfort and would be the better option for the meditative experience with technology. Approaching the mindlessness experience with this medium would open the door to greater user experience and a larger scale immersive area. Exploring room scale video wall approaches provides the

content in a less intrusive manner. Using this approach like the Art and Design facility at the University of New South Wales where they have large scale ultra-high resolution immersive environments could be one of the possibilities this research can go towards.

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Appendix One: Other Research Artefacts

Discussed here are iterations created during the research. These highlight the exploration and evolution of my research that has not been touched on in the main body of the thesis. Each stage of the research flowed into the next with successful and unsuccessful artefacts created in response to my practice.

Iteration one: Initial concept exploration

Astrophotography

Astrophotography has settings internally needed to capture the night sky. Aperture controls the area over which light can enter your camera, shutter speed controls the duration of the exposure and the ISO speed controls the sensitivity of the camera's sensor to a given amount of light.¹ These artefacts were created in initial testing and exploration of practice. The core idea of relaxation and contemplation during the night time hours is contained within these artefacts influenced the VR environments artistic direction.



Figure 24. Patrick Hanna.[Photograph] Time Lapse Star Trail. Auckland, New Zealand. (2017)

¹ McHugh Sean. Camera Exposure, Exposure: Aperture, ISO & Shutter Speed
<https://www.cambridgeincolour.com/tutorials/camera-exposure.html> Accessed January 2, 2018

Sound Design – Binaural Beat & Shepard Tone Video

Exploring the role musical tones play in bringing forth certain feelings led to combining two auditory illusions; the binaural beat² and Shepard tone³ with my visual time-lapse. Additionally, sound proximity within VR was tested using Unity.



Figure 25. Patrick Hanna.[Video] Star Trail. With Binaural Beats. Auckland, New Zealand. (2017)



Figure 26. Patrick Hanna.[Video] Star Trail. With Sheaprd Tone. Auckland, New Zealand. (2017)

2 Binaural beats are created through the process of concurrently sending a slightly different sound frequency (tone) to each ear through headphones. The brain, upon hearing these tones, perceives a third tone based on the mathematical difference between the two frequencies, thus creating a binaural beat. These tones by themselves induce a relaxing effect and are often coupled with ambient relaxing music.

3 Shepard tone is another auditory illusion that utilities multiple tones to create a sense of constant ascension or decent



Figure 27. Patrick Hanna.[Video] Unity Sound Proximity (2017)

Iteration Two: Abstract video

Artefacts created were abstract in nature and explored non-conventional means of creating an immersive experience. The general idea of nature and the surreal carried forth into the final artefact.

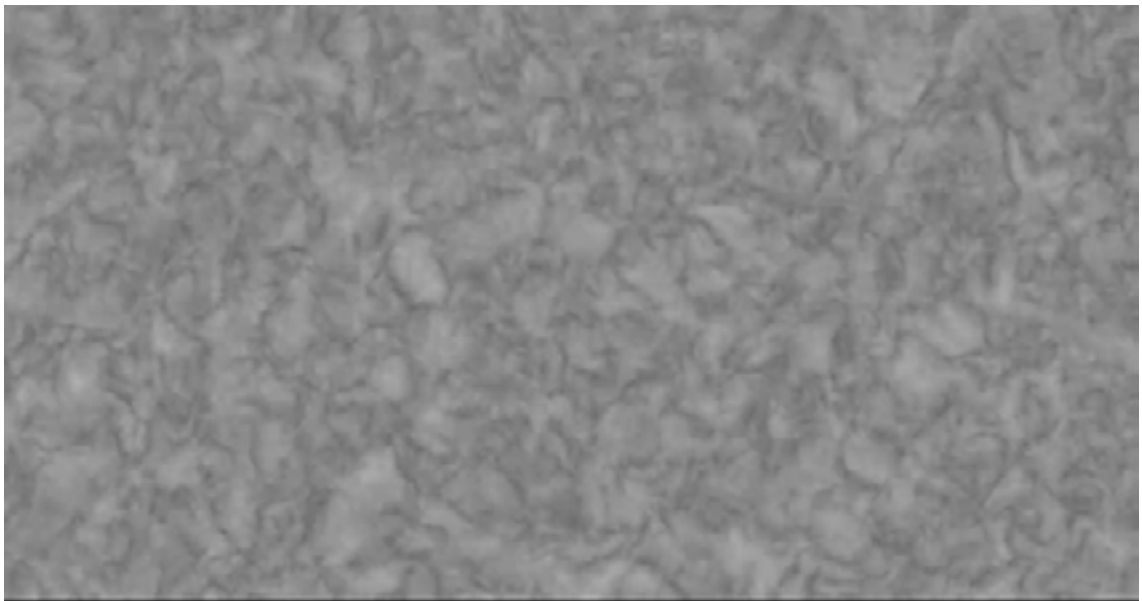


Figure 28. Patrick Hanna.[Video] White Noise Audio & Visual(2017)

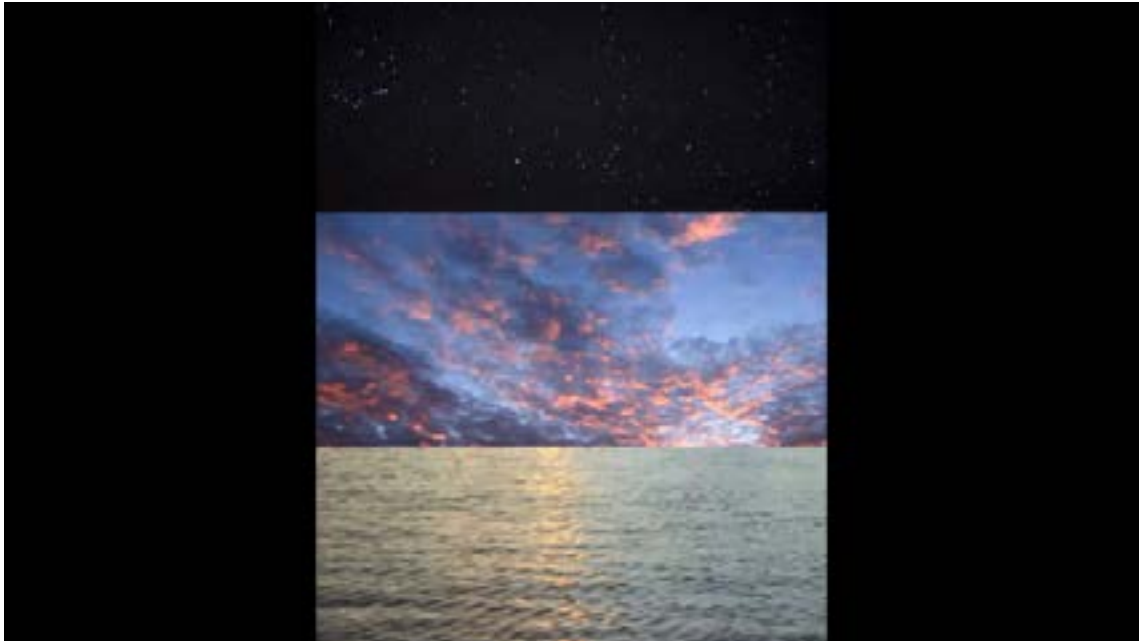


Figure 29. Patrick Hanna.[Short Film] Layers Of The World; Serenity (2017)



Figure 30. Patrick Hanna.[Video] Reflections On The Water At Night (2017)