The Impacts of Unguided Immersive and Interactive Storytelling in VR on Emotion, Mood, and Self-Reflection

Author 1[1], Author 2[1] and Author3[1]

[1] Anonymized

Abstract. Storytelling entertains, educates, and inspires people of all ages and a compelling story has the power to motivate, elicit emotions, behavioural change, and inspire self-reflection. Interactive Digital Narratives (IDN) offer, arguably, a greater potential for impact on their audience due to the participative nature of interaction whilst storytelling in Virtual Reality (VR), benefits from high levels of immersion. This work focuses on the design and development of compelling narrative elements towards a non-narrated and unguided VR experience aimed at portraying and evoking emotions, moods, and self-reflection. We explore how the combined elements of light, colour, shape and music can play a role in creating compelling stories and supporting affect within an immersive VR experience. Finally, this article presents an extensive study of relevant literature, the design of an impactful immersive VR narrative experience and an exploratory practice-based study.

Keywords: Immersive Storytelling, Interactive Storytelling, Wellbeing.

1 Introduction

From childhood to adulthood, stories are part of everyday life and represent an important way to connect and influence with any audience whether they are told, written or shown. "Stories have a transformative power to allow us to see the world in a different way than we do if we just encounter it on our own. Stories are an entry point to understanding a different experience of the world" [1]. It gives people the opportunity to learn and it can shape, strengthen or question their opinions and values. When a story captures a person's attention and captivates them, they are more likely to absorb the message and meaning. Similarly, if a person is able to experience a world in the way others might perceive it, emotions such as empathy or fear can be elicited.[1]

Like traditional storytelling, virtual reality has played a pivotal role in influencing and impacting people's lives through its immersive nature. Immersion is the perception of a physical presence in a non-physical world. In contrast to traditional storytelling, where the recipient is the passive witness of the characters, VR allows the user to become a character. In essence, VR transforms the storytelling experience through having a presence in the world, and by becoming part of the narrative environment, VR. This immersive narrative experience has the potential to put across powerful messages and

connect an audience emotionally as illustrated in Nonny de la Peña's work such as Hunger in Los Angeles [2] which invites the participant to experience poverty while waiting in line at a food bank, or Across the Line [3], a production focused on pro-choice and abortion legal rights. Additionally, Aardman Animations' We Wait follows a Syrian family seeking asylum in Greece, and the hopes and fears that follow [4]. VR storytelling projects such as the ones presented above have the potential to trigger strong emotional reactions from their audience and have the ability to connect people visually and emotionally in ways that other media cannot. As such, we argue that there is growing potential for impactful VR production targeted at emotional well-being and self-reflection interventions.

Emotional well-being is inextricably linked to mental health and a positive emotional well-being can help people make better decisions, be optimistic, be more productive, and influence physical health [5]. Self-reflection, on the other hand, is the ability to think about one's own feelings and behaviours and the reasons behind them. Engaging in practices that exercise these abilities lead to many benefits, including increased compassion, self-acceptance and self-confidence, as well as improving the quality of life and the reduction of stress-related health disorders [6].

The aim of this research is to investigate the potential of unguided immersive storytelling on emotional wellbeing and self-reflection. Against this background, we propose to provide a critical review of previous implementations of immersive storytelling for emotional and behavioural therapies, investigate how immersive storytelling can produce emotional and psychological outcomes and identify key aspects of compelling storytelling towards the development and assessment of an immersive narrative VR experience (The Journey). Whilst providing a practical illustration through which to explore participants' experiences, we hope this work can provide a foundation onto which future immersive stories can build upon towards facilitating better emotional and behavioural therapies.

2 Affect and Storytelling

This section focuses on emotional regulation, self-reflection, general well-being, and mindfulness through storytelling. In particular, the emotional outcomes and impacts on mindfulness and the self in non-goal-oriented, story-based virtual environments. Our aim is twofold and consists in exploring emotional and physiological outcomes associated with immersive experiences (i.e. presence, avatars) and investigating the emotional impacts of immersion in natural environments, and the narrative elements supporting emotional connection and self-reflection. Immersive and otherwise participatory storytelling in a virtual environment offers not only the opportunity to share a story, but also to support meditation [7] and to improve understanding of empathetic responses to stimuli [8]. Studies suggest that even casual video games have had positive emotional influences, including improved perceived mood and lowering stress [9]. In view of this knowledge, it is reasonable to continue to use these interdisciplinary effects of virtual reality beyond the entertainment industry. If casual games have the ability to positively

influence social and emotional well-being, then it is reasonable that targeted, serious virtual environments could have the same, if not greater, impact.

2.1   Emotional Responses in Immersive Environments

Immersion in an alternative, but similar and understandable world, which allows for free exploration and opportunity for meaningful problem solving and interaction, often has several positive social and emotional effects. Much research on mood and social emotional well-being focuses on casual video games (CVG) and massively multiplayer online role-playing games (MMORPG). However, these research results are equally applicable to both virtual and serious gaming. Consider the following example:

Russoniello, O'Brien, and Parks [9] set out to determine if casual video games had an impact on players' mood outside of the game, specifically positive perceived mood and/or a decrease in stress. 134 participants were randomly assigned to a control group or to the game. Together with brainwave and heart rate data, all participants completed the Profile of Mood States [10] before and after the study to determine whether mood changes occurred before and after the tasks. Participants were given a choice of three CVGs to play, while the control group completed internet searches on a health topic. "The POMS scores on Total Mood Disturbance significantly changed for all three games, supporting the theory that while there were effects on brain wave activity in different parts of the brain, the end result was improved perceived mood" [9]. Moreover, measuring empathetic responses to virtual avatars [8] and animals [7] deepen our understanding of what empathetic responses are, on a physiological level, but also about the dynamic nature of self-awareness and importance of self-reflection and personal growth.

2.2   Physiological Connection and Presence

Given a simple virtual scenario of a hand at a desk, researchers Fusaro, Tieri, and Aglioti [8] set out to compare the "behavioural and physiological reactivity of participants who observed pain and pleasure stimuli delivered to the body of an embodied avatar when viewed from an egocentric perspective [8]. Participants in the study, were seated at a desk in an unadorned room with their right hand on the desk to align with their avatars'. Participants were then told that their avatar's hand would experience three different types of stimuli from a first and the third-person perspective. Researchers fitted the participants with Oculus sets and electrode systems to monitor the heart rate (ECG) and skin conductance responses (SCR). The stimuli in the virtual environment used were needle penetration, a caress from another hand, and a ball gently touching. Respectively, this translated to pain, pleasure and neutral stimuli. The scene was devoid of any facial cues, and participants observed only the hands on the desk. After each stimulus, participants were asked to respond with the visual analog scale 0-100 for illusory ownership, intensity, and (un)pleasantness. Illusory ownership was found higher in first rather than third person perspectives. Ownership also gained a marginal increase in relation to the pain stimuli vs the pleasure.

The results of possession and presence were more significant between the first and third perspectives, but the physiological responses were only marginally different,

possibly due to variations in personal perspective and cultural background about physical touch. Further clarity about the pleasure stimulus, and perhaps a more diverse stimulus, is needed to assess whether pain really has a greater empathetic response than pleasure. Additional research could also examine response variations in various virtual environments, especially from the first person within a complete environment in which the player has little to no control over the scenarios. If participants have the ability to empathize with a disembodied hand on a desk without any other context, then it is reasonable to conclude that a deeper empathetic response and potentially more connected presence would be experienced in a saturated, precisely created environment.

2.3 Compassion Based Interventions

Compassion-based interventions (CBIs) can be effective for increasing empathy and compassion, and reducing stress, anxiety, and depression. [11] With this background in mind, researchers Cebolla et.al [11] compared the efficacy of immersive technologies versus casual meditation systems using modified virtual reality and casual meditation procedures with regard to self-compassion. Notably, the VR experience also included a post meditation body-swap experience that 'allows participants to see themselves from a third perspective and have the illusion of touching themselves from outside' [11]. The 16 participants in the study were assigned randomly to either the usual meditation (CAU) or Meditation the Machine to Be Another (TMTBA-VR). Both groups used the same audio guidance for either medication method. The Cebolla et.al [11] study found that while there was some variance in outcome, both groups showed similar and impactful increases in positive self-image. Prior to the Cebolla et. al. [11] study, Falconer et. al, [12] looked deeper into the concept of self-compassion in VR. This was achieved comparing first and third person perspectives in participatory virtual reality. As with the Cebolla et. al. study [11], participants were immersed in a simple room visually matching their actual surroundings. Recordings of head movement and physiological responses were taken during the trial. First, they proceeded through a scenario of a crying child to elicit compassion responses in a third person view, and then were immersed in the story again in first person as the child. The key finding from the Falconer study was that VR had an additional effect of positively increasing self-compassion in naturally self-critical individuals [12].

2.4 Using Music, Colour, Shape and Light in Design to Affect

While the potential of influence of emotional responses and mood can be deduced from the previously mentioned studies, the environment of the experience can play a significant role in aiding this, particularly on the concepts of music, color, shape and light.

The Musical Mood Induction Procedure (MMIP) has been used in music research for over thirty years [13]. Overall, research shows that music does have an impact on emotion, but due to variation in self-reporting and other extrinsic factors it is difficult to know with certainty what is truly altered and what is situational. Therefore, the use of technology has been implemented by the use of functional magnetic resonance imaging (fMRI) and positron emission tomography (PET). A review of current studies in

music showed that evoked emotions, fMRI and PET based studies identified areas of the brain activated during specific songs or sounds. Interestingly, fMRI shows emotional response as energy, while PET shows the same response on a molecular level. Regardless of the music sampled, participants showed autonomic response [14]. Västfjäll [13] mapped variations of musical elements and their likely emotional responses. Slow tempo produces seriousness, sadness, anxiety and even serenity, while a higher tempo can evoke humour, happiness or excitement. Low pitches tend to evoke seriousness, sadness and fear, while medium and higher pitches evoke serenity, humour, happiness and excitement. [13]. With this knowledge in mind, the creators of serious games and immersive experiences will be better able to refine their musical choices to induce certain emotional responses in the average player.

As with music, creators of impactful serious games and immersive realities must also make use of colour theory to create the intended ambiance of a scene or story. Anecdotally, colour matters, but Wilms and Oberfeld [15] explored the physiological responses to colour, hue and saturation along with perceived mood. 62 participants viewed 27 chromatic colours and 3 achromatic colours for 30 seconds each and rated their emotional state while skin conductance and heart rate were measured continuously. "The emotion ratings showed that saturated and bright colours were associated with higher arousal. The hue also had a significant effect on arousal, which increased from blue and green to red." [15]. For creators, the impact of this knowledge is clear. In order to create scenes and serious games with high emotional impact, colour saturation and hue are key.

Another crucial element is shape. Shape has long been used in art to convey emotions and personalities in stories. Regarding the psychology of shape, Arnhiem [16] suggested that shapes are simplified into three categories:

- Circle: innocence, youth, energy, femininity
- Square: maturity, stability, balance, stubbornness
- Triangle: aggression, masculinity, force

Psychologically, people associate with these shapes and their corresponding concepts due to real-life experience and the sense of touch. Through touch, people visually assess the characteristics of objects based on experience (angular = sharp = harmful). These shapes can be used to influence an individual's perception of certain elements in a VR environment, and in extension affect their mood through that pwercetion.

Finally, the use of light is an invaluable asset in VR. Light can influence the psychophysical wellbeing of an individual as it affects their perception of the world [17]. According to Tomassoni [17] light may stimulate perception through type and range of exposure and its colours can induce specific emotional states or behaviour. This stimulus is able to "excite, move, impress, communicate, heal and generate wellness, and create a sense of harmony and syntony." The strategic layout and modulation of lighting by VR designers may influence the perceiver's mood, creating a sense of calm and rest, or add mystery and suspense.

.

Practices of mindfulness and self-reflection are well-known to have positive effects and change on an individual's well-being and the above studies indicate that immersive experiences are able to connect people visually and emotionally in a way that TV, books and other forms of entertainment may not. Moreover, the creation of an immersive natural world inevitably leads to a deeper emotional response; however, eliciting this response requires a degree of openness and awareness on the part of the participant. In other words, emotions are influenced by past emotional states or pre-existing individual characteristics, dispositions and context factors [18, 19].

3 The Journey and Evaluation

3.1 The Virtual Reality Experience

Story plays a strong role in the emotional connection and involvement of people in all of the media in which it is represented. It was therefore an integral part of creating the immersive experience. Therefore, a storyboard was used to capture the overall movement of the scenes as well as base colours, and to set written guidelines for the story sequence. For this project (see Fig 1), our approach was oriented more towards a cinematic quality than one of pure game play and we developed an immersive virtual reality in Unreal [20], based on the composition of marine elements from reference images of ocean ecosystems. The models used were selected on a scientific basis of animals that co-existed in nature, interacted regularly with each other, and were native to specific locations in the Pacific [21]. The project consisted of a total of seven scenes. The scenes were conceptualized in order to elicit different emotions, namely, scene 1 (Joyful), scene 2 (Worry), scene 3 (Sad), scene 4 (Anxious), scene 5 (Mysterious), scene 6 (Calm) and scene 7 (Relief). In particular, Scene 3 (Sad) was a pivotal moment as it was designed so that the story could not continue until the user completed a task. This task was a physically reaching out to the whale and removing debris from its fin. Without any prompt from the experience, this scene was meant to elicit a response of empathy. To influence the targeted emotions/moods of each scene, the concepts of music, color, shape and light were implemented.

Using the previous knowledge on the influence of music, the animation, story, and movement of each scene were all created to revolve around the music. The music needed to enhance and, in some instances, cause the change of mood as the story progressed. Therefore, the tempo, volume, rhythm, and harmony were carefully chosen through many hours of testing with each scene. Likewise, ambient whale sounds played a pivotal role. Raw whale audio vocalisations were added through the story to convey emotional aspects of the whales. For instance, the 2nd scene included a whale crying out for its mother to evoke worry, while the final scene includes the inviting sounds of a pod of whales, calling out and welcoming the young calf in to join them to evoke the emotion of relief.

As mentioned previously, colour is a powerful tool that can be used to influence mood and emotions. Consequently, the psychology of colour was carefully applied throughout the project and was at the forefront of the design process. Since each scene was broken down into a target emotional response, colour was added according to the

mood. To give an example, the first scene was meant to have a jovial, energetic ambience, therefore oranges and yellows were used in more abundance as these colours tend to elicit feelings of enthusiasm and excitement. Conversely, the third scene was designed with a solemn and lonely atmosphere, and as a result, deep blues and desaturated colours were used instead [22].

Shape theory was also applied to the environment of the experience. This was achieved by adding softer, rounder elements (such as rocks and coral) in the beginning scenes, and as the mood and narrative became more tense, harsher, sharper elements were introduced to surround the viewer. These are subtle changes that can influence the viewer on a subconscious level.

Finally, light and fog were implemented per scene to fit the corresponding targeted moods. An illustration of this would be the second scene in story. This scene was a pivotal point in the story, one that involves tragedy and loss. Hence, there is a greater amount of fog and murkiness, framing the shapes in the distance to appear unsettling and slighting out of focus. Additionally, the sunlight did not shine as brightly through the surface of the water as it had in the previous scene. This in turn helped create a general sense of uneasiness and foreboding.

The project is available for download at the following location (anonymized for blind review).
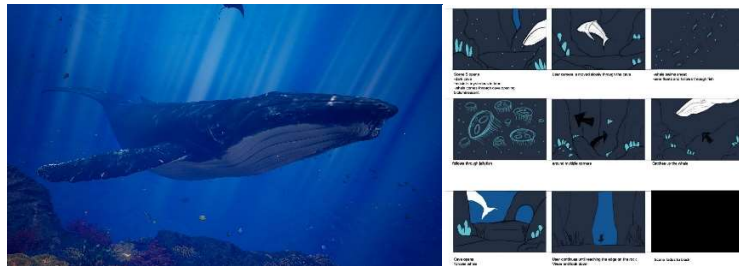
Fig. 1. A screenshot of the Immersive VR Narrative "The Journey" and storyboard for scene 5

3.2 Measurements protocol

After the completion of the project, a study was conducted using self-reporting measures. For each participant, these questionnaires were used and collected via an online link. These were applied in two phases: the baseline and the reflection.
For the baseline phase, the questionnaires were implemented before the playthrough of the experience to establish their natural baselines. These questionnaires consisted of a mood evaluation (MQ), the Positive and Negative Affect Schedule (PANAS), and the modified Five Factor Mindfulness Scale (FFMQ-15).

The (MQ) required participants to rate how they feel at this moment in time on a 7-point Likert scale (where 1 = not at all to 7 = extremely), with reference to each of the moods measuring Happiness, Sadness, Anger, Surprise, Disgust, Anxiety, and Quietness. The (PANAS) was composed of a list of 20 adjectives used to describe 10 positive emotions (which compose the global Positive Affect Score) and 10 negative emotions

(which compose the global Negative Affect Score). Respondents are required to indicate the extent they experience the emotions included on the schedule "in the past week" on a five-point scale (where 1 = very slightly or not at all, to 5 = extremely). The (FFMQ-15) is the short form of the 39-item FFMQ [23]. It includes the same five facets at the long form: Observing, Describing, Acting with Awareness, Non-Judging of inner experience, and Non-Reactivity to inner experience. This measure is composed of a list of 15 statements used to describe the participants. Respondents are required to indicate the extent the statement is true to themselves on a five-point scale (where 1 = Never, or very rarely, to 5 = Very often or always true).

For the reflection phase, participants completed questionnaires after the completion of the VR experience. During this phase, these questionnaires were applied per each scene to assess each targeted emotion. These were the (MQ), (PANAS), emotional storytelling questions (ESQ), and the modified Slater-Usoh Steed Questionnaire (SUS-3). The (ESQ) rates how connected participants felt to the story at the moment of the scene on a 5-point scale (where 1 = not at all to 5 = extremely), with reference to targeted responses per each scene. Participants were asked three scene specific questions pertaining to their emotional connection. The (SUS-3) measures presence on a 7-point Likert scale asked the questions per each scene:

Table 1. VR (SUS-3) Questionnaire.

SUS1	"To what extent were there times during the experience when the environment was reality for you?"
SUS2	"Rate your sense of being in the specific environment?"
SUS3	"During the time of the experience, which was the strongest on the whole, your sense of being in the environment, or of being elsewhere?"

4   Results and discussion

4.1   Experiment

Ten virtual reality equipment owners took part in the experiment. Participants did not receive any payment or credit for their collaboration and were all volunteers. All users of the application experienced the VR experiment in their own homes and without supervision.

The virtual program was run on the participants' home headset and personal computer. The headset was required to be an Oculus, either the Rift, Rift S, or the Quest, with the latter requiring Oculus Link. The PC to operate the program was expected to have a graphics card equivalent to a GeForce Nvidia 1060 or similar compatible card, as well as at least one controller. As the physical space was unable to be regulated, each participant was advised to have a standing room area of at least 1.5 meters by 1.5 meters. The experiment was then divided into three main phases: baseline, navigation, and reflection. This was due to Covid restrictions, as at the time in person studies were unable to be conducted. The study consisted of four phases: Baseline, Navigation, Reflection, and Analysis.
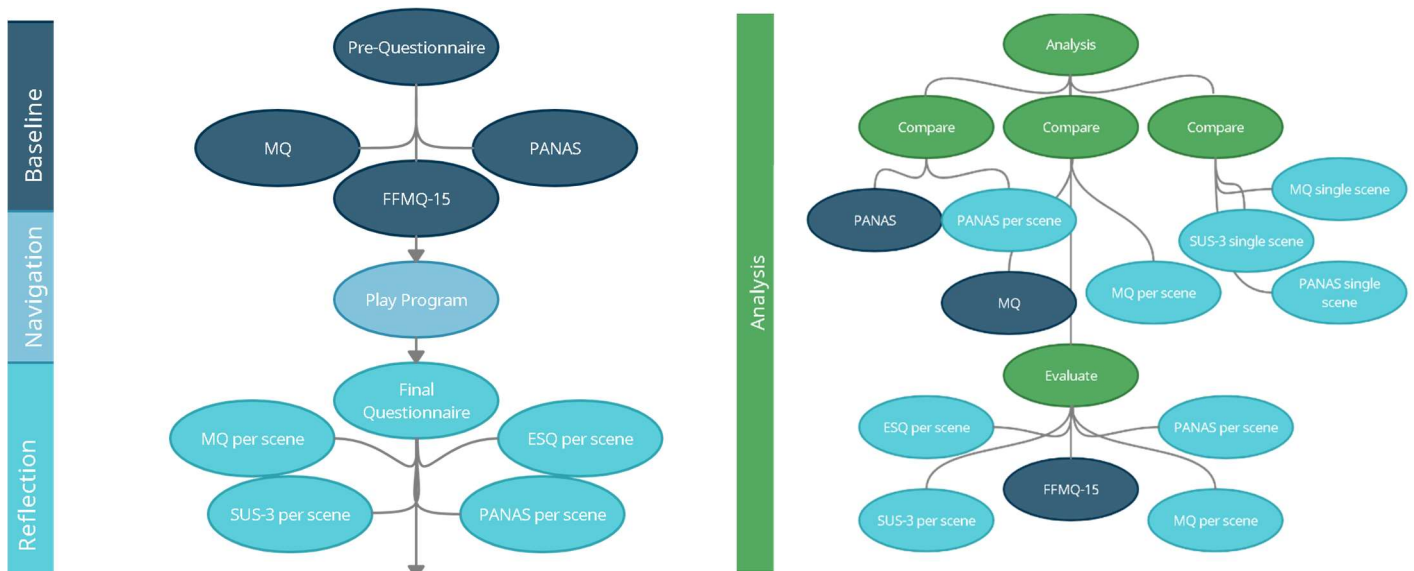
Baseline phase. For the first phase, participants were invited to complete the MQ, PANAS, and FFMQ-15 questionnaires as a means to assess their baseline emotional and mindfulness state. These questionnaires were completed online via a provided link to each participant. At the end of the questionnaires, participants were provided with one link to download the project and a second link providing the final set of questionnaires to be completed after the VR program.

Navigation phase. Once the participants had downloaded the program, it was then played through to its entirety. Navigation for the user in each scene was open to their available standing room and lasted about 2 minutes per scene, with the user having little influence on the progression of the story. At the end of the seventh scene, the credits rolled, and the program automatically ended itself.

Reflection phase. After the completion of the VR experience, participants returned to the link previously provided in the baseline phase to complete the final set of questionnaires. The MQ, PANAS, ESQ, and SUS-3 were provided per each of the seven scenes in order to assess their emotional state, presence, and emotional story connection elicited by each environment.

Analysis. The analysis began with scoring calculations for the standard questionnaires to assess the effectiveness of virtual environments in evoking emotions. The PANAS, MQ, SUS-3, and ESQ were all scored with direct scoring, and the FFMQ-15 with a combination of direct and reverse scoring. This resulted in a mean (M) and a standard deviation (SD) based on sample size.

Fig. 2. Project Phases

4.2   Results

A comparison was carried out to explore the changes of the mood states (PANAS and MQ) before (baseline) and after the first scene of the application. As the baseline PANAS measured the participants' mood over the past week compared to at this moment of the first scene, the data showed different significant changes. The first scene indicated a reduction in the positive affect and the negative affect schedules (see Table 2). The initial intention behind using the in the last week as opposed to at this moment was to get an indication of the total range of moods from the participants. In contrast, the MQ was measured both as at this moment before and after the first scene. Consequently, it showed an increase/decrease as expected. The scene significantly increased happiness and surprise, while reducing sadness and anxiety (see Table 2).

Table 2. Comparison of Mood States.

PANAS	Baseline (Pre-Questions)	Scene 1 (Joyful)
Positive Affect	M = 33.8 / SD = (1.16)	M = 28.8 / SD = (1.33)
Negative Affect	M = 18.8 / SD = (1.21)	M = 11.1 / SD = (.35)
Mood (MQ)		
Happiness	M = 4.8 / SD = (1.03)	M = 5.7 / SD = (1.25)
Sadness	M = 1.6 / SD = (.69)	M = 1 / SD = (0)
Anger	M = 1.1 / SD = (.32)	M = 1.2 / SD = (.63)
Surprise	M = 1.6 / SD = (1.07)	M = 2.8 / SD = (1.87)
Disgust	M = 1.1 / SD = (.32)	M = 1.2 / SD = (.63)
Anxiety	M = 3 / SD = (1.6)	M = 1.3 / SD = (.67)
Quietness	M = 3.9 / SD = (2.56)	M = 3.3 / SD = (2.31)

In addition, the FFMQ-15 was analysed to determine a general mindfulness/self-reflection factor of the participants before the experience. This was divided into its five factors and assessed accordingly. These subscales are rated with a range of 3-15. The highest score was achieved with a mean (M) of 11.9 in Observing, followed by Describing (11.1). The lowest levels were noted in Acting with Awareness (9.18) and Non-Reactivity (9.00) (see Table 3).

Table 3. Baseline of Mindfulness Factors.

Five Facet Mindfulness Questionnaire (FFMQ-15)	Baseline (Pre-Questions)
Observing	M = 11.9 (3.93) / SD = (1.05)
Describing	M = 11.1 (3.70) / SD = (.98)
Acting with Awareness	M = 9.18 (3.06) / SD = (1.14)
Non-Judging	M = 10.90 (3.63) / SD = (.92)
Non-Reactivity	M = 9.00 (3.00) / SD = (1.08)

Following the preliminary survey, separate analyses of mood and emotion were carried out from each of the seven scenes.

First, the PANAS was considered across all seven scenes. The positive affect schedule showed some variation through all scenes, with the lowest recorded at 21.4 and the highest at 28.7. In contrast, the negative affect schedule showed a significant difference between the lowest (11.0) and the highest (22.9). As expected, scene 6 (calm) and 7 (relief) lead the highest levels on the positive affect schedule, (28.4) and (28.7) respectively. Similarly, scenes 2 (worry), 3 (sad), and 4 (anxious) marked the highest increases on the negative schedule at 22.9, 18.9, and 22.1 (see Table 4). It is also noted that the highest levels all exceed the previously recorded baseline at 18.8 (see Table 2).

Table 4. Difference PANAS across 7 Scenes.

PANAS	Scene 1 (Joyful)	Scene 2 (Worry)	Scene 3 (Sad)	Scene 4 (Anxious)	Scene 5 (Mysterious)	Scene 6 (Calm)	Scene 7 (Relief)
Positive Affect	M = 28.8 / SD = (1.33)	M = 21.6 SD = (1.35)	M = 23.9 SD = (1.40)	M = 21.4 SD = (1.42)	M = 27.4 SD = (1.44)	M = 28.4 SD = (1.56)	M = 28.7 SD = (1.51)
Negative Affect	M = 11.1 SD = (.35)	M = 22.9 SD = (1.37)	M = 18.9 SD = (1.25)	M = 22.1 SD = (1.45)	M = 11.5 SD = (.61)	M = 11.0 SD = (.50)	M = 11.1 SD = (.39)

Next the mood questions (MQ) were evaluated across all scenes. As presumed, happiness was recorded at its highest at 6.1 in scenes 1 (joyful), 5 (mysterious), 6 (calm), and 7 (relief). Scenes 2 (worry), 3 (sad), and 4 (anxious) marked a significant decrease in happiness at 1.7, 2.3, and 1.7. Similarly, sadness markedly increased for scenes 2, and 3, at 5.1 and 5.9, with a reduction in scenes 1 (1) and 6(1). Anger and surprise also have notable increases in scenes 2 and 3, the highest being in scene 2 with anger at 3.5 and surprise at 4. Finally, anxiety increased in scenes 2, 3, 4 at 4.4, 3, and 5 respectively. Interestingly, quietness varied from 2.7 to 5 with no discernible pattern, and with the largest standard deviations compared to all other moods (see Table 5).

Table 5. Difference of Mood States across 7 Scenes.

Mood (MQ)	Scene 1 (Joyful)	Scene 2 (Worry)	Scene 3 (Sad)	Scene 4 (Anxious)	Scene 5 (Mysterious)	Scene 6 (Calm)	Scene 7 (Relief)
Happiness	M = 5.7 SD = (1.25)	M = 1.7 SD = (1.56)	M = 2.3 SD = (2.06)	M = 1.7 SD = (1.25)	M = 5 SD = (1.69)	M = 5.6 SD = (1.57)	M = 6.1 SD = (1.1)
Sadness	M = 1 SD = (0)	M = 5.1 SD = (2.08)	M = 5.9 SD = (1.1)	M = 2.2 SD = (1.75)	M = 1.2 SD = (.42)	M = 1 SD = (0)	M = 1.3 SD = (.94)
Anger	M = 1.2 SD = (.63)	M = 3.5 SD = (2.41)	M = 3.2 SD = (1.81)	M = 2.2 SD = (2.29)	M = 1 SD = (0)	M = 1 SD = (0)	M = 1.3 SD = (.94)
Surprise	M = 2.8 SD = (1.87)	M = 4 SD = (1.33)	M = 3 SD = (2.21)	M = 2.8 SD = (1.75)	M = 1.8 SD = (1.31)	M = 2.4 SD = 1.16	M = 1.9 SD = (1.28)
Disgust	M = 1.2 SD = (.63)	M = 2.7 SD = (2.06)	M = 1.6 SD = (.96)	M = 1.5 SD = (.97)	M = 1 SD = (0)	M = 1 SD = (0)	M = 1 SD = (0)

Anxiety	M = 1.3 SD = (.67)	M = 4.4 SD = (2.17)	M = 3 SD = (1.76)	M = 5 SD = (2.4)	M = 1.5 SD = (1.26)	M = 1 SD = (0)	M = 1.4 SD = (.96)
Quietness	M = 3.3 SD = (2.31)	M = 2.9 SD = (2.18)	M = 4 SD = (2.0)	M = 2.7 SD = (2.49)	M = 5 SD = (2.31)	M = 4.9 SD = (1.72)	M = 3.5 SD = (2.54)

Lastly, results gathered to test emotional connections were assessed. On the 5-point Likert scale, all scores remained above 3 during all scenes. Interestingly, there was an unexpected drop in emotional connection during scene 2 (worry), at the lowest recorded (3.43), as well as recording the largest standard deviation. However, as expected, it increased to 4.56 in scene 3 and recorded highest in scene 5 at 4.83 (see Table 6 and Figure 2).

Table 6. Emotional story connections – Emotional Story Questions (ESQ).

	Scene 1 (Joyful)	Scene 2 (Worry)	Scene 3 (Sad)	Scene 4 (Anxious)	Scene 5 (Mysterious)	Scene 6 (Calm)	Scene 7 (Relief)
ESQ	M = 4.2 SD = (.92)	M = 3.43 SD = (1.65)	M = 4.56 SD = (.81)	M = 4.1 SD = (1.49)	M = 4.83 SD = (.87)	M = 4.63 SD = (.76)	M = 4.63 SD = (.61)

After finding that the scenes in the story were able to induce the expected mood states and emotion, the association between presence and emotion was investigated. The data (see Table 7) showed a constant level of presence above 5.6 on the 7-point Likert scale. Furthermore, the level of presence was highest in scene 6 (calm) at 6.36.

Table 7. Presence level between 7 scenes

	Scene 1 (Joyful)	Scene 2 (Worry)	Scene 3 (Sad)	Scene 4 (Anxious)	Scene 5 (Mysterious)	Scene 6 (Calm)	Scene 7 (Relief)
SUS (Presence)	M = 5.9 SD = (1.03)	M = 5.6 SD = (1.27)	M = 6 SD = (1.31)	M = 6.06 SD = (1.14)	M = 6.03 SD = (1.51)	M = 6.36 SD = (1.24)	M = 6.16 SD = (.91)

To better investigate the possible relationship between emotion and presence, two scenes between the presence level (SUS-3) and the PANAS and MQ were analysed (see Table 8). These scenes were scene 6 and scene 2, which had the highest and lowest values of presence respectively. Scene 6 (calm) recorded the 2nd highest level on the positive affect schedule (28.4) and the lowest level on the negative affect schedule (11.0). Furthermore, scene 6 indicated the 2nd highest level of quietness (4.9) and the 3rd highest of happiness (5.6). In contrast scene 2 (Worry) with a presence of (5.6) indicated the 2nd lowest on the positive affect schedule (21.6) and the highest on the negative (22.9). In addition, it had the lowest level of happiness (1.7), the highest level of anger (3.5), disgust (2.7), anxiety (4.4) and surprise (4), with the second highest degree of sadness (5.1).

Table 8. Comparison of Presence and Mood

PANAS	Scene 2 (Worry)	Scene 6 (Calm)
Positive Affect	M = 21.6 SD = (1.35)	M = 28.4 SD = (1.56)
Negative Affect	M = 22.9 SD = (1.37)	M = 11.0 SD = (.50)
Mood (MQ)		
Happiness	M = 1.7 SD = (1.56)	M = 5.6 SD = (1.57)
Sadness	M = 5.1 SD = (2.08)	M = 1 SD = (0)
Anger	M = 3.5 SD = (2.41)	M = 1 SD = (0)
Surprise	M = 4 SD = (1.33)	M = 2.4 SD = 1.16
Disgust	M = 2.7 SD = (2.06)	M = 1 SD = (0)
Anxiety	M = 4.4 SD = (2.17)	M = 1 SD = (0)
Quietness	M = 2.9 SD = (2.18)	M = 4.9 SD = (1.72)
SUS (Presence)	M = 5.6 SD = (1.27)	M = 6.36 SD = (1.24)

5 Conclusion

The driving force of this project was the ability to create an immersive story in VR that would effectively portray emotions and induce emotional responses. This endeavour was undertaken by the careful review of storytelling elements, as well as the analysis of relevant immersive models on mindfulness, self-reflection, and emotional impact. While the development of the experience took considerable time to implement, the data recorded suggests a successful execution. The values regarding presence (SUS-3) showed a consistently high rate across all scenes, indicating a high degree of immersion. Furthermore, the ESQ gross values showed an above average emotional connection to the specifics in each scene, as well as the individually evaluated values.

Likewise, as recorded in the results, the targeted MQ followed a distinct pattern across all scenes, with the values indicating the expected targeted emotions for each scene. The exception to this was the quietness value of the MQ. Dissimilar to the other factors, quietness did not have a discernible pattern, and had a larger standard deviation. This may be due to different interpretations of the word. Whereas happiness and

sadness are easy to identify with, it is possible that quietness is too complex to connect with, (especially across cultures) suggesting the need to change the word used. If, for instance, the word had been changed to calmness, based on the other MQ values, it would have been expected to have a more recognisable pattern.

Additionally, the PANAS was significantly successful in showing positive values in the scenes deemed to have positive emotions, and negative values in the scenes with negative emotions, so much so that the negative values outweighed the baseline values of participants for the past week. To surmise, the creation of an immersive VR story that portrays and induces emotions is deemed as successful by this study.

The self-reflection after the experience does not have a measurable value in this study. The use of the FFMQ-15 before the experience, set out an overall value of mind-fulness and self-reflection values. On average, the participants were in the above average to high range on this scale. However, the success of self-reflection is evident based on the success of the other data recorded after the experience. Participants were required to experience all seven scenes before filling out the final questionnaire. Therefore, participants had to critically reflect on each scene in terms of their emotions, moods and presence, after the entire experience. Since the recorded data followed the projected result, one can assume that the experience was successful in depicting and evoking emotions. Thus, if the experience in this aspect was meaningful enough for the user to remember and record its effects, one can infer that this high degree of impact corresponds to a high degree of self-reflection.

In addition, based on the expected results of the questionnaire, it was concluded that the combined narrative elements in VR (colour, shape, light and music) could successfully evoke and represent emotions. The literature identified several elements that create a compelling emotional connection in storytelling: colour, shape, music and light. On the subject of music, the ESQ did create a strong connection to participants, when asked "the music made me feel..." Additionally, as mentioned in the previous section, the PANAS noted a higher positive affect in scenes that featured saturated bright colours, and a negative affect with desaturated colours. However, colour, shape, and light were not individually evaluated by the user. Instead, they were combined as a stealth element to influence an emotional connection in the storytelling. In this aspect, it is believed to be effective, as the data recorded (ESQ) high emotional connection across, and the expected changes in the PANAS. With that in mind, while these elements are effective combined, further exploration is needed to assess the individual elements pertaining to successful emotional connections in stories. Nevertheless, it is recommended that more specific research be carried out on each element to determine the individual effects and effectiveness, either through qualitative or quantitative methods.

References

1. The Health Foundation (2016) The power of storytelling. In: The Health Foundation. https://www.health.org.uk/newsletter-feature/power-of-storytelling. Accessed 11 Jun 2020

2. Emblematic (2012) Hunger in L.A. In: Emblematic. https://emblematicgroup.com/experiences/hunger-in-la. Accessed 22 Jul 2020

3. Emblematic (2016) Across the Line. In: Emblematic. https://emblematicgroup.com/experiences/across-the-line. Accessed 22 Jul 2020

4. Aardman (2016) We Wait. In: Aardman.com. https://www.aardman.com/work/we-wait. Accessed 28 Jul 2020

5. Fiocco A, Mallya S (2014) The Importance of Cultivating Mindfulness for Cognitive and Emotional Well-Being in Late Life. Journal of Evidence-Based Complementary & Alternative Medicine 20:35-40. doi: 10.1177/2156587214553940

6. 12. Bennett-Levy J, Lee N (2012) Self-Practice and Self-Reflection in Cognitive Behaviour Therapy Training: What Factors Influence Trainees' Engagement and Experience of Benefit?. Behavioural and Cognitive Psychotherapy 42:48-64. doi: 10.1017/s1352465812000781

7. Ahn S, Bostick J, Ogle E et al. (2016) Experiencing Nature: Embodying Animals in Immersive Virtual Environments Increases Inclusion of Nature in Self and Involvement With Nature. Journal of Computer-Mediated Communication 21:399-419. doi: 10.1111/jcc4.12173

8. Fusaro M, Tieri G, Aglioti S (2016) Seeing pain and pleasure on self and others: behavioral and psychophysiological reactivity in immersive virtual reality. Journal of Neurophysiology 116:2656-2662. doi: 10.1152/jn.00489.2016

9. Russoniello, C., O'Brien, K, and Parks, J., 2009. The Effectiveness of Causal Video Games in Improving Mood and Decreasing Stress. Journal of Cybertherapy and Rehabilitation. 2(1), pp. 53-66.

10. McNair, D. M., Lorr, M. & Droppleman, L. F. (1981). Profile of mood states. San Diego: Educational and Testing Industrial Testing Service.

11. Cebolla A, Herrero R, Ventura S et al. (2019) Putting Oneself in the Body of Others: A Pilot Study on the Efficacy of an Embodied Virtual Reality System to Generate Self-Compassion. Frontiers in Psychology. doi: 10.3389/fpsyg.2019.01521

12. Falconer C, Slater M, Rovira A et al. (2014) Embodying Compassion: A Virtual Reality Paradigm for Overcoming Excessive Self-Criticism. PLoS ONE 9:e111933. doi: 10.1371/journal.pone.0111933

13. Västfjäll D (2001) Emotion induction through music: A review of the musical mood induction procedure. Musicae Scientiae 5:173-211. doi: 10.1177/10298649020050s107

14. Schaefer H (2017) Music-Evoked Emotions—Current Studies. Frontiers in Neuroscience. doi: 10.3389/fnins.2017.00600

15. Wilms L, Oberfeld D (2017) Color and emotion: effects of hue, saturation, and brightness. Psychological Research 82:896-914. doi: 10.1007/s00426-017-0880-8

16. Arnheim R. (1954) Art and Visual Perception. University of California Press. pp.10-444

17. Tomassoni R, Galetta G, and Treglia E, (2015) Psychology of Light: How Light Influences the Health and Psyche. Psychology. [e-journal] 6(10), pp.1216-1222. https://doi.org/10.4236/psych.2015.610119.

18. Verduyn P, Brans K (2012) The relationship between extraversion, neuroticism and aspects of trait affect. Personality and Individual Differences 52:664-669. doi: 10.1016/j.paid.2011.12.017

19. Kim S, Park G, Lee Y, Choi S (2016) Customer emotions and their triggers in luxury retail: Understanding the effects of customer emotions before and after entering a luxury shop. Journal of Business Research 69:5809-5818. doi: 10.1016/j.jbusres.2016.04.178

16

20. Epic Games Unreal Engine https://www.epicgames.com/site/en-US/home
21. NOAA Fisheries (2020) All Species Directory Page. In: Fisheries.noaa.gov. https://www.fisheries.noaa.gov/species-directory. Accessed 10 April 2020
22. Cherry, K., 2020. Can Color Affect Your Mood And Behavior? [online]. Verywell Mind. Available at: <https://www.verywellmind.com/color-psychology-2795824> [Accessed 17 April 2020].
23. Baer R, Smith G, Hopkins J et al. (2006) Using Self-Report Assessment Methods to Explore Facets of Mindfulness. Assessment 13:27-45. doi: 10.1177/1073191105283504