Psychedelic VR Experience: An Exploratory Study on Cosmic Flow

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ABSTRACT

Virtual environments are emerging as a tool for providing psychedelic experiences due to the increasing interest in altered states of consciousness (ASCs) and the spread of VR headsets. However, the user experience of commercial psychedelic VR applications has not yet been adequately explored in HCI. To fill this gap, we conducted a user experience study of Cosmic Flow, one of the psychedelic VR available on Steam. In this exploratory study, six participants experienced Cosmic Flow and got interviewed. Analysis of user interviews revealed three main themes that articulate different aspects of the experience: moderate interaction, reflections on personal experience, and VR ergonomics. In the discussion, we derive seven design considerations to guide the development of psychedelic VR: non-active engagement, positive indolence and idleness, non-invasive multi-sensory modalities, creative and introspective activities, effects of priming, virtual nature, and comfortableness. The study contributes to design researchers and practitioners working on related experiences.

CCS CONCEPTS

• **Human-centered computing → Virtual reality**.

KEYWORDS

Psychedelic; Altered States of Consciousness, Virtual Reality; Cosmic Flow; User Experience

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1 INTRODUCTION

With the development of virtual reality (VR) technology and resurgent psychedelia subculture, the potential of virtual environments as novel means for psychedelic experiences draws attention [31]. Recently, psychedelic experience-themed VR applications have been launching on popular video game platforms such as Steam and Oculus Store [38]. In addition, TRIPP, a developer of VR meditation experiences, has received 11.2 million US dollars in funding from Amazon, Qualcomm, HTC, Niantic, Mayfield, and others to build the mindfulness meditation metaverse [14]. The technology and media industry's interest in immersive technologies for altered states of consciousness (ASC) (e.g., hallucination, awe, lucid-dreams, mindfulness, hypnagogic states, transcendental experiences) is noteworthy in the HCI community as it represents a significant milestone toward which the current technological development is aimed.

Commercial VR applications that are classified as psychedelic, simulate rich and profound experiences where it is unusual in ordinary states. In general, these VR experiences provide multi-sensory stimulation with psychedelic artistic modes (e.g., distorted or surreal visual and audio, bright colours, kaleidoscopic images) that resemble or are inspired by experiencing psychedelics like Psilocybin or LSD [36]. The extent and types of psychedelic VR are manifold, and each application can have distinct effects and purposes. For example, the objective of certain psychedelic VR experiences (e.g., TRIPP VR [37], DeepStates [40]) may be more practical, such as assisting people who lack traditional meditation practice access to a meditative state [36]. However, other psychedelic VRs, such as Ayahuasca [19] and SoundSelf [9], may be designed to provide a perceptual shift or hallucinatory experience through intense immersion and sensory stimulation.

In recent years, research in mental health care using psychedelics has made notable progress and is out of outsider status [16]. Psychedelics have been reported to provide various health benefits when used as an adjunct to psychotherapy. Medical studies support the use of psilocybin and MDMA in treating post-traumatic stress disorder [25] and anxiety toward end-of-life [13]. Contrary to widespread belief, psychedelic substances such as psilocybin have a low risk of toxicity and dependence or addiction [7]. There is also interest in psychedelics in the medical industry. Life sciences company Compass Pathways conducted a large-scale study of 216 patients across Europe and North America to register psilocybin as a licensed medicine [34]. In addition, popular podcasters like Joe Moore and Lorenzo Hagerty talk about the use of psychoactive plants and chemicals and their benefits for mental health. Also, the legalisation of marijuana promoted by a few political parties is not independent of the above facts.

However, despite these positive impacts and potential, recreational psychedelic use is strictly restricted by law in most countries. In this current situation, the possibility of psychedelic experiences through immersive technology intrigues our interest. Tart [35], the pioneer of the field of ASC and transpersonal psychology, stated that the worlds we experience are virtual realities created by each body and envisioned that computer-generated VR would have future applications as a technology for inducing ASC. Earlier, Marshall McLuhan [24] viewed media as extensions of our sensory selves. Contemporary neuroscience indicates that the brain works like VR

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by a mechanism called embodied simulation [28]. This leads us to speculate that we may be able to have novel experiences and change our perception of the world by overlaying computer-implemented VR on top of our biological VR. A recent study by Sekula et al. [31] proposes VR as a full-spectrum tool that can employ and catalyse intrinsic therapeutic aspects of psychedelic experiences, such as mystical types of experiences induction, disconnection from familiar reality, augmentation of sensory perception, and alteration of one's experience.

HCI studies began to explore psychedelic experiences through VR technology. A few studies have provided evidence suggesting a phenomenological similarity between experiences induced through VR and conscious awareness through psychedelic drugs. For example, Suzuki et al. [33] proposed a Hallucination Machine, a VR 360 panoramic video fabricated with a deep convolutional neural network to simulate biologically plausible artificial hallucinations. The study showed that VR 360 video could elicit visual distortions and hallucinations similar to psilocybin experiences. Furthermore, Isness has demonstrated that, like LSD and psilocybin experiences, VR can create conditions for mystical-type experiences, such as a sense of transcendence, ineffability, and connectedness [12]. In a broader context, including research on profound transcendental experiences through VR technology, subjects including lucid-dreaming [17, 18], flying dreaming [21], meditation [23], awe inducing overview effects [27, 32], and ethical concerns around disembodied VR experience [15] have been discussed and explored in the HCI community.

As discussed earlier, the positive impact of psychedelic experiences and the potential of VR technology to recreate those experiences are fascinating. It is encouraging that research on psychedelic VR is underway in mainstream academic circles, but the exploration of profound experiences within HCI is still in its infancy. Blythe & Buie [3] evaluated that HCI research in transcendence technology lags behind the development of techno-spiritual products in the market. According to their study, searches of various general aspects of spirituality and religion on Apple's US AppStore in late 2012 and 2020 returned results of 6,000 and 7,060 iOS apps, respectively, but the number of related HCI studies found in the ACM Digital Library was negligible [3, 5]. Unfortunately, the situation is not much different in psychedelic VR research.

Psychedelic VR research, especially regarding the user experience of it is underexplored and the current state that the development of psychedelic VR products seem to progress faster than HCI research with many different applications available. Therefore, understanding the user experience (UX) of commercial psychedelic VR, for example compared to intentionally designed research apparatus, can help producing meaningful design space and guidelines to researchers and designers. In this article, we present a user study of Cosmic Flow (see Figure 1), one of the commercial psychedelic VR apps available on Steam. The reasons we chose Cosmic Flow are as follows. First, Cosmic Flow is an app that has both practical (e.g. mindfulness meditation, relaxation) and recreational purposes (e.g. visual auditory hallucination) of psychedelic VR. Therefore, we expected Cosmic Flow to produce diverse user experiences and responses. Second, Cosmic Flow is a passive VR without user interaction other than head rotation and has no narrative or game elements. Thus, we anticipated that participants would be able to focus on the audiovisual stimuli of Cosmic Flow. In addition, Cosmic Flow was the most popular VR-supported app with a psychedelic search tag on Steam.

The primary objective of current exploratory study is to understand the end-user experience of commercial psychedelic VR Cosmic Flow. We ask the following research questions:

- RQ1. *How do end-users describe their experience in Cosmic Flow VR?*
- RQ2. *What are the design features and considerations for psychedelic VR?*

To answer the questions, we take a qualitative and exploratory approach. We conduct user tests and unstructured interviews coupled with journey mapping to collect UX data. Collected data is thematically analysed and discussed later in the paper. The study will allow us to understand better the current state, limitations, and opportunities of psychedelic VR. Our research contributed to the field of HCI, with implications not only for researchers to better study psychedelic VR or ASC inducing artefacts but also for designers to design psychedelic VR. Our research contributes to the field of HCI, with surface qualitative knowledge that can help design researchers and practitioners better understand the users' experiences in psychedelic VR and technically develop a psychedelic virtual environment.

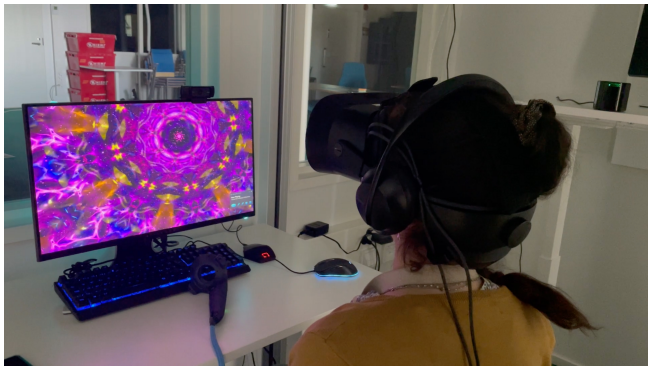

Figure 1: Cosmic Flow VR Experience

2 METHODS

2.1 Aim and Experimental Conditions

The study aimed to understand the user experience of a psychedelic VR application, Cosmic Flow, viewed in a head-mounted display (HMD). The subjects were exposed to the VR experience for fifteen minutes. The VR was a relaxing psychedelic audio-visual experience with a kaleidoscopic 360 motion graphic. The video was viewed on a Varjo VR2 stereoscopic HMD, with a display resolution of 1440x1600 per eye (standard screen) + 1920x1080 per eye (micro-display), 90Hz refresh rate, and 87° field of view. The HMD ran on a 4.7GHz Intel Core i9 CPU, GeForce RTX 3090, 16 GB DDR5 RAM desktop PC with Windows 10. The tracking system used was Steam VR. The audio was through stereo sound, noise-cancelling headphones: Bose Noise Cancelling Headphones 700. Participants sat on an office swivel chair that could rotate 360°, and HMD cables were hung over the backrest to prevent entanglement.

2.2 Participants

The study was carried out with 6 participants comprising 3 men and 3 women in the age range from 26 to 41 (M=34). None of the participants defined their gender as non-binary. Participants were university employees and students recruited via the university's internal mailing lists. All participants were voluntary. All participants had normal hearing and vision or corrected to normal hearing and/or vision. None of the participants has been diagnosed with audio-visual seizure, epilepsy, or any related clinical condition. All participants had a good understanding of the English language. Among the participants, 3 have had VR experiences before, and 3 did not. Meanwhile, 3 participants had tried meditation before, and 3 did not. Each participant was given a movie voucher as compensation.

2.3 Unstructured Interview

The study collected data using unstructured interviews. In qualitative research, semi-structured and unstructured interviews are two main varieties. However, Morse [26] recommends an unstructured interview protocol because data from semi-structured interviews seldom comprise continuous in-depth narratives [1]. Given the subjective and non-shareable nature of VR experiences and abstract audio-visual of Cosmic Flow, fragmented data obtained from semi-structured interviews may not provide a vivid picture of the overall user experience. Therefore, in this study, we followed Morse's advice and conducted unstructured interviews.

2.4 Journey Map

We used a journey map, a UX tool, in user interviews to help participants chronologically visualise and holistically describe their experiences. In UX research, a journey map is generally understood as a visualisation of the process a user of a product or service must go through to achieve a goal [11]. However, in this study, a journey map has been used to facilitate the depiction of each participant's Cosmic Flow experience in interviews, not aimed to contribute to or develop a generalised journey map of a particular VR. The journey map we used had a timeline in the centre and blank spaces on the top and bottom for describing moods, thoughts, and insights. The journey maps were printed on A3 papers. Figure 2 is a journey map of one participant.

2.5 Procedure

The study took place in Tampere University's digital interaction laboratory Ludus. The laboratory was dedicated place to studying immersive technology and its end-user experience. The study was conducted in a soundproofed room where the experimenter could see the participant inside through a window. When arriving at the laboratory, a participant received an oral description of the study and was given written consent. After signing the informed consent, an experimenter guided the participant to the test room.

To avoid priming, we only revealed the study is about VR user experience and did not provide detailed information like the title and content of the VR application. Therefore, participants did not know what kind of experience will they have until the app began. Priming implies exposing participants to information that could influence their behaviour in an experiment. In a user experience study, avoiding priming is generally recommended [8, 10, 20, 29].

The experimenter asked the participant to sit on a swivel chair and told them that the experience would take 15 minutes. Also, the participant was informed that they could stop the experiment without any consequence to the study. The experimenter told the participant that audio and video records would not be taken. The participant was informed that the experimenter would be waiting outside the room. When participants were ready to start the experience, the experimenter ran the Cosmic Flow application on a PC and helped the participant put on the VR headset and fit the headphones. The experimenter pressed the start button on the screen, and the participant experienced a VR experience for 15 minutes.

After the experiment, the experimenter helped the participant remove the VR headset and headphones. Next, the experimenter guided the participant to the main room where the interview happened. The participant sat down in a chair, and the experimenter asked if they agreed to make an audio-recording. After getting consent, the experimenter started an unstructured interview with a very open-ended question: 'How was your VR experience just had?' The experimenter worked with the participant to unveil the details of the user experience in the before, beginning, middle, end, and after stages of VR by filling the journey map (see Figure 2).

The detailed interview process is as follows. First, the participant expressed their mood changes by drawing a curved line on the journey map. Second, the participant was given different coloured sticky notes corresponding to each VR stage and attached to the journey map. Third, the participant was asked to write a short sequence of words to describe the stage. Finally, the experimenter asked the participant to explain what was written on the sticky note. Participant interviews were typically lasting 30 minutes. Interviews were audio-recorded and transcribed. The whole experimental session took approximately 1 hour.

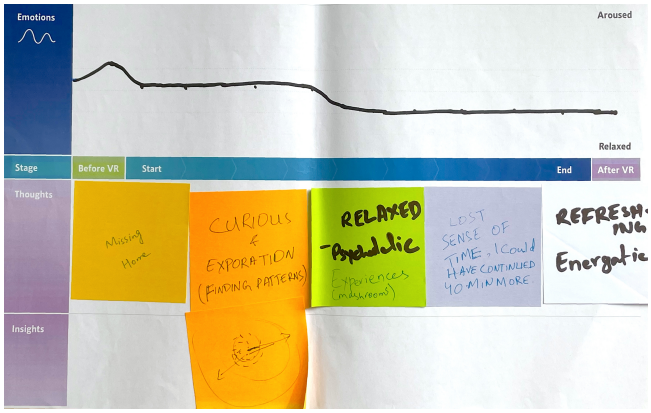

Figure 2: Journey Map

3 THEMATIC ANALYSIS

Transcriptions were imported into the qualitative data analysis programme Atlas.ti 22. The data consisted of six transcribed interviews from the audio-recording. We analysed the data using an inductive thematic analysis, following the approach outlined by Braun and

Clarke [4]. The first author did the coding and discussed analytical patterns with the second author to examine themes within the data. This thematic analysis highlighted three major themes of discussion and nine sub-themes, which captured participants' views on their experiences. We return to a discussion of the future opportunities later in the paper.

3.1 Moderate Interaction

The only interaction that was allowed in Cosmic Flow was looking around. Thus, engagement with the content was quite limited. This design decision had been the subject of discussion regarding distinct facets of the experience both in **positive and negative** ways. Some users said that additional interactions are unnecessary for VR experiences for relaxation. *"It might be a bit cumbersome to use the hand instead of being relaxed."* [P1], *"I think if the goal is to look for an application that helps to relax and relieve stress levels, the interaction is unnecessary."* [P2]. Meanwhile, some users wanted more interactivity. Two participants even felt bored or annoyed that they could not move around or influence the virtual environment because the app did not require active interaction. *"Neutral, bored and tired… I might have been expecting something a little bit more active."* [P2], *"Can I go there and see what's happening there, or can I go closer to the source of the patterns and colours? But then no, I'm here… My feeling about that? Maybe I'll put it here annoyed."* [P5]. These different interpretations led to the following sub-themes regarding the experience of the application.

3.1.1 Feeling Trapped and Boredom. One of the experiences that were reported by two users were the **feeling of being trapped.** They felt trapped in the virtual space or felt uncomfortable due to excessive perceptual stimulation. They were disturbed by being entrapped in the virtual environment that lacks interactivity. *"I'm kind of stuck in that space… that's not active, that's just being in, and you need to just be in that spot."* [P5], *"Probably the negative feeling when I get entrapped in time… then the beginning excitement starts to wear out."* [P2] Two users said they were annoyed by too many patterns, colour variations and particle effects. *"I find it a bit disturbing when there's lots of going on. So, it actually annoyed me."* [P5] *"There's a lot of different bright lights and colours. I also think that might not be the best suited for me."* [P2]

That lack of interactivity also led to **boredom**. Participants frequently mentioned boredom during interviews. Lacking interactions, repetitive pattern changes, absent meditative effect, and prolonged exposure to a virtual environment caused boredom. *"I thought I was a bit bored because there's no interaction… It's repeating and repeating and repeating. It's always new because it changes colour and shapes, but it's still like one thing."* [P6], *"It was quite long. And since I didn't feel the kind of meditative effect, I think that's one of the reasons why I might have got a little bit bored at some point."* [P2] Some users thought about something else when they feel bored for some time. *"I was thinking about my own stuff."* [P4], *"I had lots of time to think. I also thought about the movie I was watching on Saturday night."* [P5], *"My thoughts were more wondering, just like into personal things and then kind of getting back to the experiment."* [P2] Some users accidentally found certain shapes in patterns when they felt bored. In particular, one user turned finding shapes into a game. *"When I feel like I'm a bit bored, I start to find something interesting to myself… So, I start to look into the figures and see what they look like. They look like insects, and some of them look like faces. So, I think, at that moment, it became interesting because I made this own game for myself."* [P6], *"I noticed I found the pattern of the butterflies… I recognised the pattern, which was a sort of an image that I found positive. And that I can grasp onto. Something concrete among all the abstract."* [P4]

3.1.2 Pleasure of Being Idle. As discussed in the boredom part, the lack of interaction, while it led to unpleasant experiences for some, it also helped **self reflection and relaxation** for others. The rest of the users had a positive experience from observing visuals in the virtual environment. *"I just wanted to look at the centre and kind of look at the pattern… it was relaxing for me."* [P1], *"I was just observing. So, I noticed right away, great, this is nice… the emotion here was already towards more relaxed."* [P4]. One participant, who had never had a VR experience, was scared and afraid that he might have a similar experience to the VR roller coaster he watched on social media. *"When you ride those vehicles, you go up down, and there are movements that make you scared? I was expecting something like that… I have seen some videos on social media that people are experiencing virtual reality with those."* [P3] However, he was relieved after the experiment began and felt the positive emotions of **relaxation, freedom, and comfortableness** from the VR experience. *"Relaxation, comfortable, freedom, music was perfect, and also aurora."* [P3]

3.1.3 Multi-sensory Interaction. There were several mentions of multi-sensory interaction. One user said she would like to have a fruity or flowery **smell, which represents the colour** of an environment or object. *"I thought about the smell. Moreover, I thought that these different paint colours could represent different smells and that it would be very interesting… I think that would make this experience even more fascinating… you know the colours do have some mood in them like yellow can be more like fresh lemon and a red can be raspberry. So, it can be associated with the fruits of the same colour… or flowers."* [P6] Several users have mentioned **haptic and embodied interactions**, especially wanting to touch and feel the texture of the particles. *"I really want to touch this sparkling stuff, of course, but I don't see my hands… If I had some gloves, that would give me some feedback, so it would be really interesting to interact with them."* [P6], *"I thought that if these are touchable and tangible, I'm going to touch a very soft, I'm going to touch a soft thing, sweet thing."* [P3].

3.1.4 Real-body in VR. One participant, who introduced herself as a dancer, wanted to dance in a virtual space. *"I was mainly thinking about… dancing in this kind of environment because I do dancing."* [P6] The participant wanted to be able to use VR standing up to dance. *"If I'm standing on the floor and I do the movement."* [P6] The user also said she wanted to splash moving particles in the virtual space with her hands and feet while dancing. *"I do the movement with my leg like this, and there can be splashes going on."* [P6] The user wanted to see her **real body in a virtual space**, not the avatar. *"I will feel completely there if I see my body… my real body, not some kind of avatar."* [P6]

3.1.5 Role of Sound. Another mention regarding the effect of interaction was about the **sound design** of Cosmic Flow and its complementary role in the holistic experience. One user reported that the sound gave a sense of relaxation and meditativeness, and it worked better than visuals. *"I noticed that there's a relaxation on music, and I think it worked quite nicely for that purpose as well. I think probably better than the visual pattern side of it."* [P2] One participant said the sound came from space and was perfect. *"It was like I'm hearing real sounds coming from the stars, coming from other planets, it's musical, it's the sound of space. It was for me, felt like that."* [P3] One user felt the sound is artificial but in line with the video. *"There's a type of sound that you can hear in spas. I somehow find them a bit artificial… But then would have been, I found that the music was in line with the image I saw… So, without the music, it wouldn't have been a wholesome experience."* [P5].

For some users, the sound was not good enough. Some of them wanted to have a more rhythmical sound. *"I am used to listening to ambient music a lot… the effect was not reaching me at all… there could be, for example, drums"* [P1], *"If the music was like more of my style, which is house music based on bass. I would love to get them."* [P6] One user wanted to have the sounds of nature. *"Forest environment, birds singing, or something probably helps."* [P4] Some participants wanted to have music that is synchronised with visual elements or bodily action. *"There could be, for example, drums, and then the pattern changed with those drum music… Visual pattern changing responding to the music might be a really good interaction."* [P1], *"I think it should be music then you follow the music and environments following you. That would be a super cool experience."* [P6].

3.1.6 Focus in 360° Environment. Although the only interaction was looking around, it was still effective for consuming the content in different ways. One user expressed concern about whether she was looking in the right **direction**, where the **focus** was, and if anything was missed by looking elsewhere. *"You couldn't focus on everything, and then you're thinking that what am I missing? What did I miss here?"* [P5] The participant wanted the VR application where the user can change the focus, and each focus shows different things to see. *"I would change the source of the images… or maybe just the focus shifts from here to here, for example, and then the patterns might change a bit… when it shifts, and something else starts happening."* [P5] Looking back was not essential, given that particle generation is happening in the front. However, one user said it was more peaceful to rotate the chair to look back and watch the particles disappear. *"I actually found I'm more peaceful when I turned around. And in front of me, the patterns were coming at me, but behind me, they were going away from me. So, it was somehow easier to follow the flow when I turned around. And it was less annoying."* [P5]

3.2 Reflections on Personal Experience

When discussing VR experiences, many participants related to their previous experiences and personal backgrounds. This suggests that the notions formed from prior experiences strongly influence the quality of VR experiences.

3.2.1 Previous Experience Related to Psychedelics and Meditation. Participants mentioned, compared and contrasted the VR experience they had with the Cosmic Flow to their previous experiences with psychoactive substances and meditation. Two participants related their experience with the alcohol and psilocybin mushroom, which are **psychoactive substances**. They said it would be interesting to experience Cosmic Flow with a psychoactive substance. *"Probably if I play again, I will probably do it with psychedelic."* [P1], *"I know some friends who did [used psycedelic substances], and I think they would love it."* [P6] One user said an hour of Cosmic Flow might be like the psilocybin mushroom experience. *"Maybe spending one hour on this VR might be quite the same thing… it might be a slow process in VR compared to what a psychedelic could do."* [P1] He noted that the visual patterns, especially in the middle of VR, are reminiscent of a psilocybin mushroom experience. *"When I was looking at this VR thing. The colours, these scenes kind of remind me of that experience."* [P1] He expected that meditative VR could be used as part of drug addiction clinics. *"If it is used with the therapy, it might actually be kind of a good experience."* [P1].

Meditation experiences also affected the VR experience. Three participants had a meditative experience, and two reported that their VR experience was qualitatively different from meditation. *"I didn't feel it would have been a huge meditation relaxation experience."* [P2], *"It's a different approach from meditation."* [P4] They said in VR that they received external stimuli instead of focusing on their inner self. *"This is more coming from the outside, so you don't have to draw it all from your emotions or thoughts."* [P4], *"What I've done is the type of meditation where I concentrate a lot on my body… In this case… it was quite a visual experience… I don't know if that's the best type of relaxation for me."* [P2] However, another meditation practitioner said that the VR experience was closer to meditative. *"I think something makes me say this is somewhat of meditation."* [P1].

Some users have experienced an **altered sense of time**. These users reported that time in VR went by faster than they thought. *"I lost track of time. It was like; I can continue being here for like 40 minutes more… I think it's kind of a flow. An experience like I did not really feel whatever the time is."* [P1], *"At this stage, it was already that I didn't think too much anymore, and I didn't know how much time had passed already and how much was still ahead. And I didn't care."* [P4]

3.2.2 Effects of Momentary State and Mood. Users' emotions and thoughts gradually changed through the VR experience. Their momentary experiences and moods before experiencing the VR content also had effects on their perception of the VR journey. Three participants were under stress before participating in the experiment. Two participants reported that they were **less stressed** or left with **less thoughts** after experiencing VR. *"Not too much in my thoughts anymore. So, I think that's a good thing."* [P4], *"Right now what I feel is more like, I'm relaxed, but I'm feeling energetic to do stuff… I was a bit tired from the day."* [P1]. One participant was busy with work at the end of the university semester. This participant said she would like to use VR in the workplace to get rid of stress. *"In the language centre… If you could have something like this there, I think people would use it. I would use it."* [P4]. However, another participant said the **tiredness worsened** after the VR experience.

"After the workday, so that also affects me, I got a little bit sleepy towards the end." [P2].

Two users wanted to **share** their VR experience with others after the experiment. One participant said she would like to recommend the cosmic flow VR experience to stressed co-workers. *"If you take time, you are less stressed out, and you might be more efficient… So, I'll recommend it to my colleagues."* [P4] Another participant was excited to show cosmic flow VR to friends at the party. *"I would definitely like to show it to my friends… That would be an awesome party mood."* [P6] The participant was also excited to share the VR experience with the experimenter. *"I think like when the experience ended, I was excited that I will talk about it right now."*

Anticipation has been another factor in how users experienced the content. Users who participated in the experiment in anticipation of a novel and exciting VR experience were disappointed. *"They can do so many things already with the movies and TV and so on… But it didn't do me a wow effect, or that it didn't give me anything that was really unexpected."* [P5], *"I expected something a little bit more active… And then when it's just a kind of this type of very passive relaxation application… That probably affected my whole experience."* [P2] However, one user said it was good to experience passive VR, contrary to the expectation that active participation might be required. *"I wasn't expecting just to lean back and enjoy. I thought I should… actively participate in the game. But there was no game. It was so good. That was nice."* [P4].

3.2.3 Effects of Personal Preferences on the Interpretation of Content and Experience. **The outer space**, which was the theme of the virtual environment, caused conflicting experiences depending on the user. One user said that looking into space does not give a sense of relaxation but rather a feeling of being trapped. *"I don't find space for relaxing… I'm kind of stuck in that space."* [P5] However, another user felt like he was going to a black hole in a spaceship, so he was free from the Earth, had no worries and felt at ease. *"It was like I'm in the middle of a spacecraft and going through a black hole… I left the planet Earth, and I'm free. I have nothing to worry about any longer."* [P3]

Frequent mentions of the **natural environment** were noteworthy. Many participants positively mentioned nature-related words, including Lake, Forest, Aurora Borealis, Coast, Archipelago, Water, Plants, and Park. The green patterns reminded of Aurora Borealis to two users. *"When it looked like Aurora, that was cool."* [P6], *"I saw some green colours that reminded me about the aurora."* [P3] One user said that the deep green colour in VR, like the forest on a sunny day, calmed her mind. *"These colours were more like on a sunny day in the forest, which is nice."* [P4] Two users thought the real nature experience would give more relaxation than the abstract synthetic environment of cosmic flow. *"Just average nature you can go and experience. So, forests, lakes, nature. So, not nature above, even though space is nature as well. The nature we can experience here makes me relaxed."* [P5], *"It's a little bit synthetic… I would imagine if I had this more realistic, let's say lake or natural environment might be more relaxing for me."* [P2].

3.3 VR Ergonomics

Although Cosmic Flow was designed to induce experiences that can be named as psychedelic, transcendental, meditative or relaxing, the medium it is designed for (in this case, VR Headsets) might be hindering the intended experience. Many users also felt **uncomfortable** due to the weight of the HMD pressing on their faces, and one user stated that the HMD had to be supported by hand due to its weight. *"It didn't like, you know, pressed my head too much, but I noticed it was heavier than I thought."* [P4], *"At some point, I already was tired of the headset, and I really need to sometimes hold it in my hands."* [P6], *"The device is very heavy. So, when I was trying to look so, it was easier to focus a bit straight and down. And then I noticed that the centre wasn't there, that I had to lift my eyes. And then I Just notice that I'm getting a sore neck just by that I have to just hold the apparatus up or higher or hold my head up that I also find a bit disturbing."* [P5] Long and heavy cables caused inconvenience to users. *"The only thing that was bothering me was the cable. I was trying to adjust it, but I still like feeling kind of bothering to me… I just put a bit more cable on the back, so I could move."* [P1] High-resolution focus area of HMD also hindered full immersion. *"They made a great resolution in this small box, but I can see this small box. I could not hide it."* [P6], *"In the middle of the screen, I think that there was this type of shade. That kind of here I notice every time I moved my head, it got like more obvious."* [P2] However, none of the users showed signs of cybersickness and were soon able to adapt to the real world.

4 DISCUSSION

4.1 Yin and Yang of Boredom

The study uncovered that the lacking interaction in Cosmic Flow had opposite effects on different users. For some users, the absence of interaction provided a personal virtual shelter where they could feel self-reflection, relaxation, freedom and comfortableness (Theme 3.1.2). The severance from reality, the absence of a goal to achieve, and the unnecessity of influencing the virtual environment were attractive factors to these users. In general, while an interactive application would be aimed at maintaining engagement, in psychedelic VR development, designs intending users to be **active and engaged may be undesirable**.

On the other hand, for other users, the lack of interaction was a negative factor that made them feel bored because they were stuck in a virtual space and couldn't do anything (Theme 3.1.1). According to the flow theory, boredom is one of the experiences we need to avoid to reach the optimum experience in games or other applications [6, 30]. Our finding shows that providing an appropriate level of **positive indolence and idleness** while not causing boredom should be a major goal of psychedelic VR user experience design. **Non-invasive multi-sensory modalities** (Theme 3.1.3) such as embodied, haptic, and tangible interactions can be used as useful mechanisms to shift boring moments towards optimal experiences in psychedelic VR.

Meanwhile, prior research has shown that boredom has an intrinsic value in human life and is one of the main drivers of creativity, pro-activity and self-reflection [39]. In this study, we witnessed that boredom or a moment of idleness causes participants to reflect on themselves and their daily lives or think creatively about representations and changes in shape, colour and sound in Cosmic Flow (Theme 3.1.2). This provides a glimpse into the future potential of psychedelic VR as a tool for **creative and introspective activities**.

4.2 Effects of Priming in Psychedelic VR

Although psychedelic VR is designed to induce or represent a certain type of ASC (e.g., awe, lucid-dreams, hallucination, transcendental experiences, mindfulness, hypnagogic states), the users' experience can vary depending on their state of mind, mood or prior experience (e.g., psychedelic, meditation). For example, a few participants discussed that Cosmic Flow is reminiscent of the psilocybin experience or that using psychoactive substances (e.g., alcohol, psilocybin) would enrich the experience of Cosmic Flow (Theme 3.2.1). Meanwhile, participants' momentary states and moods (e.g., stressed, relaxed) affected how they felt through and after the VR (Theme 3.2.2). Overall, these themes suggest that the different **states of mind, moods, and previous experiences** might lead to different understandings and interpretations of the same VR content. As such, designers of psychedelic VR experiences need to be aware of the fluidity and uncertainty of the end-user experience. Therefore, a designer should design a psychedelic VR application based on an in-depth understanding of multiple usage scenarios, considering the various possible mental states and backgrounds of end-users. Studying a technology that reads and adjusts the user's states of mind and mood before emotional engagement or ASC induction is happening can be a possible direction of psychedelic or affective VR research.

4.3 Psychedelic Virtual Nature

Almost all participants found a relation to elements in nature even if most of the shapes were abstract shapes (Theme 3.2.3). Some participants also voiced that they would prefer natural landscapes, which might induce relaxation. Being exposed to nature in VR has also been found relaxing by previous studies [2]. SoundSelf [9], which is another psychedelic and meditative experience, used elements of nature as content. In our study, the prevalence mention of **natural elements** also shows that nature can be an inspiration point for designing psychedelic VR experiences. The shape and the form of nature might be varied. Some participants could have associated abstract shapes with the elements of nature (e.g., butterfly, aurora borealis), while some others demanded more direct representations. Thus, abstract or exact representations of nature through different modalities might be a departure point in the design of psychedelic VR experiences.

4.4 Toward Comfortable Psychedelic VR

Cosmic Flow is mainly designed as a calming and relaxing experience. However, almost all participants complained about comfortableness and ergonomic factors (Theme 3.3). That is interesting because although the content aimed at providing a relaxing experience, it was hindered by the headsets, even though we have used one of the most advanced VR headsets (Varjo VR2). Although resolution and vision were top notch, factors such as high resolution focus area, weights, cable of the headset hindered the experience. This might indicate that **comfortableness** is an important part of having a proper psychedelic VR experience, and this might significantly change depending on the headset that is used. Thus, the psychedelic VR content designers might need to be mindful of the headset which will be used and look for the optimum balance between the visual quality and ergonomic factors for reaching the intended experience.

5 LIMITATIONS AND FUTURE DIRECTIONS

Although our study is the first example of an attempt to qualitatively and deeply understand the subjective user experience of psychedelic VR content, it is based on one VR application, Cosmic Flow. Thus, examinations of other applications might yield further insights into diverse aspects of the psychedelic VR experience. We believe that conducting similar studies with other VR experiences such as SoundSelf [9] or Ayahuasca [19] might reveal knowledge that can be turned into comprehensive design recommendations. Our study provides a platform for similar conversations and paves the way for other studies to further this field.

Another limitation is the generalisability of our study. We conducted a user experience study with a small sample size of 6 participants. Our sample size is small but fits a qualitative user experience study. The size follows the information power concept, which is appropriate for producing denser, stronger and narrower information from a single case [22]. Further cross-case studies might produce broader and more generalisable knowledge. Although a small sample size fits a qualitative user study, our results cannot be compared to a large-scale quantitative study in terms of generalisability and may not be generalised to a different population. Yet the aim of this study is not to produce generalisable knowledge that would apply to most of the designs of experiences. Instead, our study aims at providing an in-depth understanding of the possible experiences that might be created by psychedelic VR content. The themes in our study are not a complete picture of what experiences can be induced by psychedelic VR but a solid starting point for understanding the possibilities. While the current study produced meaningful thematic knowledge, we will confirm and build upon these findings with a larger sample and different VR applications in the future.

6 CONCLUSION

In this paper, we explored the user experience of the psychedelic VR application Cosmic Flow. Based on the insights collected from our users, we found three major components of the psychedelic VR experience (RQ1): moderate interaction, reflections on personal experience, and VR ergonomics. We discussed findings and suggested the following design considerations (RQ2): non-active engagement, positive indolence and idleness, non-invasive multi-sensory modalities, creative and introspective activities, effects of priming, virtual nature, and comfortableness.

Overall, the study provides an initial foothold for understanding psychedelic VR user experiences to design researchers and practitioners who work on related topics. Our themes can serve as inspirational and generative pieces for creating these experiences and provide contextual knowledge for making sense of psychedelic VR. Meanwhile, using a journey map and unstructured interview in our research demonstrates that such methods could be suitable when understanding the user experience of ASC inducing artefacts. Finally, the authors hope that the presented user experiences and design considerations will be valuable to the HCI community in realising profound VR experiences.

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