Fragments of Fungi: Eliciting Dialogue Through a Virtual Experience

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Abstract. Both the arts, natural phenomena and technologies hold possibilities for profound emotional experiences. This interdisciplinary project explores the world of mycelium networks through an artistic virtual reality (VR) experience, as a medium to communicate the awe-inspiring natural phenomenon. The VR application was conceptualised and designed through various creative activities and participatory design workshops with external participants. The final VR experience *Fragments of Fungi* was brought into a physical forest setting in the north of Copenhagen, Denmark, and evaluated by four participants engaging in a two-hour collaborative workshop, including individual exercises and collective discussions. The findings suggests the potential of virtual reality as an awe-eliciting medium, and highlights the benefits of collective spaces for reflection and dialogue when presenting such self-contained and emotional experience inherent to virtual reality. Finally, the paper encourages VR artists to consider the holistic experience, rather than focusing solely on the VR aspect.

Keywords: Collective Experiences · Awe · Virtual Reality

1 Introduction

The act of *experiencing* is a fundamental part of living, however the notion of having *an experience* is something else. An experience is something we recall, something that had a profound impact on us, and we retain them with a certain character [10]. Such an experience may arise from the arts, which is known for lending itself to emotional responses, sparking conversations, and captivating people's attention [17]. Other experiences arise from nature, which can leave us in awe, by connecting us with something much larger than one can comprehend, both physically and mentally [24].

While searching for such natural experiences in the preliminary stages of this project, we came across mycelium networks, a phenomenon which left us

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struck by its inherent intricacy and complexity; leaving a feeling of being awe-struck. This emotional response can envelope individuals when they encounter something vast, captivating, or beyond their usual experiences. It is a feeling of reverential wonder, a sense of being simultaneously humbled and inspired by the grandeur or beauty of the world around us [9]. Recognising the innate capacity of artful experiences to evoke similar affective states, inspiration was found in combining these elements - an artistic representation of the awe-inspiring mycelium phenomenon. By harnessing the potential of art to ignite conversations, spaces can be created where individuals can connect and collectively reflect on their experience. When people experience art together and engage in dialogue about their interpretation and emotions, it can foster a sense of connection and shared experience, allowing for the exchange of ideas, challenging assumptions, and gaining new perspectives.

Though both nature and the arts can undoubtedly give rise to profound experiences, novel technologies, such as virtual reality (VR), allow for entirely new experiences to be had; we can travel to places otherwise impossible, experience life from the perspective of others, and immerse ourselves in fictional worlds. Such opportunities give rise to new areas of study, but is still in its adolescent state in the realms of academia in regard to what emotions and conversations might arise from such experiences. Literature reviews in the field of VR often focus on its applications in diverse domains such as gaming, education, and social learning. These reviews also investigate the effects of VR on improving task performance and usability. [2,4]. Exploring VR as a medium for artistic expression and prioritising the emotions of the audience opens up new frontiers of creativity.

As we dwell on the opportunities arising from the arts, nature, and technology, we present this interdisciplinary study, which introduces the development of an artistic VR experience that unfolds the natural world of mycelium. The development is based on artistic practises as means to create an emotional experience that would encourage dialogue and reflection. The experience acts as the foundation for an experimental workshop that took place within a forest north of Copenhagen, Denmark. The project aims to unfold the impact that the unification of art, nature, and technology has on fostering impactful experiences and conversations. As such, the means of this project are as follows; *facilitating a conversation about nature through a virtual experience.*

2 Background

When entering the human experience and the fluctuating emotions that come with it, it is beneficial to present the academic work that has directed this project. Therefore, this section will investigate the realms of the arts, awe, and digital media in the following.

2.1 Academia and Art

The arts have captivated the human species throughout times; it compels our attention through its mesmerising and mysterious nature, which remains ambiguous and up for interpretation. It does not hold one truth, but rather stimulates multiple meanings. Many scholars have dwelled on the application of art in academia and highlighted its importance in different regards. In *The Participatory Museum*, Simon stresses the importance of participation in the arts and focusses on the conversations that might arise from engaging in artistic experiences and how this is often neglected in museum contexts. She calls attention to people who wish to participate, rather than passively consume, and demonstrates how cultural institutions can actively cultivate a shared space to engage in dialogues between visitors about the material exhibited [20]. Leavy has also highlighted the conversation-provoking quality of the arts, speaking about the emotional connections formed through art and how they may spark conversations and community among people. She highlights how such conversations are crucial in facilitating and reconfiguring our understanding of others [17].

Other academics have reinforced the representational value of artistic performances and the emotional and bodily engagement that may arise: *By expanding the possibilities of representation- using theatre, art, or multimedia, for example- scientists invite a more fully embodied response from their audiences* [11]. However, the arts not only offer an alternate form of mediation, but can also act as the subject of enquiry throughout the course of a research project [17]. This has been emphasised within the area of artistic research, which merges artistic practises with research and theory. Such research approach can allow for a deeper understanding of one's artistic work, as well as a more unified relationship with one's research. [13]. Although the area of artistic research remains rather ambiguous in its form, it develops an experimental and playful attitude toward research, which allows alternatives and speculations to thrive [3]. In Halberg's reflections on her own artistic research practise, she draws focus to *experiential reflections* that arise from her own experiences and the experiences of others. These are documentations of aesthetic experiences, which reflect both an empirical- and an artistic value, arising from the interplay of reflection and experience [12].

2.2 Awe

Within the realms of profound experiences lies awe. In the paper titled *Approaching Awe: A Moral, Spiritual, and Aesthetic Emotion*, the authors propose a conceptual framework to understanding the complex emotion of awe. Drawing from a literature review of works across various disciplines, including religion, sociology, philosophy, and psychology, the authors identify two predominant themes that are crucial for experiencing awe: vastness and accommodation. Vastness refers to encountering entities, phenomena, or experiences that surpass an individual's sense of self. While accommodation denotes the cognitive processes of adjusting mental structures that cannot assimilate a new experience, an appraisal

to awe becoming necessary when faced with encounters that exceed one's prior knowledge, requiring an adaptation of their cognitive framework [16].

Applying the framework of awe to the domain of art, the authors argue that vastness can be represented in physical forms, such as large-scale objects, or in conceptual forms, such as depictions of god-like figures or capturing exceptional moments resulting from powerful forces. Additionally, artworks that elicit awe are not easily comprehended, but rather possess an element of obscurity and challenge the viewer's interpretation, creating a need for cognitive accommodation to fully experience the sense of awe [16].

The experience of awe has been found to evoke a shift in one's self-perception, wherein attention is directed towards entities or phenomena that surpass one's own magnitude, thereby diminishing personal concerns and objectives. Research indicates its potential to help people perceive themselves as integral components of a larger social framework, fostering an augmented sense of empathy and consideration toward others [18]. With these transformative potentials of awe, researchers have investigated the potential of synthetically eliciting the emotion by presenting participants with immersive VR environments, depicting nature scenarios. Findings indicated that the researchers achieved significantly higher reports of awe and presence under their experimental conditions [8].

In the study by Quesnel et al., the fundamental concept of awe was the foundation of a VR application specifically developed to improve mental well-being [19]. This application drew inspiration from the overview effect, a cognitive phenomenon encountered by astronauts when observing the Earth from outer space. The experiment was physically located in a mediation lounge, while the VR experience consisted of serene forest landscapes and underwater scenarios, ultimately transitioning into a view of the Earth from outer space. Using physiological measures, the designers observed that approximately half of the participants experienced goosebumps, with greater reports of awe. In addition, a significant majority of participants reported a positive sense of connection with nature after engaging with the application [19]. Therefore, inducing awe is not an unexplored realm in the field of VR, as previous research has demonstrated its feasibility. Furthermore, the work by Quesnel et al. suggests considering the surrounding physical environment before the VR experience initiates.

2.3 The Virtual Experience

Human escapism is a deeply rooted inclination. The earliest concept of VR can be dated back to 1935, in the novel Pygmalion's Spectacles by the science fiction writer Stanley G. Weinbaum [23]. The novel stands as a testament to our inherent desire to transcend the confines of reality and immerse ourselves in captivating alternate worlds. Almost ninety years later, the virtual world imagined in the book has gradually become a reality. In the virtual world, the body's presence is felt but not seen. Yet, there remains a sense of agency and the ability to perceive independently of the outside world. Thus, one can briefly escape the real world, as if they were fully engaged in the illusion before them [14].

This phenomenon above written has been the subject of classification by Slater as *immersion* and the *illusion of presence* [22]. A classification in which the level of immersion might correspond to different levels of the illusion of being in the virtual world. The illusion of presence presents the essence of an interesting paradox: the feeling of 'being there', despite one's conscious knowledge of its unreality. It is a perceptual illusion, but not a cognitive illusion, where the perceptual system instinctively reacts to stimuli. Although the cognitive system may later comprehend the illusory nature of the experience, the initial reactions have already transpired. Therefore, the powerful capacity of virtual reality lies in its ability to evoke genuine perception and elicit authentic responses, unfettered by conscious acknowledgment of its illusory nature [22]. This quality makes VR a powerful medium for evoking authentic and impactful emotional responses, providing a valuable avenue for creating art. Starting in 2017, La Biennale di Venezia launched the first competition for work in VR. However, despite the artistic merit of VR becoming clearer, it is still in its adolescent phase [25].

Exploring the concept of embodied cognition, Hsin-Chien's VR installation *Samsara*, allows the audience to experience the six realms of existence in Buddhism, by reincarnating the audience into the bodies of different persons and creatures [7]. He claims that *it is when we feel this world in different bodies that we may truly appreciate thoughts of others, empathize with them, and comprehend our existence in full.* Similarly, virtual worlds grant us the ability to inhabit impossible spaces. *To the Moon*, by the same artist, allows the individual to explore the surface of a new moon using imagery and tropes from Greek mythology, literature, and science; commissioned by the Louisiana Museum in Denmark [6]. This duality of embodied cognition and transport to impossible spaces exemplifies the captivating nature of VR as a medium. *In the Eyes of the Animal*, an immersive installation created by Marshmallow Laser Feast, explores the realm where virtual and real-world experiences converge. The experience presents an artistic interpretation of the sensory perspective of three species of animals, blending virtual and physical environments within a real-world forest setting. By anchoring the virtual experience in parallel with the real world, the installation provides a unique opportunity to investigate the interplay between human perception, the constructed virtual environment (VE), and the authenticity of the natural world [1].

Although VR has allowed a variety of artworks that cater to the sense of wonder and curiosity, there are works such as Taryn Simon's 'An Occupation of Loss' - a provocative VR piece exploring the anatomy of grief [21]. The artistic value of this piece is not determined by its experiential pleasantness, and the artistic aspiration transcends mere aesthetics, seeking to evoke emotions and provoke contemplation, surpassing immediate comfort.

3 Design Development Process

It was clear already from the initial stages of conceptualisation, that this project would take a creative approach with participatory elements. The creative design

process in art is complex and multifaceted and can be approached in different ways depending on the individual style of the designer and the stage of the design process [5,15]. The activities undertaken throughout the project were not viewed as a linear succession of stages, but rather as an iterative process.

The beginning phases were shaped by independent research and artistic expression exploring the phenomenon of mycelium networks. Throughout the remainder of the process, collective discussion and diverse forms of creative expression remained essential. This was supported by dynamic activities such as body- and brainstorming sessions on the whiteboard, excursions to museums and the forest, as well as engaging with tactile mediums like clay and drawings, as shown in Fig. 1. This collaborative and multidimensional approach aligned with our commitment to artistic, participatory, and exploratory practises, paving the way for a rich exchange of ideas, insights, and emotions.

Fig. 1. Creative work with tangible mediums

3.1 Initial Participatory Workshop

As part of the early development stages, a group of four participants were invited to partake in a two-hour design workshop, as an instantation of the participatory design methodology. Since the goal of the project was to provide a meaningful experience, the importance of focusing on the users was essential; hence, it would not seem rational to enter a design process that neglected the individual and their experience. As we wanted a high level of user participation, the participatory design approach was deemed highly applicable for creating the framework of the cooperative workshop. Furthermore, since the overall theme of the workshop deals with abstract topics of underground mycelium networks, it was important to facilitate a common space wherein participants felt comfortable to cooperatively thinking outside the box, and challenge their own preconceptions.

Fig. 2. Participant working with the mushrooms in the creative warm up exercise

The workshop was held in three parts; an initial introduction, a creative warm-up exercise as seen in Fig. 2, and finally, the evaluation of three different noninteractable VEs following a *think aloud* protocol. The workshop provided the groundwork for our participatory understanding, new design requirements related to both interaction and VE design, and validated pre-established conceptions related to the emotional arc of the experience, across the three acts. The framework for this initial workshop would shape the methods for the final evaluation; which itself would resemble a collaborative workshop. This will be further described in Sect. 5

4 Fragments of Fungi

The target audience for *Fragments of Fungi* includes young people with an interest in cultural and artistic experiences. The viewer embarks on a journey, traversing the hidden realms of the subterranean across three acts, as depicted in Fig. 3. Each act was designed and developed with the requirements acquired from the aforementioned participatory design workshop, along with internal discussions and design activities. Throughout the whole experience, a narrator accompanies the viewer, directing their interactions while also supplying narrative context and information.

`PROLOGUE`
The stage is set with an introductory speak about a network hidden in plain sight and introduces the viewer to the journey that lays before them; a journey into the enchanting world of mycelium.

`ANTICIPATION`
The viewer is presented with a forest at dusk and is asked to take a deep breath and settle into the surrounding environment. They are then prompted to pick up the glowing mushroom within reach, which shortly after disintegrates into particles in their hand, before fading out to the next act.

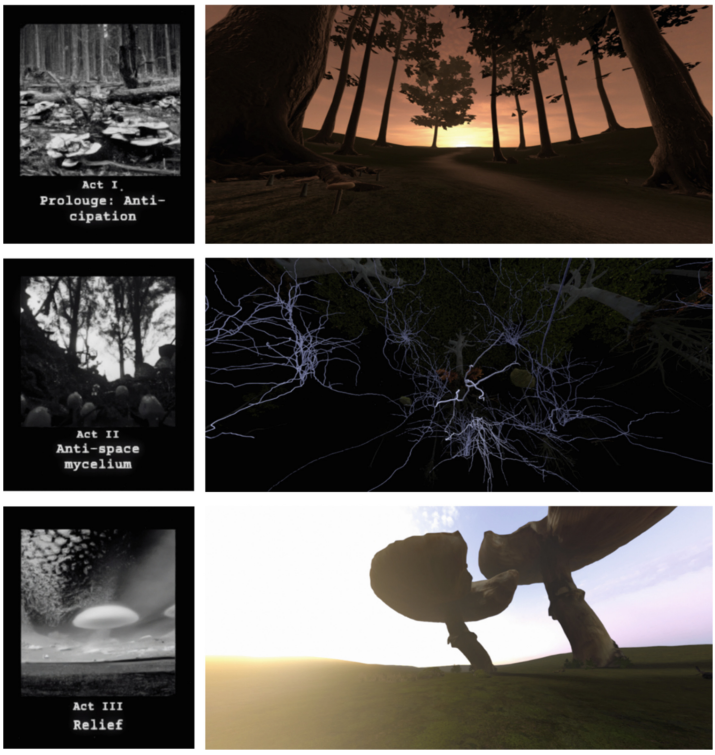

Fig. 3. From top: prologue and initial scene, middle: anticipation and mycelium scene, bottom: anti-space and outro scene

ANTI-SPACE

The viewer is situated underneath the forest floor, looking up at the roots of the trees they were previously surrounded by. As the narrator speaks about the phenomenon of mycelium networks, mycelium threads gradually begin to form in the distance, enveloping the visitor. Branches of mycelium then slowly grow towards the viewer, and as they touch the branches, the network further entangles them and light up - visualising the complexity of the network. As the viewer moves their hands through the mycelium network, the interconnected branches illuminate sequentially, extending into the distance. Simultaneously, reactive auditory feedback propagates from these branches.

Two distinct branches of mycelium emerge, and the viewer is prompted to be the bridge that unites them. As the branches are connected, a symphony of light and sound unfolds within the network and the trees above, which extends into the dark vastness. Fruiting fungal bodies appear besides the viewer, and as these begin to grow, the viewer grows with them, moving them up towards the surface, and the next act is initiated.

RELIEF
Surrounding the viewer are high-reaching mushrooms, standing tall as guardians of the delicate balance of the forest. The narrator speaks of viewing the world with refreshed eyes, attuned to the subtle miracles that exist beneath the surface.

The objectives of this project encompass not only the immersive VR experience, but also the emotional outcome that emerges from it. In addition to taking participants on a journey through the virtual realm of mycelium, the experience was extended to the physical world. The VR experience was to be held in a physical forest setting, followed by a collective discussion that would spark reflections and foster meaningful conversations. The combination of virtual exploration and real-world discussions would allow for a deeper connection with the subject matter and a shared exploration of its significance, enriching the experiences beyond the virtual realm. The group discussion was recorded and later transcribed for further analysis. The qualitative data from interviews and observations were analyzed thematically, identifying recurring themes, emotional responses, and patterns of understanding.

4.1 Technical Implementation

The implementation of the virtual experience was carried out using Unity version 2021.3.11f1, a powerful game engine that facilitated the integration of interactive elements and the creation of intricate VEs. The 3D objects were modeled and optimised in Blender version 3.4.1 and exported into Unity using the .fbx format. The application was targeted a Meta Quest 2, and the Oculus Integration package for Unity was used as the main interaction framework. As tracking outdoors was needed, the use of hand tracking was omitted, as this feature was more susceptible to overexposure in the sunlight compared to tracking the Touch controllers. The interaction techniques was simple; using just the trigger button to select and manipulate the virtual objects, along with collider-based physics to detect collision between controller and interactive objects.

The experimental feature of Application SpaceWarp by Oculus was used through a custom render pipeline (URP) providing increased computational overhead for standalone Oculus Quest development. In Unity, optimisation strategies as Level Of Detail on terrain objects and offline light rendering with lightmap textures were utilised. For visual feedback when touching the mycelium, the implementation of shaders was done in Unity ShaderGraph 12.1.6, while various particle effects were done in Unity VFX graph 12.1.6.

The audio-engine of choice was FMODUnity, using the Oculus Spatializer plugin for spatialisation and reverberation. The audio SDK provides spatialisation of monophonic sounds using generalised head-related transfer functions (HRTFs). It was important to include spatialised audio in order to guide the user's attention to the main action. During the process, it was of interest to compose our own soundscape for both the ambience and the auditory feedback triggered when touching the virtual mycelium. The sound design took inspiration from samples of fungi sonification, using authentic biodata. The soundscape was designed and synthesised using an Arturia MiniBrute 2 combined with Ableton

Live. To increase the expressivity of the auditory feedback, the hand/controller tracking velocity was captured and used as threshold values, enabling different audio samples with various tempo and pitch; high velocity would increase tempo and pitch. This reactive feedback would propagate from the location of the specifically touched mycelium branch, facilitated by the Oculus Spatializer plugin.

5 Framing a Collective Experience

With the experience being at centre for the entirety of this project, this was to also be reflected in the final evaluation; thus blurring the boundaries of the central artistic experience and the evaluating parts. This resulted in an almost performance-like excursion to a forest north of Copenhagen, Denmark, which involved four individuals over the course of two hours. The participants had varying backgrounds; an actor, a graduate in Diversity and Change Management, a graduate in Medialogy, and a neuroscientist.

The workshop was situated in a reclusive area of the forest amidst towering trees, following the structure illustrated in Fig. 4. Gathered in a circle on the forest floor, participants were given a general introduction to the project and what was to unfold during the workshop; additionally, all facilitators and participants took a moment to present themselves and complete a formal consent form. Finally, a brief introduction to VR interaction was demonstrated on the Touch controller. Afterward, as a means to attune the participants' senses to the surrounding forest, they were asked to spend a few minutes taking a picture of something that caught their attention. These pictures were saved and reintroduced later during the discussion part of the workshop. After completing the picture task, each participant was accompanied to a designated spot in the forest, scattered around the central space, where they would experience *Fungi fragments*. Facilitators helped initiate the experience and equip the participants with the head-mounted display, headphones, and controllers. Upon completing the experience, the participants would hand over the devices and find a pillow with a clipboard next to their spot. On the clipboard, a piece of heavy art paper, a pencil, and a brief instruction were attached. The instruction prompted the following: *Document how you are feeling in this moment through writing or drawing. Return to the group when you are finished.* The participants were left alone for this task and would return to the group when they wished. The three activities - photography, VR experience and documenting - are depicted chronologically in Fig. 5.

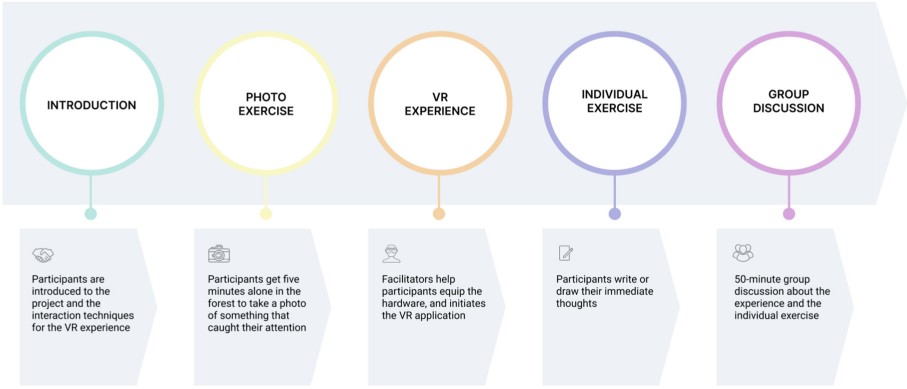

Fig. 4. Evaluation workshop structure

Fig. 5. From left: photo-exercise, middle: VR experience, right: individual writing exercise

Once all participants had returned to the group, a 50-minute group discussion was held, predominantly focused on their emotions during the experience. The discussion was recorded and later transcribed using an intelligent verbatim approach. To initiate the discussion, participants were asked to present their immediate experience as they had documented on paper. The continued discussion grew out of these initial manifestations, and subtle prompts from facilitators continuously guided the conversation without too much interference. In addition, printed pictures of the three VEs were laid out for the participants to have more concrete points of reference during the discussion. Toward the end of the discussion, the participants were asked to revisit the pictures, which they had taken in the beginning of the workshop, and asked what made them take the pictures in the first place and if anything had changed now looking back at it. As a finalisation of the group discussion and workshop as a whole, participants were asked if there were parts of the experience that they would have changed and their experience of the overall format of the workshop.

Throughout the entire workshop, it was important for us/the facilitators to provide a safe poetic space, in which the participants would feel comfortable

to share their emotions. This was reflected in both the workshop activities but also in the physical setup, which catered to the simple details and having the group discussion unfold in a circular position on the forest floor submerged in the greenery of the forest and the soundscape of the birds. The setting is captured in Fig. 6.

Fig. 6. Picture of the group post-experience discussion setting

6 Findings

This section is structured around two main themes of investigation, wherein the results will be presented and discussed. Subsequently, these findings will be challenged in light of the inherent bias within this project. For readability purposes, throughout the remainder of this paper, the four participants will be referred to by an alias. All participants, except Bastian, had little to no prior experience with VR. Firstly, relevant quotes related to *the illusion of presence* will be presented, as this is an important element to generate genuine emotional responses in a VE. The feeling of "being there" in the virtual environment was explicitly conveyed by Carl when asked about the transition from VR back to the real world:

> I felt a little sad because I was leaving, like waking up from a nap, but also in a nap in which you had a really good dream. And you wake up and you're like, if I could just fall asleep right now, just again, I could maybe continue it for a little bit longer.

When asked about presence within the VE, Luna expressed this as: *(. . .) like being in two places at once; the real world, and what felt very like the real world; the VR (...) I guess I was quite present during the seven minutes.* All participants agreed to this sense of presence throughout the whole experience. The physical

setting of the forest further added to this, as Mark noticed: *you have the leaves underneath feet. And the wind*, followed by Bastian: *and also when you walk around in the experience, (…) the leaves are kind of crunching, that just adds to the whole experience.* It can therefore be suggested that all participants had indeed experienced a high sense of presence. The presence was increased by the use of headphones, providing immersive audio, and the sensation of tactile stimuli from the surrounding forest environment, which would serve as a foundation for evoking intense emotions such as awe.

6.1 An Awe-Inspiring Experience

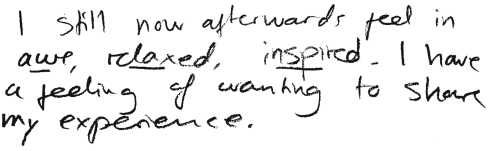

Fig. 7. Luna's individual exercise

Though being a nebulous and transcendent concept, the participants did describe their experience as awe-inducing. This observation was prominent without directly imposing the word on the participants and was initially broadened in the discussion by Luna, who highlighted the term in her individual reflective documentation, as depicted in Fig. 7. Upon further elaboration, Luna explained:

> I often get it [the feeling of awe] when I see nature; like when you come to the Grand Canyon. In the same sense that it was beautiful, I felt small (..) I feel like the awe-feeling is when you realise you are small (..) and one day you will be gone; but the world is still here

The remaining participants consented to the same feeling and highlighted its presence towards the second and last scenes of the experience. Prominent in the further discussion of awe were elements of feeling small or being in the presence of something much larger than one self, as initially described by Luna. Bastian directly linked the scale of the mushrooms to the feeling of awe and described the last scene as follows: *This was also a very explicit representation of this feeling [awe].* Within the same topic, Bastian spoke to the complex nature of awe as the feeling of being scared; *it is a bit of an ambiguous feeling when you are in awe, and I think being scared is part of that.*

In the talks of a larger entity, associations to god-like creatures and tribal encounters came to mind. Mark elaborated on this association: *I felt that the scale, with small birds and huge mushrooms, really made it feel like they were*

gods (. . .) like big Greek statues. In continuation Carl adds: *(. . .) the God aspect of it is its complexity.* Both notions speak to the scale and complexity as elicitors of the religious, and both connect to the idea of vastness related to awe.

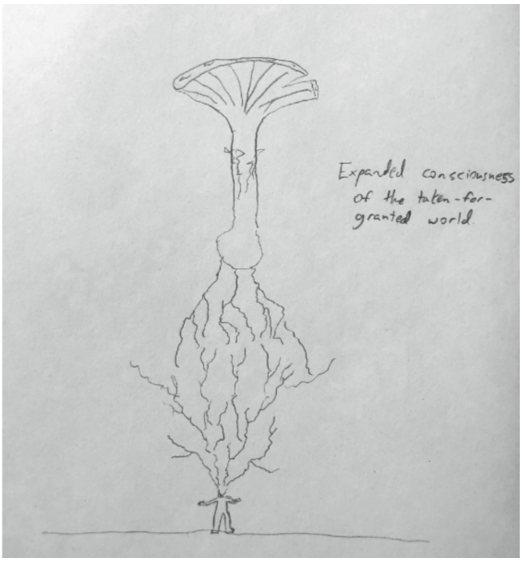

Fig. 8. Carl's individual reflection exercise

Drawing upon the conceptual framework outlined in Sect. 2.2, the emotion encompasses two primary themes: vastness and accommodation. The concept of vastness was prominent in the discussion, but understanding the cognitive process of accommodation of participants presents a greater challenge. However, Carl expressed a transformation in how he understood the surrounding forest after the experience, whilst pointing to the drawing on this individual reflection exercise depicted in Fig. 8:

> Coming to a new understanding of a world that was taken for granted. (. . .) I forget to see how complex they really are. (. . .) With this experience it becomes easier to understand how complex it actually is.

This newfound understanding was expressed in a similar way by Bastian, as he stated *I felt it was a very meditative journey that helped me realise the subjective scale of human consciousness and I was introduced to a new state of interconnectedness.* Luna describes another shift happening when she entered the second scene: *that is when my brain stopped thinking about if it was artificial or not, because it was so new and different.* In the abstract mycelium world she felt more perceptive, whereas the initial forest scene had her being analytical. This shift conveys the captivating power of the arts - whereas the forest is to be experienced in the physical world, the imaginative power of art and VR allowed Luna

to enter realms otherwise unseeable. Carl talks about the same experience and describes the shift as: *shifting from rational to perhaps emotional or interpretive*. These views resemble the idea of accommodation, in the sense of acquiring a new cognitive framework due to a new experience.

6.2 A Collective Experience

Through the workshop, we were able to bring four people together in conversation about nature and emotions. Although they had never met each other before, participants shared their emotions over a common experience. It was noted that the experience would not have been the same without the collective elements, as the participants expressed they enjoyed the collective aspects of the experience and would not have liked it differently. Carl reflected on what it would have been like if there had not been a collective discussion: *it would have been super lonely (. . .) and then you are with all these ideas and feelings in your head and you cannot communicate them to anyone or anyone who would understand*. This speaks to a phrase by Luna: *can't help but notice (...), we come out from a short experience, and we all feel like talking about it*. Both Luna and Carl's statements underline the importance of the experience being collective and the collective potentials arising from artistic experiences, as established in Sect. 2.1.

Luna enjoyed all the different elements which composed the entire experience: *having this [the group discussion] as a part of the experience, to reflect by yourself, doing everything in parallel, I think it wouldn't have been the same if it had just been me, out here by myself*. This aligns with the initial goals set for the workshop and supports the deployment of more participatory evaluations. It was clear that all participants felt all elements as parts of the experience: *us connecting afterwards really adds to the experience* (Mark). The resulting product of this project was not just about going through the virtual environment, but all other aspects played a significant part in the experience as a whole; from being scattered around the forest and dwelling on ones own reflections to gathering on the forest floor and sharing thoughts and perspectives. Mark specifically recalled the act of physically bringing your own documented thoughts into the collective space and how such small details enriched the flow of the experience.

In further reflection, the participants spoke to a calmness and a meditative state rising from the experience: *it was a kind of meditation experience*(Luna), *As you're coming out of that experience, also really calmed me down and made me just really relaxed and grounded* (Mark). These feelings were related to both the virtual experience and the physical setting in the forest, as Luna put it: *it was a good choice to be in a real forest. If it was on the main plaza in Copenhagen having people talk and bicycle, it would have been kind of weird*. These notions once again emphasise the importance of pertaining to the whole experience and how the forest brings a different layer to the discussion: *Looking around at the forest, I feel like I wish I could see the level of detail that I was able to see in the scenes*.

6.3 Final Discussion

It's important to highlight that the above findings stem from a thoughtfully orchestrated combination of factors: the forest backdrop, the evocative tone set by facilitators, and group conversations on the forest floor. The workshop's overall atmosphere likely primed participants to delve into these abstract themes. Moreover, the very notion of engaging with mushrooms could align with spiritual and abstract concepts for some. Looking at the findings related to awe, all participants explicitly stated this emotion. In relation to the conceptual framework introduced by Keltner and Haidt, the most apparent element was the perceived encounter with something bigger than themselves, whether it be in size or complexity [16]. As for accommodation, it can be suggested that the transformation in how the participants viewed the forest after the VR experience could imply the occurrence of the cognitive process, though this cannot be validated. However, given the highly subjective nature of emotions, the most reliable indications of awe lie within the first-hand accounts provided by the participants. It is relevant to acknowledge that awe is made up of more elements than accommodation and vastness, such as sense of time, self-loss, and connectedness, although the above findings speak to multiples of these variables. A summary of the qualitative results can be seen on Fig. 9.

It is important to recognise that a central element for this project was the experience of being located in the real world forest. In addition to providing an important point of reference for discussion, the surroundings offered multisensory stimuli furthering presence within the VE. To ascertain the contributions of the forest setting to the overall experience, conducting a comparative study in a more controlled environment, like a laboratory, could provide valuable insights. Same applies for the impact of post VR experience group discussion atmosphere, to shed light on its contribution to the overall experience and emotional outcome.

It was prominent that all participants enjoyed the collaborative aspects of the workshop, which made an otherwise individual experience, that is, VR, collective. As affirmed by [20], humans are eager to participate, and this is truly noticeable within the collective workshop. These collaborative efforts were not only a reflection of the final workshop, but are also a reflection of the entire process of the project. We have continuously valued new thoughts and ideas, and as such these are reflected in the final outcomes. *Fragments of Fungi* allowed the participants to enter the awe-inspiring world of mycelium networks, and afterwards share this with others. As participants accentuated the need for more experiences that provide space for reflection and collective dialogues, this underscores the potential of more holistic VR experiences, and suggests that designers should be mindful of both before and after the VR experience has occurred.

The reliance on voluntary participation of participants in the study introduces bias, as people who were mentally prepared to disclose and express themselves have been more likely to participate. Similarly, had the participants been more introverted and less eager to do so, the same result might not have been achievable. The framework of the workshop was highly dependent on the collaboration of the participants, which could have led to less successful outcomes.

Findings	Description	Relevant Quotes
Awe-inspiring experience	Participants reported feeling awe during the VR experience, especially in the second and last scenes	"I feel like the awe-feeling is when you realize you are small (..) and one day you will be gone; but the world is still here." "The God aspect of it is its complexity." "It is a bit of an ambiguous feeling when you are in awe, and I think being scared is part of that."
Collective experience	Participants valued the collective aspects of the workshop, especially the group discussion after the VR experience	"Having this [the group discussion] as a part of the experience, to reflect by yourself, doing everything in parallel, I think it wouldn't have been the same if it had just been me" "Us connecting afterwards really adds to the experience."
Transformation in understanding	Participants' perception of the forest environment transformed after the VR experience, leading to a new understanding of its complexity	"Coming to a new understanding of a world that was taken for granted. (…) I forget to see how complex they really are." "Helped me realise the subjective scale of human consciousness and I was introduced to a new state of interconnectedness" "Shifting from rational to perhaps emotional or interpretive"

Fig. 9. Summary of Qualitative Findings

Furthermore, although the participants had different backgrounds, they all had their appreciation of art and culture in common. And though these qualities align with our target audience, it introduces the risk that attaining the same findings would likely be compromised with participants exhibiting different degrees of pre-existing art appreciation. Given that the workshop was not conducted under controlled conditions but was taken out of a laboratory setting, this strongly advocates reproducing the setup with a different set of participants to ascertain the reliability of the results.

7 Conclusion

This project explores the interplay of the arts, nature, and technology, and how the union of these can allow new means of artistic expression that facilitates emotions and dialogue. From this position we present an artistic virtual reality experience that uncovers the hidden world of mycelium networks, an experience titled *Fragments of Fungi*. As part of an evaluative workshop, four participants were brought to a physical forest setting, explored the virtual world, and engaged in a collective conversation. The findings suggest that the participants indeed

experienced awe and related emotions, such as the feeling of a smaller self and a higher connectedness.

It is believed that these results would not have surfaced without the collective parts of the workshop. We have continuously, throughout this study, emphasised the importance of enveloping the virtual experience in a prolonged holistic experience, that caters to further reflection and dialogue among individuals. This paper should not be regarded as a definitive guide for developing awe-inspiring VR experiences or a framework for eliciting conversations. Instead, it serves as an illustration of the advantages and the desire for such reflective spaces, and peoples' desire to engage collectively and share their otherwise lonesome VR experience. Furthermore, it emphasizes how facilitating this sense of connection afterward can potentially amplify emotional experiences within the virtual environment. In light of the findings, we propose a greater emphasis on harnessing the potential of deploying a comprehensive artistic experience induced through virtual experiences.

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