

Designing Mind(set) and Setting for Profound Emotional Experiences in Virtual Reality

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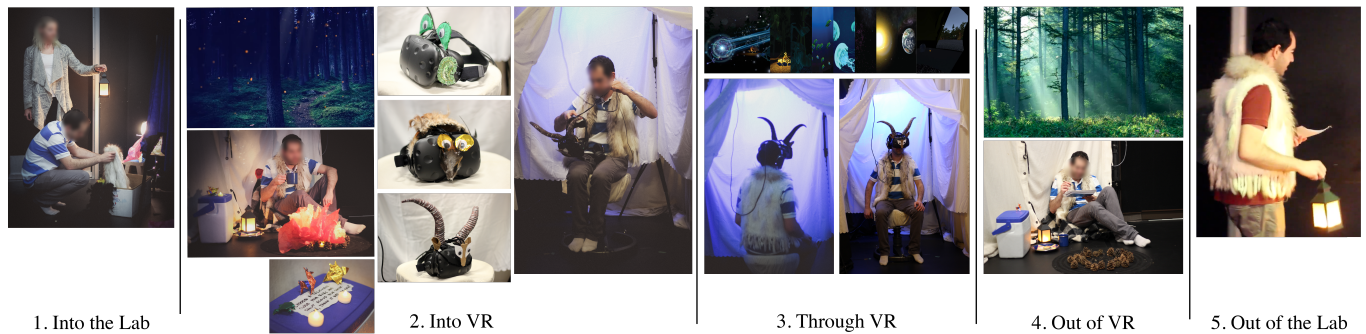


Figure 1. Five stages of the multisensory experience: into the lab, into VR, through VR, out of VR, and out of the lab. For more detail, please see this supplementary video: <https://youtu.be/SW6hN13mgJw>

ABSTRACT

Virtual reality (VR) has the potential to support profound emotional experiences, such as experiencing awe when virtually viewing the Earth from space. In doing so, VR can potentially both give people positive emotional experiences contributing to their overall well-being and give researchers a way to study these profound emotional experiences in a more controlled environment. Through a design refinement process, we explored the potential influence of the “set and setting”—one’s mindset and the physical and social environment—when transitioning people into and out of VR designed to support profound emotional experiences. We present our findings from a design refinement session and a case study exploring how set and setting may support the profound emotional experience of awe. We discuss common themes in user experience and trends of awe-related measures. Our results contribute to the discourse around the role of the design of set and setting in overall user experience.

Author Keywords

virtual reality, user experience, design, positive technology, emotion, awe

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CCS Concepts

•Human-centered computing → Virtual reality; User studies; User centered design;

INTRODUCTION

Virtual Reality (VR) allows for realistic sensory simulations in which a person can perceive, feel, and interact in a way that is similar to real-world [46] when they are exposed to a vivid illusion of reality [58]. One application of VR involves using it to induce experiences capable of leading to improvement of well-being and positive emotions [30, 81], which generally refer to the interconnected dimensions of physical, mental, and social health [16, 61]. VR is especially useful in supporting specific types of profound positive emotions, such as wonder and awe [9, 10, 52], because these emotions are complex and embodied, hence need a suitable medium able to provide a multisensory embodied experience. The ability to use VR to support profound emotions provides new opportunities and also raises new questions for design research [20]. Most previous research in VR involved health care interventions, training simulations, and entertainment applications [13, 64]. However, a growing number of VR experiences is intended to induce specific positive emotional states in a controlled environment [12, 81]. These VR experiences can not only be used to put an individual in impossible or inaccessible situations, such as seeing the Earth from space [54], but also help researchers understand the specific manipulations that influence these profound experiences.

Using consumer grade VR headsets, e.g., HTC Vive, and custom software, e.g., Unity3D, helps make it feasible to de-

sign virtual environments (VE) that may enable people to experience profound positive emotions, and thus increase well-being [4, 55]. The potential benefit of increasing exposure to emotional experiences could affect millions of lives since there is a lot of evidence that well-being and positive human functioning are both correlates and outcomes of these experiences (see review [82]). For example, one in four people worldwide are affected by mental or neurological disorders at some point in their lives that negatively affect their well-being [1]. Exposure to positive emotional experiences, such as spirituality and nature, is dwindling [26]. If we can provide people with an effective alternative to experience profound positive emotions, then this may improve mental well-being for millions of people. The overarching research question for this design space is then:

(How) can we design VR experiences that are effective at supporting profound positive emotions? And, if so, what are the important design features of such experiences that contribute to promoting profound positive emotions?

Preliminary studies have begun to use VR for studying awe, one of several profound positive emotions, in lab settings [9, 10, 53, 74]. Although we focus specifically on the positive qualities of awe in this study, awe is a complex emotion characterized by intense feelings of astonishment, wonder and connectedness that arises when one is confronted with something vast that transcends previous knowledge schemas [29]. Studies have yet to reproduce intense feelings of awe, possibly because of the sterile lab conditions. Thus, there is an opportunity to shape user experience by designing the journey leading to profound emotional experiences from the moment the immersant, person immersed in VR, arrives at a space, where they will enter a VE, to the moment they leave that space. Here, the immersant is gradually transitioned to another reality rather than simply putting on an “immersive” headset and expecting to have this intense and profound experience. Already we have seen researchers studying the effects of gradual transitions in VR to increase presence [28, 32, 66, 69, 70, 75]. Nonetheless, these studies have so far only focused on the visual transitions rather than the emotional and embodied transitions that are important to profound emotional experiences. Moreover, the space after the VR experience may be important for immersants to reflect and accommodate what they just experienced. There are few research-based design guidelines for the design space of VR-based profound emotional experiences and the set and setting surrounding it [7, 10].

Our goal is to provide design knowledge that can support other HCI researchers and designers to explore and contribute to experiences surrounding immersive technologies such as VR. First, we design a prototype of transition space in and out of VR and focus on the specific design elements that support our intended user experience in VR, in this case the feeling of awe. Second, we refine our design elements and improve user experience through a design refinement process inspired by future workshops and walk-throughs. We sketch and discuss the outcomes of the workshop. Third, we explore the potential of set and setting for supporting profound emotional experiences with our revised design in a case study by using

semi-structured interviews and behavioural measures. A case study approach facilitates exploration of a phenomenon within its context using a variety of data sources. A case study is used because this topic is relatively new and needs exploration first, and we seek to capture the complexity and variability of participant responses before narrowing the scope of research in a more controlled study.

The intended goal of the virtual experience is to support a profound emotional experience of awe. Our research question for this study asks *how can gradual transitions into a VE support the experience of presence, a profound emotional experience, and correlates of awe, such as diminished perceived self-size, creativity, and pro-social behaviour?* Furthermore, *what design features are important in creating the set and setting for the virtual experience?* We present the findings of both our design workshops and case study, and discuss common user experience themes suggesting the promise of set and setting in supporting profound emotional experiences in VR. In the future, a more wide-scaled controlled experiment would enable us to make stronger claims about the effectiveness of set and setting. Our work makes the following contributions:

1. a research prototype and case study that explores transitional elements supporting the profound emotional experience in VR;
2. user experience themes for supporting profound emotional experiences in VR based on both our design workshops and case study results that through discussion can contribute to future development of design considerations.

RELATED WORK

This project intersects multiple fields: it builds on theories of profound emotional experiences, incorporates positive technology, and is inspired by both non-media and media’s use of ceremony and gradual transitions into and out of experience.

Profound Emotional Experiences

Defining Profound Emotional Experiences

Profound emotional experiences refer to a feeling of very great or abnormal intensity to an experience, often accompanied by a feeling of unity or ineffability [68]. Profound emotional experiences are congruent with the characteristics associated with mystical, peak, aesthetic, and self-transcendent experiences. Researchers have provided a vast amount of evidence that these varieties of profound emotional experiences are both correlated with and directly result in well-being and positive human functioning—see reviews [35, 65, 82]. These well-being outcomes include mental and physical well-being, prosociality, self-management, and life quality and satisfaction [6, 21, 79]. Yet, accessibility to these experiences is limited due to many factors, including decreasing exposure to both nature [39] and spirituality [18] in parts of western society in recent years.

Technology and Profound Emotional Experiences

Technologies can provide novel opportunities to experience phenomena that might not otherwise be available, including profound emotional ones—see Mossbridge [42] for a recent review. Immersive VR can enhance research of profound emotional experiences because it offers realistic simulations with

a high degree of experimenter control; researchers can track behaviour and correlate it with the provided multisensory experience; it can be integrated into narrative contexts, supporting a sense of presence [25]; and VR can produce "impossible" situations to investigate research paradigms [57], which can extend to better understanding so-called ineffable profound emotional experiences. Yet, we still do not know the full potential of using VR to support profound emotional experiences, or how to best design for such experiences. That is, what are its limits and challenges? Some researchers have proposed that combining immersive VR with gaming and narratives can possibly create novel and powerful ways to induce profound emotional experiences [19].

Specific examples of VR supporting profound emotional experiences are sparse but show promise for future investigation. Immersive VR experiences of the Earth from space can elicit awe in people [53, 74]. Similarly, a virtual scene of high snow mountains, a forest, and the Earth can induce higher levels of awe and presence compared to a neutral VE [10]. Several meditation-inspired virtual experiences exist too. *DEEP* [76], *Life Tree* [47], and *Pulse Breath Water* [50] use breathing biofeedback to control virtual nature elements. Both *The Meditation Chamber* [62] and *Inner Garden* [56] use forms of meditation to lower stress and promote self-reflection. These experiences all make use of immersive VR, which block out audio-visual distractions and help participants focus on the experience. Yet, simply putting a headset on someone and expecting them to have a profound emotional experience seems optimistic at best. It seems like there might be a better way to ease people into and out of VR in a way that better supports and aligns with profound emotional experiences.

Set and Setting

Most VR research so far has focused on the experience of being in VR and the effects after exiting, and little work has been done on the set and setting surrounding VR [32]. The set (short for mindset) and setting (physical and social environment) might be important for both preparing for VR and giving space for reflection and accommodation after VR. Many forms of immersive media use transitions to support a particular mood or response, e.g., theme parks and theatres. The experience itself seems to be greatly influenced by the actions and thoughts that come directly before and after actually engaging with it. Therefore, designing for the set and setting might better support profound emotional experiences in VR.

Set and Setting in Everyday Life

In our everyday life we experience transitions, often in the form of ceremony or ritual, e.g., getting ready for the day or winding down after work. These rituals seem to prepare us mentally and physically for the intended activity, and not doing them can have negative consequences, for instance, not taking a bath before bed may lead to a bad sleep. These rituals are not only ingrained in our everyday lives, but also in contexts such as art galleries, spiritual or religious practices, and drug-induced altered states of consciousness. The key to supporting a profound emotional experience is by carefully considering the design of *set and setting* —a term first coined by Alfred Hubbard and later used by Timothy Leary and colleagues to describe the importance of the physical, mental, social, and

environmental context one brings into a psychedelic experience [33]. A recent study on the phenomenology of lucid dreaming, knowing one is dreaming while dreaming, supports the idea of ceremony as being integral for having introspective experiences [31]. These non-media examples may be helpful in informing the design of profound emotional experiences in VR because the field is relatively new and there is little guidance on how to do so.

Set and Setting in Performance and Entertainment

We see set and setting in media all the time, such as going to the movies, theme parks, art installations, and black box theatre. The entertainment industry especially has exploited the fact that transitioning people into and out of media gradually and effectively helps to support and enhance the total experience, often leading to a more positive user experience and greater profit [22]. Theme parks, such as Disney, have used 3D projections to enhance the experience of attractions such as the *Haunted Mansion*, the *Tower of Terror*, *Snow White's Scary Adventures*, and *The Storytellers Sandbox* [41]. Video games use foreshadowing and pre-experience narrative to spark curiosity and enhance perceived continuity [60, 80]. In immersive theatre, Punchdrunk spectators don masks before being set free in the performance space, allowing their inhibitions to fall away so that they can fully explore their surroundings and become totally absorbed in the world around them [51]. Benford and colleague's [5] trajectories framework points to the importance of continuity through an experience. They have identified key transitions to consider to maintain continuity, most relevant to our project being *beginnings and endings* and *traversals between physical and digital worlds*. Beginnings must be designed to introduce narrative, build suspense, brief participants, and deal with practical concerns. Endings must be designed to encourage participants to re-engage with the experience, which can include ritual debriefings. For traversals between physical and digital worlds, one should embed the virtual technology within the space so that the virtual extends outwards. Moreover, participants should be physically separated from potential distractions; and the use of doorways, curtains, or passageways can both physically and mentally transport the participant into and out of the virtual space. Set and setting in these existing performance and entertainment spaces could provide a rich insight into how they affect user experience in VR, particularly how set and setting affect the ability of VR to support profound emotional experiences. These frameworks and best practices guided our design, which we detail later.

Set and Setting in VR

Some of the earliest studies looking at designing VR set and setting come from Disney's VR Studio and Imagineering. In *Aladdin's Magic Carpet Ride*, they found that narrative before VR helped ease people into VR [48]. In *Pirates of the Caribbean*, interactive story structure helped satisfy a guest by dividing the experience into three phases: an introduction to learn the interactions, the main experience for players to explore, and an exiting conclusion to bring closure [40]. Other researchers found improved awareness and perceived interactivity [75] as well as improved illusion of virtual body ownership and presence [28] when users are not directly "thrown" into an unknown virtual world but start their journey from

a replica of the room which slowly morphs into the desired virtual world. Similarly, researchers found that gradually transitioning users from a virtual replica into the intended VE helps users perceive the VE as more real, supports perceptions of possibility to act, and levels of presence because the familiarity eases users into the novel experience [66, 69, 70]. Other researchers proposed using embodied transitions to both physically and perceptually ease the participant into VR [67]. Most recently, Knibbe and colleagues looked into the precise moment of exiting VR and found five components related to the experience: space, control, sociality, time, and sensory adaptation [32]. The implications of the above work point toward set and setting of VR as a way to either heighten or lessen an experience. While prior work has looked at user experience in terms of reducing spatial disorientation and increasing productivity, we look toward how set and setting might heighten or lessen the more profound emotional experiences in VR.

PROJECT OVERVIEW

We provide an overview of the AWE, Awe-inspiring Wellness Environment, project including the context and virtual environment. In the subsequent sections, we present the process in designing our research prototype of set and setting surrounding a VR, the design process for refining our design elements, and the case study. We present our design research process in the order it occurred. This research was approved by the local ethics review board.

Project Context

We used an existing non-commercial VR experience¹—AWE [54]. AWE is inspired by the overview effect, i.e., the profound experience that astronauts have, when seeing the Earth from space and feeling overcome with a sense of awe, wonder, oneness with the planet, and compassion for the environment [77, 83]. AWE is staged in a lab setting, designed to help researchers study the overview effect and participants' potential reactions of awe. The AWE project makes use of a meditative-like physical mixed reality environment for privacy and emotional priming [54]. However, the inclusion of a pre-VR experience was not something explicitly designed for nor formally studied or explored in detail in that paper. Moreover, researchers of the AWE project did not include a post-VR experience, which could be helpful in supporting accommodation of the profound emotional experience experienced in VR. We only used the VE part of AWE; we explicitly studied the set and setting surrounding the VR experience that would gradually transition the participant from the physical reality to the virtual, and back again, in order to amplify and better support a profound emotional experience. This process involved drawing on the literature as well as our own personal experiences. Each design decision needed to be justified and support the overall intended outcome—awe.

There were three project phases that overlapped (see Figure 2). The development team included two experienced VR researchers; senior graduate students; and a small team of digital media students. We worked closely through iterations of the design and development, including technical experiments, concept designs, and usability testing for two weeks prior to

¹We obtained permission from the original authors.

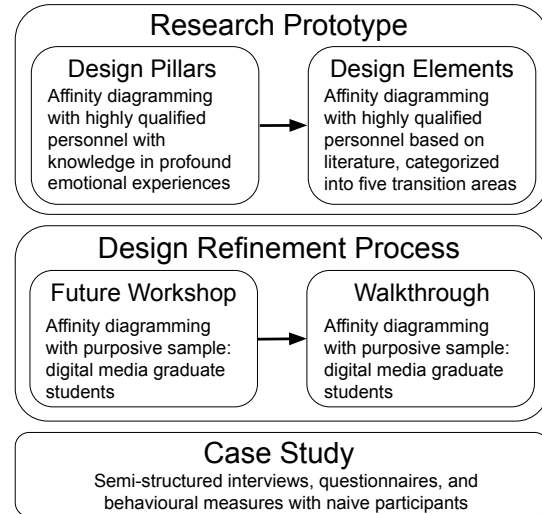


Figure 2. Design and evaluation process with three phases: (1) Research Prototype, (2) Design Refinement Process, and (3) Case Study.

the design refinement session. We then iterated on the design following the design sessions to hone in on the most relevant and potentially fruitful design aspects.

Virtual Environment

The VE took the immersant on a journey through three stages. First, the experience started in a tent at a campsite, from where the immersant was lured to exit into the night forest by a magical creature—"Sprite" (an animated particle system). Second, the Sprite invited the immersant to follow it through the forest and then take a leap of faith into the lake where the immersant descended through the deep-water environment with fish and jellyfish. Third, the immersant transitioned into Space and followed the "Sprite" to the climax of the experience, where the Sun and Earth revealed themselves. After orbiting around the Earth, the immersant was brought back to the tent, where it was now daytime. Please see this paper [54] and video for a more detailed description of the VE: <https://vimeo.com/268130902>.

Technical Apparatus and System

The AWE experience system was composed of the HTC Vive stereoscopic head-mounted display (HMD), which has 2160 x 1200 resolution, 90Hz refresh rate, and 110° diagonal FOV. We used its Lighthouse laser tracking system, along with a portable desktop computer. Audio was through stereo sound, noise-cancelling headphones: Sennheiser HD 4.50 BTNC. Participants sat either on a modified stool that could rotate 360° or an office swivel chair that had the wheels removed, and HMD cables were hung above to prevent entanglement.

DESIGNING A RESEARCH PROTOTYPE

Design Pillars

We grounded our design elements in three "design pillars"—a game design concept that defines 3-5 elements or emotions the experience is trying to explore or make people feel [49]. Design pillars are used in the games industry for brainstorming high-level, action-centric concepts or goals that act as development guidelines before the team begins working as

a way to streamline the design process and create a focused, unique experience [15]. Despain [15] states brainstorming is a common method used to generate pillars and three pillars are a common practice as it allows for depth without too much complexity; we chose affinity diagramming as a brainstorming method because the process not only generates ideas but also organizes and coheres them. Specifically, we brainstormed ideas relating to our overall goal of supporting awe and mental well-being in VR. Our group consisted of awe experts and we drew ideas from both the literature and our personal experiences. Within the affinity diagramming exercise, we agreed on three design pillars:

(1) **Childlike Wonder**: curiosity and exploration are fostered by an openness to the experience as it unfolds [63];

(2) **Perceived Agency**: courage and confidence lead to empowered choices and actions that further the depth of the participant's exploration [14];

(3) **Self-transcendence**: increase the participants sense of connectedness, oneness and prosocial attitudes and behaviours, as well as decrease self-saliency or ego [68].

Design Elements

An affinity diagramming exercise was repeated for generating specific design elements for transitions that were grounded in literature while also keeping in mind our three design pillars above. We categorized the elements into five transition types based on participants' perceptual shift from one space to the next as described by Benford and colleagues [5] and Sproll and colleagues [67]: into the lab, into VR, through VR, out of VR, and out of the lab, as illustrated in Figure 1. Implicit in these transition types is continuity of narrative, which helped inform our design choices. Next, we describe each design element for these transitional types in terms of how they relate to our core **design pillars** (in bold) and their expected effect. *Design elements* (italicized) are presented as they are experienced in chronological order by the participant.

Transitioning into the Lab

Entering the space, the participant found themselves in a *dark room* with *forest* smells from a diffuser and sounds from a speaker. Sense of smell is strongly tied to memory [78], so we speculated participants would conjure up images from their past camping trips and perhaps ignite **childlike wonder** since camping was a common childhood experience for members of the design team. Beside the entrance was a *costumes* trunk containing articles of nature-like quality: fur vest, cape, lei, feather boa, fur scarf, and an inflatable bee beard (see Figure 1: 1. Into the Lab). Dress-up can provide the opportunity for transformative play; by dressing up and taking on new roles, we learn more about ourselves [17]. We expected the *costumes* to intrigue the participant and allow them to embody a new character in the spirit of playful curiosity and **childlike wonder**. Next, the guide handed a *lantern* to the participant, which provided the participant with **perceived agency** to light their path, explore their surroundings, and engage with curiosity about the forest-like environment. We expected the participant would feel an increased sense of trust and safety by using a *lantern* because it keeps the path lit in an unfamiliar space and can invoke a sense of part-taking in a new experience [14, 40].

Transition into VR

The participant walked down the dark hallway with the *lantern* and saw a projection of a *nighttime forest* with small fireflies, meant to "set the scene" and foreshadow the virtual forest environment to come. Projections have been shown to enhance location-based experiences [41]. The ground was also lain with black plastic to simulate the sound and feel of walking over leaves and the *forest floor*. A small, artificial *campfire*, a *camping chair*, and a *cooler* were at the end of the forest hallway. The participant sat in a *camping chair* with a mug of *hot chocolate* and a *s'more*, a traditional camping snack, often for children (see Figure 1: 2. Into VR). With all of these campfire design elements, we aimed to inspire **childlike wonder** through nostalgia and playfulness of wilderness camping. We anticipated the items were familiar and comforting to participants, which would feel soothing and safe at this point in an unfamiliar environment. Moreover, by layering familiar elements into unfamiliar junctures of the experience, we hoped the design elements also fostered the participant's sense of connection to the experience, perhaps opening them up to a **self-transcendent** experience. We used a simple narrative of a camping scene combined with physical props before VR since these can help transition people into VR [40, 48]. On top of the cooler were three origami animals or *talismans* with a note (Figure 1: 2. Into VR). These *talismans* used an art-form that was **child-like**, and also provided a choice or **perceived agency** because participants had to select one, throw it into the fire, and yell out their choice. *Talismans* are often used in rituals or ceremonies because of their magical associations [24], and we expected participants to see these origami figures in the same way. After the talisman was voiced, the experimenter would then place the corresponding headset *mask*, i.e., owl, frog, or deer (see Figure 1: 2. Into VR). These *masks* were selected because of their nature-like qualities, which matched the theme of the experience; and because masks are used in rituals as a means of transgressing boundaries, which might relate to **self-transcendence** [44]. The experimenter would then turn on a *blue light*, shifting attention to the VR *mask* and signaling to the participant that the VR experience was ready. The participant would then don the headset and go through the AWE virtual experience (Figure 1: 3. Through VR).

Transition out of VR

The end VR scene had the participant back in the tent they originally started except it was now daylight, suggesting it all might have been a dream. Upon taking off the headset, they were greeted with a similar change in scenery in the physical environment: a *daylight forest* projection, sounds of *birds chirping*, the *campfire* extinguished, and "*sunlight*" beaming down. These design elements supported the third design pillar of **self-transcendence** because the transition from night to day continued the sense of connectedness to nature and the transience of the moment. We expected the use of projections, sounds, and lighting would contribute to the experience by giving continuity and story structure [40, 41, 48]. On the *camping chair*, the participant found a *journal* to record their reflections (see Figure 1: 4. Out of VR). We wanted to give space for thoughtful reflection in a playful way that afforded **perceived agency** and **childlike wonder**, and journaling can support transformative learning by helping people develop

an understanding of connections between themselves and the world [27]. We also left the self-image drawing task (explained below) next to the journal, which participants could complete at any time before rejoining the guide. This was playful and creative in itself, but also a reflection of how participants see themselves in the world—an opportunity to reflect on **self-transcendence**.

Transition out of the Lab

Once finished journaling, the participant had unrestricted time to reflect on their experience in the immersive installation, and could linger in the reflective state for as long as they needed and perhaps finish their *s'more* and *hot chocolate*. This time was designed to provide the space for reflection that would allow participants to accommodate the potentially profound experience they have gone through [19, 38]. When the participant finally met back with the guide, they handed back the *lantern* and *costumes* before exiting together (Figure 1: 5. Out of the Lab).

DESIGN REFINEMENT PROCESS

Our aim for the project's second phase was to refine our design elements to support the gradual transition into and out of the "AWE" project. We sought to bring in an outside perspective and generate creative solutions for transitioning people into and out of VR. To this end, we held a workshop with a walk-through of the experience to inform the use of transitional elements in our project. The focus here was on further developing and solidifying our design choices, whereas the next phases focus on exploring the user experience in depth through a case study.

Participants and Methods

We recruited a purposive sample of persons with VR experience in order to maximize our understanding of the perspectives of immersants, even though a randomized sample would have given greater external validity [37]. We invited seven graduate students from a digital media university to participate in a design workshop and walk-through of our experience. They were already very familiar with the AWE project but were naïve to the pre- and post-VR experience.

Designing for self-transcendence through technology, such as VR, is a complex design problem because the experience itself is ineffable and multiple factors such as prior experience, expectations, and mindset can greatly affect the outcome. To this end, we involved users in the design process itself because a more wide-ranging perspective fosters detailed understanding of the problem, gives room for diverse ideas, and may produce creative solutions [59]. For our design refinement process, we married two activities to foster and communicate new concepts and ideas: future workshop and affinity diagramming. Future workshops are best known in participatory design, and proceeds in three stages: critiquing the present, envisioning the future, and implementing the new initiatives [43]. To facilitate brainstorming, we used affinity diagramming—a commonly used method in Contextual Design and HCI to organize and make sense of qualitative data in four stages: creating notes, clustering notes, walking the wall, and documentation [34].

Procedure

After signing the informed consent, participants received an oral description of the study, which included three stages:

future workshop with an affinity diagramming exercise, walk-through of the immersive experience, and postmortem reflection. In the future workshop, participants first engaged in a brief discussion of the challenges facing transitions into and out of VR today. Second, they used affinity diagramming to envision what their "perfect", imagined transitions into and out of VR might look and feel like. We provided the same five categories we used in the first phase that participants could think about in terms of transitions in our experience: transition into the lab, transition into VR, transition through VR, transition out of VR, and transition out of the lab. In the next stage, walk-through of the experience, we led two small groups separately through the existing prototype. Participants were encouraged to "think aloud", while we carefully observed and took notes of their behaviours and responses. After both groups had completed the walk-through, both groups together completed an oral reflection on how aligned the current prototype was with the "perfect" ones they envisioned previously. We prompted them with questions to facilitate discussion. Finally, we helped idea prioritization on the affinity diagram map and created an action plan to move forward with the next prototype iteration.

Results

Here we present the results from the design exercises, which were generated by the participants and then categorized into higher-level categories for each transition type through facilitation by our team.

Into the Lab: tactile stimulus; sensory information. Participants suggested that the initial arrival into the lab should place people at ease and set the tone for the experience as a whole. Most research labs typically are very sparse rooms with LED lighting and neutral colours. This tends to give people the feeling of a sterile medical clinic. Therefore, participants suggested a dark room with dim lights, nature and ambient sounds, and incense to place people at ease.

Into VR: tactile stimulus; calming effect. Participants suggested gradually building on the calming effect by placing small, twinkling lights around the room and having a space welcoming a meditative practice, such as cushions to sit on. Participants also suggested adding foreshadowing elements like leaves on the ground to foreshadow the virtual forest environment to come, and lights above that act as stars that will also be present in the VE.

Through VR: synced sensory stimuli; controlled sensory stimuli. Although not the focus of our study, participants suggested using synced sensory stimuli while people were in VR, e.g., spraying water when they went into the lake or running a fan when there was wind. Participants also suggested controlling what people could sense while they were in VR by using noise cancelling headphones or ensuring a "cone of silence" surrounded them as to not break presence.

Out of VR: synced virtual and physical senses; story and narrative continuity. Participants found the exit of VR the most intriguing transition because most VR experiences end with simply taking off the headset into an often bright and disorienting reality, and immediately leaving without reflection. To combat disorientation and ease people back into physical reality, participants suggested reciprocating the "Into VR"

transition by keeping the VR screen dark, slowly raising the lights, and playing a gentle narration to signal the end of the experience. Participants thought to have story continuity by book-ending the experience with elements present in the VE.

Out of the Lab: nurturing; creature connection. Participants voiced that to best support accommodation of the AWE experience, people would need a positive and supportive environment. Therefore, they suggested someone physically be there to encourage conversation about the thoughts and feelings that arose before, during, and immediately after the AWE experience. Participants also suggested using warm and cuddly props like furniture, beverages, or pets, to support physical comfort that might mentally open a person to a potentially profound experience.

Discussion

Our design elements that we hypothesized would support effective transitions were well aligned with the participants' imagined "perfect" transitions, generated before seeing the prototype. Thus, these design elements show promise in supporting the gradual transition into and out of AWE.

Several creative solutions emerged from the design activities that centered around creating story continuity, syncing virtual and physical sensations, and solidifying the connection to nature. While many of the elements participants listed were already in our design, we implemented those unique elements that were both feasible and within the scope of our project: nature sounds of the forest at night, including wind and crickets; small, yellow tea lights to simulate fireflies; string lights behind black curtains to simulate stars at night, and leave them on for post-VR experience when immersant takes the headset off. Other ideas, such as using a float tank to simulate space and having live animals were not in the scope of the project but are certainly worth exploring.

CASE STUDY

To explore the potential of set and setting for supporting profound emotional experiences in VR we conducted a case study. We focused specifically on one VR experience designed to support awe. We collected introspective and behavioural data relating to transcendent emotions and presence using validated instruments, as well as semi-structured exit interviews to better understand the experience of each participant. We used two behavioural measures: a self-image drawing [3] and pen-drop task [57], to study the effects on diminished self-size, prosociality, and creativity—all correlates of self-transcendent emotion of awe. We split participants into two groups, the full transitions experience and the VR-only experience, in order to gain a deeper understanding of how participants experienced the set and setting elements compared to a typical lab environment. We used this case study as an opportunity to further explore creative solutions for set and setting of profound emotional experiences in VR. While primarily interested in understanding participants' experience, we included some quantitative measures to explore potential trends in the data to inform future research with larger samples.

Participants and Methods

We again wanted a purposive sample that was familiar with VR and 3D games in general but, as opposed to the design

refinement phase, were naïve to the AWE project. This way we could concentrate on the transitional design elements without having to help with equipment. We recruited 16 participants through social media ads and snowball sampling (ages 22-46 years $M = 30$ years; 4 females).

Participants were assigned to either the full transitions (FT) ($N = 8$) or the VR-only (VRO) group ($N = 8$) based on the timeslot they have signed up for. Upon entering the lab, participants signed a consent form and filled out a demographics questionnaire. Next, those in the FT group were lead to the next room, while in the VRO group they were invited to start the VR experience in the same lab space.

After the VR-experience, immersants engaged in reflective journaling and completed a self-drawing sketch [3]. Next, they filled out two questionnaires and participated in a 5-10 min. long semi-structured interview about their experience from the moment they walking into the lab to the present moment. We video-recorded the interview with an iPhone 6S. At the end of the interview, the researcher "accidentally" dropped a stack of pens, while reaching to turn off the recording in accordance to the pen-drop task [57]. We recorded how quickly and how many pens participants helped the researcher to pick up. At the end, participants were verbally debriefed. The study took under an hour.

Interviews and journal entries were analyzed in NVivo 12. We used thematic analysis [45] with a hybrid approach of both inductive and deductive coding to examine themes within the data. This approach complemented our research questions by allowing the tenets of our three design pillars to be integral to the process of deductive thematic analysis while allowing for themes to emerge directly from the data using inductive coding. Drawings were analyzed for creative expressiveness based on expert ratings using the consensual assessment technique (CAT), a "gold standard" of creativity assessment with good discriminant validity and inter-rater reliability [2]. Three illustration experts independently rated the drawings in relation to one another for creativity on a scale from 1 (low creativity) to 10 (high creativity). Additionally, we counted the number of squares a drawing of oneself took as a measure of "small-self" [3]. Both creativity [11] and small-self [3] are associated with experiences of awe. Reaction times of pen pick-up were calculated from the recordings and, together with the number of pens picked up, served as a measure of prosociality [57] also associated with awe [71].

Results

Questionnaires

As the main goal of the quantitative measures was to explore the potential trends in the data to inform future research, we only present descriptive statistics. Future studies are planned with increased participant numbers and statistical power that would allow for inferential statistics comparison. Medians are used because the distribution is skewed. In the Transcendent Emotions Questionnaire, we observe a trend that participants reported feeling more fearful in the VRO group (*Median* = 23.0) compared to the FT (*Med* = 2.5). On the other hand, we see a trend where participants reported feeling more awe, humility, and wonder in the FT (awe *Med* = 69.5; humility

Med = 66.0; wonder *Med* = 68.0) compared to the VRO group (awe *Med* = 50.0; humility *Med* = 42.0; wonder *Med* = 44.0). Measures of curiosity and physical comfort were virtually the same for both groups. In the IPQ, we found a trend where participants reported higher general presence and involvement in the VRO (presence *Med* = 6.0; involvement *Med* = 10.0) compared to the FT group (presence *Med* = 5.0; involvement *Med* = 8.0). We also found a trend that participants felt higher spatial presence and experienced realism in the FT (spatial *Med* = 8.0; realism *Med* = 3.0) compared to the VRO group (spatial *Med* = 7.5; realism *Med* = 0.5).

Behavioural Measures

In the self-image drawing task, the size of the participants' self-image tended to be smaller, indicating smaller perceived ego, in the FT (*Median* = 9.5 squares) compared to the VRO group (*Med* = 29.5 squares). Expert judges rated the FT drawings (*M* = 6.83, *SD* = 2.15) more creative than the VRO group drawings (*M* = 4.00, *SD* = 2.20). In the pen-drop measure, the pickup rate tended to be similar for those in the FT (*Med* = 8.5 pens) and the VRO group (*Med* = 8 pens). Time to pickup the first pen was similar in both groups: FT (*Med* = 1.5 sec); VRO (*Med* = 1.4 sec). Time to pickup all pens tended to be shorter for the FT (*Med* = 4.2 sec) compared VRO (*Med* = 6.3 sec).

Semi-structured Interviews

We explored five major themes in the data relating to our design goals: child-like wonder, perceived agency, transformation, transitions, and multisensory components. We report quotes from participants with (P#), ranging from P11-P26. We add "FT" and "VRO" to the end of P# where participants experienced the full transitions and VR-only, respectfully.

Theme 1: Child-like Wonder

All but one participant in the FT group talked about how they experienced curiosity, exploration, and play. There was a general sense that the physical space felt "dreamy", and feeling like they were on a journey or spiritual quest because there were elements that seemed hallucinogenic with many glowing and seemingly magical artifacts. The whole experience seemed "like a fairy tale" (P26FT). Those in the VRO group also mentioned they "felt like a child" while walking in the forest in VR, due to the playful-like qualities of the Sprite and the ability to chase it, but not outside of VR. Participants found the elements in the physical environment were intriguing: "What is this? What is that? How can it affect my experience? I was expecting magic powers from them." (P26FT) And when these elements seemed to have their own life, it added depth to the experience, suggesting that there is more to the story: "when you come out, you get this feeling like something is happening because you're out and then the fire is gone, the talisman is on the thing" (P12FT)

Theme 2: Perceived Agency

All participants in the FT group talked about their perceived agency both outside and inside the VR experience. They also found the ability to chose a talisman gave them a sense of agency, wondering what might have happened if they had chosen another:

I think having that piece of choosing the talisman was great for both engaging, feeling like a part of the story or

what was happening as well as that little bit of exertion of will and the meaning that I would put into choosing the frog. (P15FT)

These participants also voiced wanting to explore the VE more, compared to the VRO group. For both groups, there was a strong desire to move more in the underwater and space scenes. Many participants liked having the freedom to move around the forest, but felt some tension after they jumped in the lake because they no longer had that perceived agency. This discrepancy between the initial agency and lack of it in the last phase of the VR experience was even stronger in the FT group, because participants were provided with a lot of agency in pre-VR. However, despite this drastic and salient change in the amount of agency, some participants appreciated it, as that allowed them to find a new way of experiencing VR: "I'm used to being very active within VR, so having a passive experience was nice. It was a different way of using it than I was used to and felt like an interesting and productive one." (P15FT) It was supporting reflection in some participants on how they experience the world, and how slowing down and just taking in the experience can be valuable.

Theme 3: Emotional and Perceptual Shifts

Participants talked about transformations especially relating to emotional and perceptual shifts they experienced. These perceptual shifts could be an indication of the first step towards a self-transcendent experience [72]. Those in the FT group reported shifts in affect, e.g., "feeling more calm" [P12FT, 13FT]. Moreover, many felt like the physical environment itself afforded a sort of ritualistic or spiritual journey [P11FT, 15FT, 19FT, 25FT]. There seemed to be a lot of resonances with past peak experiences of hiking and nature that helped with supporting self-transcendent emotions like awe. And, the artifacts outside VR seemed to provide a transformation of state and expectations:

Well it was an amazing transformation. I thought it was really effective. It was really, I mean, I could imagine being in a space like this [lab] and there's clutter. I think that was very effective, just to bring in another state. (P25FT)

Equally in both groups, many people had perspective changes related to the overview effect of seeing the Earth from space in VR: "I've seen Google Earth and stuff but in VR I haven't seen Earth before. So, it's really nice. It made me... gave me perspective" (P22VRO). Participants admired the vastness of our planet, which is the trigger of a self-transcendent emotion of awe [11, 29]: "It was pretty neat when you went by the Earth there. I realized that, when you see the little dots at night, there's a lot of people!" (P16VRO).

Theme 4: Transitions

Openness and Readiness to the experience: Participants in the FT group reflected on how the pre-VR space helped them "change the mindset between your usual day-to-day and getting more into the experience" (P12FT), made them "more open to the world that is being created" (P15FT) and assisted with "having that suspension of disbelief that you need to enjoy a VR experience" (P19FT). Even before entering the experi-

ence space, “*having the lamp as a starting place for coming in helped set the stage*” (P15FT). Participants speculated the physical space shaped their overall experience:

Lighting, different kinds of contextual environmental sound, the little bit of projection... The whole experience would have been completely different and I think way less interesting if it wasn't for that container (P25FT).

Conversely, participants in VRO group were thinking less of the effect of the physical space on the experience and had very short recollections of the experience in that part: “*I don't know, just waiting for the experience*” (P23VRO).

Continuity: Some of the participants appreciated how there was connection between different parts of the experience throughout from the entrance to exit: “*I really appreciated it being a kind of beginning to end kind of experience rather than something that's just putting a headset on and taking it off kind of thing*” (P19FT). The connection of elements of physical environment and objects in the VE created the sense of experience completeness: “*there was a big resonance for me between having the torch and having the lamp, and then having the guided light that takes your through it*” (P15FT). Different components that were appearing throughout “*helped to provide more mental hooks for the experience to hang onto, so that was neat*” (P15FT).

Accommodation: The post-VR phase in FT group provided space for participants to reflect and accommodate their experience. One participant reflected on exiting VR: “*A lot of VR experiences you go do, you get shoved out the door as soon as you take the headset off. So, it's nice where there's somewhere where you can either reflect on your own thoughts ... Just kind of compounds the immersion you just felt*” (P19FT).

Theme 5: Multisensory Components

It is not surprising to find many accounts of sensations in the FT group, given that we designed the full transitions environment in relation to the main five human senses. Participants noticed these elements and found them pleasant: forest floor, hot chocolate, s'more, morning light, fire, darkness, lamp, night sounds of crickets, tent lighting, stool, camping chair, and projection day/night forest. However, some participants found the camping chair seemed too small for them making them feel not welcomed and the costumes felt too hot after being in VR. Those in the VRO group found the lab space unremarkable for the most part. They focused solely on the VR experience itself, primarily on visuals and in a few cases the audio. The most discussed item in terms of its sensory dimensions was the cup of hot chocolate: the temperature was creating an inviting environment: “*it really made that warm sensation, you felt welcome*” (P12FT), that was enhanced by the olfactory dimension: “*sofa is cozy and chocolate smells good*” (P26FT), as well as the taste: “*having the hot chocolate and that physical warm, tactile as well, experience as part of it was good, was nice, it made me, as I was getting ready to come back to the front area, decided to go back and have a last sip of that to close off that sensory piece of the experience as well*” (P15FT). Interestingly, the warm temperature of hot chocolate in combination with the rest of the environment by

contrast was giving a perception of the physical space being colder: “*it's more about the night and it's chilly and fresh air and you want to get something hot*” (P11FT).

The sounds both in virtual and physical environments were often discussed, and were usually making participants feel soothed or relaxed. Sounds in the physical space were making that experience more immersive: “*I really liked coming back to the sound of the space. And somewhat in a sense of re-emerging out of the virtual world into the real one*” (P25FT). The lighting of the room was also contributing to the experience: “*the lighting effect, like the scene inside the teepee right before you take off the headset in the daylight, the light effects were really nice on the bedding, so that was cool*” (P19FT).

DISCUSSION

We described our design process that explored the design elements most important for promoting profound emotional experiences. In the case study, we found that our intended design pillars were mostly well supported but there is still much work to be done with the virtual experience itself. The qualitative descriptions of user experiences can be useful to designers in themselves. Here we discuss common user experience themes that might be helpful for designers to consider for supporting profound emotional experiences in VR. Because we only explore one case study, we cannot provide any concrete generalizable design guidelines at this time. Our work will potentially contribute to a more robust set of design guidelines in the future.

Considerations for Supporting Profound VR Experiences

Guided by our design process and existing literature on gradual transitions, we identified and prioritized five themes that were important for supporting profound emotional experiences in this case study. Based on these themes, we found that gradually transitioning participants into and out of the VR experience might help support profound emotional experiences. In our design, the pillars of childhood wonder and perceived agency were better supported than self-transcendence. This highlights that complex and understudied constructs such as STEs are lacking sufficiently explored guidelines for how to design for them. However, here we discuss three user experience themes relating to set and setting that can be further explored to support emotionally profound experiences in VR.

1. Foreshadow in-game experience: Results from the theme “child-like wonder” suggest using fantastical or ambiguous stimuli can help get immersants excited and in the right headspace for the in-VR experience. The themes “transitions: continuity” and “multisensory components” suggest a blending together and more seamless transition from real to virtual world may help increase presence in VR, and thus a more effective VR experience aimed to support a profound emotional experience. The multisensory aspects also seemed to contribute to a suspension of disbelief. Those in the FT group felt the experience would be completely different within a lab setting. In fact, the VRO participants reported it felt like a researcher was conducting an experiment rather than a guide facilitating an experience. These results are in keeping with sensory adaptation as an important component of transitioning out of VR [32].

The pre-VR space sets the expectations for VR, and as such, all of its components need to adhere to the principle of continuity. This applies not only to the specific objects and the setting, but also to the ‘rules’ of the world, such as how much agency the immersant gets over their choices.

2. Establish agency and control: Results from the theme “perceived agency” point toward gradually giving the immersant more control as a way to ease them into the experience and movement interactions. Small ceremonies, such as choosing a talisman and throwing it in the fire, may help shift the immersant’s mindset to “openness and readiness to the experience”. Based on the interview responses from participants, the set and setting of the full transitions experience both prepared them for the virtual experience and gave a reflective space to accommodate that experience. The ritualistic use of putting on costumes, selecting a talisman, and enjoying a hot beverage all set the tone and mood for having a spiritual-like journey or quest in the experience. These results are in keeping with prior literature on the use of ritual for providing profound and subtle experience [31, 33].

Always get consent and provide a way for the immersant to stop the experience at any time without repercussions; knowing how to disengage with VR can ease anxiety of the immersant. Similarly, any use of “multisensory components” should be secure and possible interactions easily known to the immersant so that they can be discovered without hesitation. Self-transcendence, as well as other profound positive emotions, is a very personal and intimate experience that requires trust between immersant and designer to allow participant to open up to the experience.

3. Make and experience art: Results from the theme “child-like wonder” suggest that designers provide engaging and striking stimuli, such as visuals, audio, or other “multisensory components”. One way to also help support “perceived agency” is by giving the immersant freedom to create and express themselves, which could be through manipulating the environment by various sensors or personalizing part of the experience. The use of “multisensory components” provides the opportunity to have the immersant interact with the experience, ultimately investing the immersant in the experience and more likely to have a self-transcendent experience. This relates to the art perception principle of *Beholder’s share* introduced by Ernst Gombrich [23]. He describes how art experience emerges in the interaction between the art piece and the interpretation of the observer. The design or art needs to leave space for the participant’s imagination to fill in the gaps, if there is no mystery or ambiguity left, there is no room for the observer to engage and contribute. Letting participants be intrigued by the elements of the environment and make their own interpretation will allow them to actively co-create the experience. Our results are in keeping with prior research that shows physical interfaces and a narrative help transition people into VR and keep them immersed in the experience [40, 48].

Overall, our user study points to the value of *set and setting* and perceived agency both inside and outside the VR experience. It also suggests that our intended goal of supporting profound emotional experiences in VR needs more exploration;

although it does appear we are heading in a positive direction. The quantitative measures point toward the set and setting better supporting transcendent emotions, presence, pro-sociality, and creativity motivating new research questions about its’ effects. Our results support prior research that advocates for using gradual transitions for VR [28, 32, 36, 66, 67, 69, 70], and build on existing frameworks for supporting STEs with positive technology [6, 12, 19, 20, 30, 55, 81].

Limitations, Generalizability, and Future Directions

We identified several design elements that were important for supporting profound experiences in an immersive location-based space. These were, however, only examined in one specific instance and we must be cautious in generalizing to other projects. There may be other design solutions we have not identified, and there are certainly more ways to create ceremony and gradual transitions into and out of VR. What we can say, based on prior literature, is that VR experiences aiming to support awe can benefit from a “set and setting” [54, 73, 74]. Additionally, our results are supported by years of industry using exhibits around a digital experience to enhance the emotional quality. For example, Disney uses haunted houses to prime fear in people in line [40, 41]. Set and setting has already proved to be important in the emotional outcome of psychedelic trips [8, 33], another kind of non-ordinary reality, and it seems like this too is the case with VR.

The question now is what are the minimal conditions of set and setting to support a profound emotional experience in VR? And, how do our results generalize to different VEs with different target profound emotions? We have explored the potential, and now we can hone in on these specific research questions. A mixed methods approach in the next studies will provide greater validity and confirmation of the impact of set and setting for profound emotional experiences in VR. In the future, we hope to provide a robust set of design guidelines.

CONCLUSION

We contribute a case study and discuss common themes for creatively exploring and developing experiences around both entering and exiting VR with ceremony and gradual transitions. (1) We conceptualize the design by creating design pillars, and then ideate design elements that support those pillars. We use physical prototyping and storyboarding to rapidly prototype our designs. (2) We refined our design to generate the ideal product and then honed in on those important design elements afterward. (3) Case study is a flexible way to check our design assumptions and iterate on our project.

This process allowed us to successfully explore and prototype in this design space. Our results suggest set and setting are important in supporting profound emotional experiences in VR. User experience themes included using elements to foreshadow the in-game experience, establishing agency and control, and making and experiencing art. We encourage the design community to further explore the role of these themes and set and setting design in supporting different VR experience for profound emotions. Collectively developing design guidelines in this emerging space of profound VR experiences would allow us to make these experiences more accessible, ultimately improving human condition and well-being.

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