An Explorative Study of the Experience of Connectedness and Well-Being in the Immersive VR-experience Elele

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Abstract

Background

In recent years, the prevalence of anxiety and depression increased after COVID-19 due to the increased isolation. Previous research has also proposed that disconnectedness could be linked to depression. Virtual reality as an upcoming treatment method holds benefits in the treatment of mental health problems. Elele is an immersive virtual reality experience that focuses on connectedness, and hence, this paper will focus on the experience of Elele.

Aims

This paper aims to investigate the perception of connectedness in the immersive virtual reality experience Elele by Sjoerd van Acker. Furthermore, this paper aims to investigate what effect Elele has on mental well-being.

Methods

This study used an exploratory research design, interviewing 20 people in groups of two and their responses were analysed using reflective thematic analysis to gain insight into participants' experience in Elele.

Results

Connectedness was experienced in three parts: a connection to oneself, to others, and to the wider world. Connection to self was experienced through intuitive movement in the artistic scenery and being alone in an environment and positioned in the centre. Connection to others was experienced through collaboration, shared goals, and shared exploration of the world. Connection to the wider world was experienced through a changing scenery. Participants reported they were in a good mood during the experience, and they felt an improvement in their well-being compared to before. Furthermore, they had a positive outlook beyond the experience.

Conclusion

While there is an understanding of how connectedness is experienced in Elele, and Elele improves participants' perceived mental well-being, further research is needed to understand the relationship between connectedness and mental well-being.

Keywords: Connectedness, Depression, Basic Psychological Needs Theory, Immersive Virtual Reality, Well-being, Elele

Introduction

Anxiety disorder and depression are the most prevalent mental health problems in the world (World Health Organization, 2022). In 2019, the World Health Organization (2022) indicated that 301 million people were living with an anxiety disorder and 280 million people with depression. The COVID-19 pandemic worsened this problem, estimating that the global prevalence is around 28% for depression and 26.9% for anxiety disorder (Nochaiwong et al., 2021).

Connectedness, or more so the lack of it, seems to be an underlying cause of many mental health problems such as anxiety and depression (Carhart-Harris et al., 2018; Watts et al., 2017). More specifically, the lack of social connectedness, the connectedness to others, has been associated with significant decreases in well-being leading to suicidal thoughts and behaviours (Daniel & Goldston, 2012). The Basic Psychological Needs Theory (BPNT) theorises that psychological well-being and functioning are based on autonomy, competence, and relatedness (Deci & Ryan, 2000). Thus, the lack of experiencing one of these needs negatively affects human well-being. As relatedness refers to the need to interact, be connected to, and experience caring for others, it falls under social connectedness and focuses primarily on the psychological need for such connections. Therefore, the lack of social connectedness, and thus the lack of one of the basic psychological needs, leads to loneliness and negatively impacts well-being, and motivation (Vansteenkiste et al., 2020).

Typical treatments for depression and anxiety are psychological therapy or pharmacotherapy (Bandelow et al., 2017), but a lot of research is looking into new treatments e.g. psychedelic therapy (Ko et al., 2023). With the increase in mental health problems, it is important to create other means of therapy and support for individuals. Immersive VR already offers interventions for addiction or phobias but lacks research on environments that stimulate the sense of connectedness and needs to be further explored (Anderson et al., 2013; Vincelli et al., 2003). Elele*,* an immersive VR experience from artist Sjoerd van Acker aims to make people feel connected using solely the individual's hands. Understanding how connectedness is experienced in Elele and how to ensure a successful implementation in future virtual environments is important to have a better understanding of how to create future interventions in VR that stimulate the sense of connectedness. Furthermore, understanding what effect Elele has on well-being helps to understand the benefits of its implementation.

This qualitative study aims to investigate how people in VR perceive connectedness by exposing them to the VR experience Elele by Sjoerd van Acker which focuses on fostering

the experience of connectedness. Furthermore, it investigates how Elele affects participants in their well-being by analysing their reported feelings and thoughts after their experience.

Psychological theory and research on Connectedness

Definitions for connectedness differ and connectedness is often used as an umbrella term. Looking at studies researching connectedness, researchers investigated the impact of social connectedness, nature, connectedness, or connection to spiritual values (Bailey et al., 2018; Ryff 2021). This highlights the differences in the understanding of what connectedness is. Existing tools for measuring connectedness have typically focused on these specific aspects, however, research suggests that a broader understanding is warranted (Cacioppo and Cacioppo 2018; Sorajjakool et al. 2008).

Watts et al. (2022) conceptualised connectedness as encompassing various dimensions including social connectedness, nature connectedness, and connection to spiritual values, defining it as "a state of feeling connected to self, others, and the wider world". Various subcategories fall under these subthemes, including social connectedness under 'others', and nature connectedness and connection to spiritual values under 'wider world'. This holistic view of connectedness highlights its importance, as feelings of disconnection have been associated with mental and emotional distress (Klussman et al., 2020). Lee and Robbins (1998) also found it to be valuable in the decrease of anxiety in young adults and improving their emotional control which is associated with lower levels of depression. Another explanation can be found in the Basic Psychological Needs Theory (BPNT) which sees psychological well-being and functioning based on the need for autonomy, competence, and relatedness (Deci & Ryan, 2000). According to Ryan (1995), these needs are important for human adjustment and flourishing and the lack of experiencing one of these needs will affect human well-being negatively. Thus, disconnectedness causes the lack of one of the basic psychological needs, relatedness, which should lead to loneliness and a negative impact on well-being and motivation (Vansteenkiste et al., 2020). Additionally, a lack of social connectedness negatively affects self-esteem which normally promotes a sense of social competence and hence would impact a second psychological need (Lee & Robbins, 1995).

These associations lead to the hypothesis that depression may stem from a fundamental sense of disconnectedness, which interventions like psychedelic therapy aim to address by promoting an increase in general connectedness (Carhart-Harris et al. 2018; Watts et al. 2017).

A limitation of the previous definition by Watts et al. (2018) is that connectedness was mostly studied in the setting of psychedelics and lacks research in other settings (Watts et al.

2017; Yaden et al. 2017). Therefore, it should be researched whether connectedness can be induced in other settings e.g. VR where it imitates the experience of a different reality.

Benefits of virtual reality

Among the emerging technologies that may potentially aid in treating mental health problems, Virtual Reality (VR) is the most exciting and technologically advanced. VR is a digital technology that artificially creates sensory experiences (Pasco, 2013). Immersive VR consists of a head-mounted display with integrated speakers and body motion sensors. To ensure safe usage, VR headsets scan the environment and replace it with information depicting a virtual environment to the user. Furthermore, the user can manipulate objects within the virtual environment created (Pasco, 2013). VR has found its application in psychiatry and has been used in various settings. In combination with counselling and cognitive behaviour therapy, it was effectively used for the treatment of addictions (Segawa et al., 2020). Counsellors would replicate a scenario where addiction behaviour is likely to be triggered and would observe their client's behaviour and reaction to it. This is then used to plan appropriate therapies.

VR also finds its effective application in the treatment of various mental problems f.e. social phobia, agoraphobia, claustrophobia, fear of driving as well as cognitive rehabilitation (Anderson et al., 2013; Vincelli et al., 2003). This treatment is called VR exposure therapy and gained popularity in the treatment of phobias (Botella et al., 2017). Other application areas are the treatment of posttraumatic stress disorder (PTSD), anxiety disorder, and psychosis (Powers & Emmelkamp, 2008; Freeman, 2008).

Hence, with the additional tools of immersive VR that can be used in psychological treatment, an alternative immersive reality could be created that elicits sensations of connectedness.

Elele

A VR application that aims to implement connectedness as a core feature is Elele (https://no-fish.nl/elele/) by the VR artist Sjoerd van Acker. He works under the name NO FISH as a creative technologist, creating virtual exhibitions and VR experiences for museums and artists. Elele, Turkish for *Hand in Hand,* is a sensory and intuitive VR experience featuring only your hands. It was presented at the Venice Immersive Festival, one of the biggest VR festivals in the world, and won the competition for a grant. The visual experience is supported by music from electronic musician Max Cooper. It invites you to a dance performance and explore the beauty of your movements. Hands are used as an intuitive instrument to create art and are becoming the artwork itself. Sjoerd aimed to create an

environment where people experience connectedness and explore their creative side. This sensation is created by connecting two unaware participants in the same virtual environment. Sjoerd's idea of connectedness is based on musicians and their jam sessions, where they improvise together and use the connection as the breeding ground for something artistic and new.

Current study

Following the previous sections, the studies from Carhart-Harris et al. (2018) and Watts et al. (2017) hypothesised that depression could be linked to a sense of disconnectedness. According to the Basic Psychological Needs Theory, connectedness is a necessity for psychological well-being and functioning. Loneliness has increased since COVID-19, hence there is a lack of connectedness in society, and it is important to facilitate the feeling of connectedness. Interventions that actively try to increase the experienced connectedness could potentially improve their well-being and hence be beneficial to use as a treatment of mental health problems. However, research is lacking on how connectedness can be created or experienced in a virtual reality environment. The artistic immersive VR experience Elele is aiming for this, creating an experience that elicits a strong sense of connectedness. Asking participants about their experience with Elele could offer insight into this.

Therefore, this study aims to explore how Elele users experience connectedness in a virtual reality setting and what effects it has on well-being. Thus, this research will address the following research questions:

RQ1: How do participants experience a sense of connectedness during their exploration of the artistic immersive virtual reality application Elele?

RQ2: How do participants feel about Elele 's effect on their well-being?

Methods

To answer the research questions, an exploratory research design was chosen. This type of design aims to uncover new insights and gain a deep understanding of experiences and feelings (Stebbins, 2001). Moreover, a qualitative study design allows the collection of detailed, descriptive information about the participants' perspectives, experiences, and contexts (Maxwell, 2008). This research was approved by the BMS Ethics Committee of the University of Twente.

Description of VR experience Elele

In this section, I will describe the experience of Elele first objectively, then through my subjective lens, and finally from the perspective of the artist who created Elele.

The experience in Elele consists of four phases. Throughout these phases, music is played, and its intensity changes according to the phase. In the first phase, the user experiences an environment where they are completely alone. They do see a bright blue floating ball called a “sphere” in front of them. Looking at their hands, they see red virtual hands mirroring the movements of their real hands. Around them is a scene of a colosseum and lights in the sky are moving around. During this phase, their virtual hands multiply around the centred sphere, and they can create rhythmic visuals. In the second phase, users are confronted with the “Are you alone”- question. Then, the sphere moves to the background, lighting up the room, and the hands of the other user connected to the experience appear. The user is then approached by the other pair of hands and the users can interact with each other. In the third phase, the sphere becomes the centre of the experience again and both pairs of hands are around it. Similar to the first phase, the hands multiply again and both users can create artistic visuals supported by the music. In the end, the sphere slowly disappears, followed by the hands of the connected user, and then the main users’ hands. The experience ends with the environment turning completely dark.

Through an interview with the artist, Sjoerd van Acker, I learned that he intended to stimulate people with Elele to explore themselves and the world more. His central goal was to create an experience for people that elicits a strong sense of connectedness, specifically with a stranger. His main idea was to make the participant meet a stranger and dance together. This was derived from musicians having a jam session, improvising, and creating something new together. With the hands as an intuitive instrument, he hopes for participants to work together on creating an artistic experience. Furthermore, he wanted participants to question reality by not letting them know about the other person they were connected to. This was only revealed after both participants took off their VR headsets. However, the artist’s usual setting differed from this study and was on big exhibitions where participants approached the experience alone from separate entrances. Furthermore, the rooms with the participants were divided by a curtain that would open at the end of the experience to reveal the person behind the other pair of hands.

My first impression of Elele was a meditative experience. During the first phase, I felt connected to myself as I was alone in this big colosseum and was mesmerised by the beauty of the whole experience. The smoothness of the movements and the music drowning any outside noises helped me to feel immersed and enjoyed exploring my creativity. In the second phase, when I realised someone joined my environment, I was happy to interact with the other hands and we showed hand signs to each other. I felt very relaxed and enjoyed

exploring the Elele together with someone. The third phase made me feel deeply connected to the other person. Working together on creating a rhythmic visual with our hands felt like we were thinking in the same way and thus deeply connected. Summarising, Elele felt like a journey to another world that I fully accepted. It elicited positive feelings in me and felt like a "healing" experience.

Sampling strategy and recruitment

A non-probability sampling strategy, i.e. convenience sampling was employed, consisting of approaching students from the researchers' social circle who were contacted and were available for the possible timeframes. Also, a self-selection sampling (Vehovar et al., 2016) was used, acquiring volunteering participants through the Test Subject Pool System (SONA) of the University of Twente, which offers mandatory study credits to participating students and therefore an incentive that helped with acquiring participants for the study.

All participants gave their written consent before participating in the study. The interview study was performed on 20 participants in pairs, with seven identifying as male and 13 identifying as female, ranging from 20 to 25. Participants were differentiated by their respective group numbers from one to ten. Participants were required to be able to understand and speak English to participate in the study. Participants also had to be present in person, due to the nature of the design. Important was, that all participants did not suffer from motion sickness and should not be impaired in a way that hinders them from listening to the audio materials, viewing the visual materials, or putting on and using a VR headset.

Materials

The study used the art installation Elele from artist Sjoerd van Acker and was installed on two Oculus Quest 2. Two separate rooms were prepared with enough space that ensure that participants had enough room to roam. Furthermore, they also had to be next to each other to have access to the same router. This enabled a good connection and ensured a lag-free experience for the participants. A Zoom H4N Pro Voice/Sound recorder was used to record the discussion with the participants in high quality, simplifying the transcribing process. Amberscript was used to support the transcribing process. The qualitative data analysis platform ATLAS.ti was used to code the interview transcripts.

For this study, a duo interview with two interviewers and two interviewees was set up. Two interviewers were needed to allow each interviewer to focus on their respective research themes: one focusing on awe and self-transcendence and the other on connectedness and well-being. Interviewing both participants together offered time efficiency and helped participants describe their experiences by discussing them together. This offered participants

the chance to add to each other's answers and hence supported them in finding the right words to describe their experiences. The interview scheme was semi-structured and included a set of predetermined questions about the first impression, sensation of awe, connectedness, self-transcendence, and debriefing (Appendix A). The questions on connectedness were based on the themes of the Watts Connectedness Scale, including connectedness to oneself, to others, and to the wider world. This structure helped to guide the interview with the participants towards the research question, while still offering room for discussion about topics expressed by the participants. Interview questions were open-ended to encourage a full, meaningful answer using the interviewee's knowledge and feelings. This was important because the themes in the interview were based on the researchers' own experience, and it was desired to still capture participants' unique experiences that might deviate from anticipated themes.

Procedure

The participants either signed up over Sona or were asked to participate in the study. Each study was timely limited by the timeslot of one and a half hours. Participants were then invited to the Serious Gaming room at the University of Twente. This room offered a breakout room with a moveable wall. Before the study started, the VR headsets were prepared for each room and connected to a Wi-Fi router. To create the shared experience, both headsets had to be on the same call. Afterwards, the participants joined and were informed on how to use VR and its risks, and that the study is based on the VR-art installation from Sjoerd van Acker. The art installation was briefly explained, and they were told to use their hands as tools to create art but also to see the hands as part of the artwork. Participants were told that they must explore the environment on their own. It was crucial to hide the fact that both participants were connected during the experience. Therefore, they were told that the reason for doing the study in pairs was to facilitate a discussion between the participants and researchers afterwards. Furthermore, we emphasized that each participant will be alone in the room and will not be observed.

After gathering informed consent, participants were divided between the two rooms and were helped with putting on the VR headsets. Participants were asked whether they could see both hands to ensure smooth functioning. If that was the case, both headsets were set on the highest volume and the participants were told to start with the experience by putting their thumbs up. During the whole experience, the researchers stood close by in case participants would ask for help or felt uncomfortable. Both participants experienced two phases in the VR installation. First, they were experiencing the world alone and only saw their own hands.

Later, they were connected and also saw each other's hands. After this, the installation told them to take the VR headset off. This was accompanied by the end of the music playing and gave the researchers the cue to approach each room. For the interview, everyone gathered again in the main room and was seated in a circle. The recording device was set up, and the interview was started. First, participants were asked about their initial thoughts and feelings. During this, they were informed that they got connected in the experience through the other pair of hands. Participants had to answer questions about their first impression and general experience with the Elele, experiences with awe, self-transcendence, and perception of connectedness. The interview ended with debriefing questions about their experience with the study and the possible points of improvement (Appendix A).

Data Analysis

To analyse the data, the thematic analysis by Braun and Clarke (2012) was performed to search for clusters in data. More specifically, the reflexive thematic analysis approach enabled a reflective and thoughtful engagement with gathered data. This helped to create meaningful interpretations rather than a consensus of meaning achieved through other approaches (Braun & Clark, 2019). The transcripts were coded in consideration of the research questions in regards to connectedness and well-being to look into the researchers' expectations. To create the coding scheme for connectedness, a deductive approach was used, and the codes were based on the definitions formulated by Watts et al. (2022). To gain an understanding of how participants felt when experiencing Elele, an inductive approach was used. For this reason, comments about participants' well-being and how people felt in Elele were looked for. Comments that did not fall under these two themes were first coded and later reviewed for possible themes. To be in line with the research, codes that could affect the previous themes and would give an additional understanding of Elele were considered relevant and repeatedly reviewed for an overarching theme. The challenge was to merge similar codes to a new overarching code and, therefore, decide which codes fit together to form a theme and subtheme. Positive effects were combined with the theme of well-being, while two additional themes appeared after going over the different codes, namely Perceiving Prompts Negatively and Prior Experience.

Results

Impression of the Interviews

The interviews ranged in duration from 22 to 61 minutes with an average of 40 minutes. Participants shared their impressions in varying paces. While some participants immediately shared their experiences and feelings, others required time and opened up during the discussion with the other participants. Generally, participants shared more the longer the conversation went. This discussion facilitated a deeper exploration of their experiences and feelings. When participants found a common ground, they were be encouraged and added additional information to other participants' experiences. However, participants still disagreed if they experienced situations differently. Interestingly, participants already mentioned feelings of awe and connectedness during the initial impressions before they were specifically asked about these concepts by the interviewers. Many participants did struggle to understand the construct of self-transcendence and needed further elaboration from the interviewer. As the interviews progressed, it became evident that self-transcendence and the sub-construct of being “connected to the world” were closely intertwined.

Participants expressed excitement and happiness during the interviews and were eager to share their experiences. This was reflected in their overall positive attitude, which contributed to the constructive and open atmosphere of the discussions. They were pleased by the interview style and felt safe and comfortable. Interviews were perceived as a casual conversation, in which jokes or stories could be told. The positive feedback received on the interview style underlines the success of this approach in facilitating open and productive discussions. This positive environment likely played a significant role in the participants’ willingness to dive into complex constructs like self-transcendence and connectedness to the world.

In conclusion, the interviews’ discussion format helped to retrieve valuable insights into the participants’ experiences and perceptions and supported participants in wording their experiences.

The four major themes (connectedness, well-being in different stages, perceiving prompts negatively, and prior experience) with corresponding codes and quotes can be found in Table 1.

Table 1

Relevant Themes, Codes, and Examples

Theme	Codes	Example of theme

Connectedness	Connected to yourself	“Connected with myself I would say like in the beginning very much so. Like you have the space to be on your own to kind of see what's around you and see what's going on”
	Connected to others	“And then I think as soon as the hands came in, that was also like I feel connected to someone else, at least”
	Connected to the world	“My first intuition would be to say, like, just more connected to her, but then also being part of a bigger thing is more like connected to being, you know, like more connected to everything”
Well-being in different stages	Feelings during the experience	“I feel very happy. Kind of connected in a way, I think. It was also very surreal, but also very pretty. Like, just to see the sun, and it changed. And the day and the sky. And the stars.”
	Improvement after using Elele	“Like when I think of how I felt before, like I was a bit low energy and a bit like exhausted from the day and afterwards I was just like all right, like fun, relaxed, happy”
	Positive outlook beyond the experience	“I think mood, but also just my outlook for the day changed. A bit like I have stuff planned and now I am a bit more excited to experience those new things as well.”
Perceiving prompts negatively	Question	"I was a bit scared when I saw that it suddenly said, are you alone?”
	Other participant’s hands	“At first I was a little scared because they were just hands, and they were coming towards me, and I was trying to move past them”
Prior experience	Knowing the person	“If it was some other participant, maybe I would be like, ‘What are you doing here?!’”

	VR-affinity	"No, because I think that this [lower immersion] is because of my previous experience with the technologies already"

In the following paragraphs, the main themes will be described in detail. The participants' names are pseudonyms, and their focus group numbers are mentioned in brackets. Each paragraph goes through quotes of participants' experience that were interpreted and were then summarised at the end of the paragraph.

Connectedness

The first theme of connectedness consists of three types of connection that participants experienced, e.g. connected to yourself, connected to others, and connected to the world.

Connected to oneself

Connected to oneself was mostly experienced in the first phase of Elele. Connected to oneself means to be attentive and attuned to what is going on inside you. Participants did experience a sense of self-connection in Elele. Charlotte (FG10) expressed that having the space to be on your own and to explore the artistic scenery, led to a heightened sense of self-awareness: "Connected with myself I would say like in the beginning very much so. Like you have the space to be on your own to kind of see what's around you and see what's going on." For Heidi (FG10), the opportunity to escape her responsibilities in VR allowed her to connect with aspects of the self that are otherwise often suppressed in daily routines, such as playfulness and silliness:

> I think I felt connected to my silly side of it because sometimes on a normal day you kind of, you do your chores, you do your tasks and you don't really get to be very playful or just have fun somewhere. And I think in that way I felt more connected to an aspect of my personality that maybe I would like to experience more often. […]. I just feel maybe a bit more like myself.

This was also mentioned by Marie (FG9), that in Elele "you can just be yourself a lot". Even in the presence of another person in the form of hands, Sarah (FG9) emphasized the personal nature of the experience:

> I also think for me, even though I knew that Marie was sort of there, it felt like an experience for myself. So, I was like this whole moment for myself. And usually, if I'm

> with other people, I try to share it with them. It's like, 'Oh, do you also feel like this' sort of. Now it's just like, 'Oh, it's just my moment.' And I made it myself because I was doing the little figures.

Immersion played an important role in this as Sophia (FG8) felt she could fully express herself with her virtual hands: "Having your hands so interactive in the environment was cool. Of course, it is still VR an experiment, but it felt way more like, oh, this is really based on me and what I do." Noortje (FG7) added that the music was a crucial factor in feeling immersed combined with the artistic scenery:

> To me, the music especially was I think the biggest thing. And then also just looking around, I was I think almost most of the times I was looking up because I love looking at the sky and I just saw it. It was changing colours and then I saw stars and then I saw clouds. So it was a mix of the music, like the environment per se, it all.

In conclusion, participants experienced a sense of self-connection by being alone in an environment and being positioned in the centre of the experience. Furthermore, immersion through music and intuitive movement of the hands, combined with the artistic scenery helped to focus more on themselves.

Connected to others

Connected to others is about social connectedness, a state of feeling close to other people. This was experienced in the second and third stages. For instance, Leona (FG1) sensed a connection to someone because she expected the hands to be part of a shared goal: "I felt some connection to the other, other hand. Like his hand, because I first thought that I had to, uh, do the same thing as the other hand to reach some goal." Sarah (FG9) described a connection to others when her actions mirrored those of the other person, suggesting a sense of relatedness and collaboration:

> When we were having like the circles with my hands in her hands, I also felt sort of connected because then I just started doing, what she was doing, and then the other way around where it felt like that. So yeah. Oh, cool. We're making, like, little figures together.

For Heidi (FG10), being in a social setting and playfully exploring the surroundings with someone else had a positive impact on her connection to the other person: "I was thinking a similar thing that how important being social is and exploring new things with someone else and being just silly together. […]. That can also have a very good impact."

Tim (FG6) highlighted the potential for such experiences to strengthen relationships: “I think I feel like I would be a better friend with someone if we did this together once.” Creating something together seems to be another way to experience a connection with someone else, as noted by Maud (FG8):

> I don't know if guidance is the correct word, but just like I saw it as a way of like cooperating to create something essentially, so as like a thing of working together maybe. Yeah, or like creating something together.

However, this sense of connectedness developed after the user realised that the other pair of hands resembled the hands of the other participant which helped Clara (FG7) to feel at ease:

> I think the biggest thing was to me when, when her hands appeared in my vision and then at some point, we were both like kind of doing like *hand movements*, yeah, yeah, that was me. I was like, oh my God, we're connecting. It made me feel at ease.

The previous situations in which participants created something together not only intensified the feeling of connection but also improved the aesthetic experience in Elele, making it “prettier” with “two colours, two sets of hands.” Interestingly, the connection was not just about the shared activity but also about the shared space. The mere presence of another person’s hands in the virtual environment, as described by Sophia (FG8) and Clara (FG7), was enough to evoke a sense of connection: “And then I think as soon as the hands came in, that was also like I felt connected to someone else, at least. And it still had to get that it was you [the other participant].” This connection became important due to the loneliness experienced, f.e. Clara (FG7) felt impacted by the lack of interaction in the environment and the other pair of hands was the only way to escape loneliness:

> Well, I think it was like I feel like maybe the fact that it was very lonely, like the only thing that you had was her hands. Yeah. Like there was nothing, nothing, nothing else around it. Not like any signs of another presence in that kind of sense. That was the only presence that was there. So then. Yeah, it felt more like that.

In conclusion, shared activities created a connection with others and were characterised by a sense of fun and exploration. Collaboration, shared creation, the mere presence of another person, and social interaction helped to achieve this. Furthermore, these

experiences and activities connected and improved bonds with other people in a virtual environment. The experienced loneliness caused by the lack of competing stimuli helped to facilitate a stronger connection to someone else.

Connected to the world

Connected to the world described the feeling of being part of something bigger. This sense of connectedness to the world was elicited by the VR environment. Leona (FG1) expressed a connection towards herself and a larger entity, leading to a state of happiness and momentary forgetfulness of prior events: “I felt a connection towards myself. But then, uh, as you said, to like a bigger like entity. And felt happy. And I don’t know, I kind of like, forgot about everything that was happening before.” This feeling of connectedness is compared to the experience of the universe, making negative experiences seem smaller and more manageable if put into contrast:

> I feel like it does have a positive impact, like this feeling of connectedness and or like a grand meaning of the universe. I feel like that gives you a nice perspective and makes the negative things a little bit smaller. You know, it’s like, okay, whatever. Like it’s part of life and it’s just as nice; Finn (FG4)

This sense of being part of a larger whole seems to be connected to the experience of a changing environment according to Maria (FG8): “When the environment became clearer, I really was just there and I felt really part of that space basically and very connected”. Noortje (FG7) also experienced this sense of connectedness, which she described as “weird” and was particularly struck by the changing environment. For Sophia (FG8), the level of immersion was what enabled this deep connection: “I would definitely agree with that as well. Like, I think that was the most immersed I was in the environment itself where I felt the most connected.” Tim (FG6) compared his VR experience to real life, suggesting that VR could foster a similar level of connectedness in a spiritual sense:

> I think I feel like equally connected in VR as in real life, which is like a decently big compliment because not feeling disconnected is already a pretty big thing. But I wouldn’t say that the VR experience gives you more connectedness. I will say. I think it gives you more connectedness in the more spiritual sense where it’s like, you know, you feel one with like I would say that was a decently spiritual experience.

This spiritual connection differed in intensity for each participant, as Arian (FG6) did describe it as an out-of-body experience, where he felt detached from his physical self and more attuned to how the external world interacted with him:

> I would have said if you guys know that feeling when you're just fading like don't know where you are or like where your body is. So like an out-of-body experience when you really focus and just forget about yourself and just focus on how the external world interacts with you.

Summarising the connection to the wider world, the changing aesthetics in Elele and the experienced immersion created the sensation of being part of something bigger. This was also described as a spiritual feeling to the extent that it was perceived as an out-of-body experience. Generally, it led to a state of happiness and made negative experiences seem smaller and more manageable.

Well-being in different stages

Well-being in different stages covers the positive effects of Elele experienced by participants. It includes the codes of *feelings during the experience*, *differences before and after experiencing Elele*, and a *positive outlook beyond the experience*, covering the different stages of study.

Feelings during the experience

Feelings during the experience are about understanding the emotions participants experienced when using Elele. There is a range of emotional responses during the experience,. Charlotte (FG10) described feeling "very happy" and "kind of connected," and found the changing environment "very surreal, but also very pretty." She also reported a sense of calmness during the sunset, which she described as a "really serene kind of view." Similar to this, Bart (FG5) described feelings of happiness and excitement, when observing the beauty of the scenery:

> Yeah. I think specifically the feeling of awe, and just looking around at the beauty of the scenery. And, uh, that was the most interesting, I think. I mean, I don't think out-of-body experience does describe it as, as it was, but it's kind of like that. I feel like, um. Yeah. And just in general happy and exciting or excitement. Happiness. When I was doing the thing.

Heidi (FG10) experienced happiness through interaction with someone else: "The part when we were together, it was more, uh, like happy. I think it made me more happy

because it was more like energetic." Clara and Noortje (FG7) both reported feelings of excitement and adrenaline. Clara described the experience as a "rush," with Noortje noting that she "just couldn't help but smile" and found herself laughing due to the excitement. Noortje's rush was stimulated by the music and changes in the environment during the transitions of the phases:

> I think for me it was like a rush. Like, I just couldn't help but smile. Like, I just couldn't help them to just have a big smile. And I was, like, laughing. Like, I don't know if you like it. At some point, I didn't know if there was somebody in the room, but just somebody at some point just started laughing because I just felt like, oh, like, this is so cool. It was kind of in a rush, like especially the music. And when the sun suddenly starts, like pulling away, it gives you like a rush, like of not nervousness, but like, more like excitement in that kind of sense.

Sophia (FG8) and Sarah (FG9) both reported feelings of calmness and comfort. Sophia felt "very much in the moment and not being bothered by other outside forces," while Sarah compared the experience to the comfort of a weighted blanket, describing it as "a warm hug." For Heidi (FG10), it was a unique experience that cannot be described by one term. Her feelings ranged from "curious, a bit hesitant as well but then like a bit silly, like just happy and silly and just testing it out."

Overall, participants reported strong feelings of happiness, connection, calmness, excitement and curiosity. The beauty of the developing environment and being able to experience it in front of it, played an important role in this, as it caused calmness as well as excitement.

Differences before and after experiencing Elele

This subtheme is about the perceived differences of participants' well-being from before participating in Elele to after. For instance, Charlotte (FG10) experienced an improvement in her energy levels and mood: "Like when I think of how I felt before like I was a bit low energy and a bit like exhausted from the day and afterwards, I was just like all right, like fun, relaxed, happy." Similarly, Heidi (FG10) noted an improvement in her mood and a decrease in worry: "For me, also mood and maybe I feel a bit more comfortable with myself, I guess. And a bit less worried too because I think laughing was very nice. And having some fun." Sarah (FG9) experienced Elele as deeply relaxing and calmed her mind:

> I feel more relaxed. Like right now, I would describe my status as if my head was filled with like cotton but like in a nice way. Not in a negative way. And yeah, I feel ready to face the last bit of the day.

Elele seemed to reduce perceived inner tensions and stress in some participants as Sophia (FG8) compared the feeling after experiencing Elele to meditation:

> I did not have a good start in the day, so I was feeling quite tense this morning, and this really brought me down. […]. I would consider myself to be way more relaxed right now than I was coming into this. […]. This feeling kind of gave me like a feeling of maybe the result of a meditation or so.

She further noted that the experiment helped her focus on the beauty of the moment, thereby reducing her stress levels:

> I think it really improved my mental status at this moment, because just this week has been super busy for me, and there's quite some stress. And with this, I really, like got sucked back into the moment and just experienced the moment and kind of like the beauty of things and how like there's a world full of beauty. So it really improved that.

Noortje (FG7) experienced Elele as "very relieving" and "feeling calmer" and Arian (FG6) reported that it helped to distance himself from previous stressful experiences: "I came from a study session working on an assignment. I forgot about that completely. So, I felt very relaxed afterwards. Like very relaxed and at ease." This was also experienced by Finn (FG4): "I would say a lot more relaxed. I was not really thinking about any big struggles or anything that I had in mind, maybe before the experiment." The duration of these effects varied among individuals, e.g. Naomi (FG2) reported only a temporary moment of calmness and relaxation: "There was this moment of just a little bit of calmness and relaxing after coming out of it immediately but not anymore."

To summarise, Elele had a relaxing and destressing effect on participants, decreased worrying, and improved mood and energy levels. Offering an escape from the real world to a place full of beauty and its meditative features achieved these effects. However, the duration of these effects seemed to differ.

Positive outlook beyond the experience

This subtheme described the impact Elele had on participants' outlook of the day. This shift was accompanied by an increased openness to upcoming social situations. Charlotte

(FG10) represented this change, stating: “I think mood, but also just my outlook for the day changed. A bit like I have stuff planned and now I am a bit more excited to experience those new things as well.” Finn (FG4) explained a bit that the feeling of connectedness “gives you a nice perspective and makes the negative things a little bit smaller” and helped him to accept the upcoming things in life. Participants also reported feeling more equipped to handle both positive and negative situations. Tim (FG6) expressed:

> If anyone were to ask me, you know for a favour, I feel like more open-minded if anything were to come across, whether it is negative or positive. I think I would like to be able to handle it a bit better.

Elele also fostered a sense of acceptance and moving on in life. Clara (FG7) described this situation:

> Now I am more relaxed, and I am like, ‘Okay, look, the exam already happened. Whatever happens, happens. Like yeah, just go on with your day. It is okay. This little thing is not going to impact your whole life, so just take it easy.’

Noortje (FG7) also reported a slower, more mindful approach to her day, stating: “Like now, I am just going to slowly do my things today. Like I am not going to try to rush anything. I feel like that is the main impact it had on me.” It even impacted the view on life and the appreciation of its beauty. Sophia (FG8) highlighted the transformative nature of the experience, stating:

> This was such a different experience like it is not a normal world what you see, but it is still so cool and beautiful that it just reminds you of the other beautiful things that we have in reality as well. I think it is like a long-term change and not just like today’s change.

This sentiment suggests that the experiment not only improved the participants’ outlook for the day but also potentially fostered a more enduring positive perspective.

To sum up, Elele caused a significant shift towards a more positive outlook, a change in the perception of the day ahead, with problems or pending work being viewed less negatively and as generally smaller than before the study. This was accompanied by being more open to upcoming social situations.

Perceiving the prompts negatively

The theme of *Perceiving the prompts negatively* describes the negative reaction some

participants had when first confronted with the prompts in Elele. These were divided into the subthemes *Question* and *Other participants hands*. The reactions to these prompts happened in the transition from the first to the second phase; the moment they got connected with the other participant. A particular characteristic of this theme is that it was only experienced by the female participants of the study.

Question

The question "Are you alone?" appeared in the transition from phase one to phase two. This question elicited a negative reaction in two female groups. They reported that while they were still trying to understand and explore the environment, reading "Are you alone" in the sky caused them to question their surroundings as Noortje (FG7) expressed: "Like, I think that's also why it's spooking me so much. Are you alone? Because I was like, clearly looking around. I was like, yeah, I am alone here. Like there is nobody." The uncertainty of the situation put Noortje in a stress situation and made her feel worried about what would happen next. She relaxed after she reminded herself that it was probably her friend in the other room:

> I was a bit scared when I saw that it suddenly said, are you alone? And I was like, well, it looks like it like that was kind of, for me, a bit scary. Um, but then, but then I thought I was like, oh, yeah, it's probably hers because they weren't moving at the same time as me or anything. Um, yeah, but weird to see your hands, but you were not there.

It was suggested by Marie and Sarah (FG9) to remove the question altogether to not overthink the environment and cause them to worry about what will happen next.

To conclude, the question caused female participants to question the perceived environment. This caused them to expect something to happen that they had no control over and caused a brief stress reaction. To fix this, it was suggested to remove the question altogether. However, it needs to be mentioned, that the sample size is too small to say it is a gender issue, and this result could have happened by chance.

Other participants hands

In the second part of the experience of Elele, participants became aware of each other and would see another pair of hands. This transition started with seeing the "Are you alone?"-question, followed by the sphere in front of the participant moving away to the background, and then the appearance of a pair of blue hands next to it. While they generally enjoyed Elele, these additional hands in the environment elicited brief negative reactions among the female participants. In the case of Monique (FG2), this was caused by losing the perceived control of

what was happening in the experience. The uncertainty of not knowing what the other hands are doing and not having any control over it made her feel overwhelmed:

> There were like another set of hands. So, I was overwhelmed again, like, 'Oh, what's happening?' because I finally had like, control, because I understood it kind of. And then the second pair of hands came, and I didn't know what was happening.

This uncertainty of not knowing what the hands are, caused Daria (FG3) to associate the other pair of hands with something bad and expected a negative outcome when interacting with them: "Like in the initial stage, I was really like, I don't want this thing to touch me. This thing will hurt me." Her stance did change when she tried to rationalise the situation and remind herself that it probably was the other student behind the hands, however, she still had to overcome her repulsive feeling: "Okay it is probably Ron. And this is probably what the like the art interaction wants me to do. So, I will force myself to interact with your hand." Romy (FG5) had a similar experience. She was aware that the hands were part of this playful experience and could not touch her, however, she still felt as if she could be touched by these other hands and not knowing who was controlling them caused this repulsive reaction:

> At first, I also got scared when the other hands, I mean, I didn't know what they were. I thought it was just, you know, uh, designed by you guys or something, but I didn't like it when they almost touched me. Even though I knew they couldn't actually touch me.

Not knowing who is behind the other hands also made Noortje and Clara (FG7) a bit "uncomfortable" and were confused by the added value of the hands:

> Oh, definitely. That was not super uncomfortable. It was just because at that moment I still could not kind of process whose hands were there and why was the head like I still was like, kind of like, what the fuck?.

Clara agreed, saying: "At the beginning when I saw her hands in blue, I was like, who the hell is this? What the. What is going on?" Seeing hands approach her seemed to be a trigger for Marie (FG9) who experienced a strong fear reaction when the hands started coming closer and she felt they invaded her safe space even though her friend was behind the hands. Female participants had a repulsive reaction to being approached by hands they did not know and associated it with negative outcomes. Heidi (FG10) e.g. became more comfortable when she realised that the other hands belonged to the other student:

> At first I was a little scared because they were just hands, and they were coming towards me and I was trying to move past them. But then I realized that it's probably her and then said, oh, okay. Yeah. And then yeah, we were just yet kind of dancing together and copying each other's moves.

Concluding these responses, the other pair of hands caused initial negative reactions in some female participants. This was experienced during the second phase when the hands appeared and/or when the other hands were approaching the participant. The uncertainty of not knowing who was behind the hands and what their intentions were, caused some female participants to expect bad intentions behind the other pairs of hands. However, this was only the initial feeling and after rationalising the situation, reminding themselves that they were in a safe environment, and the hands most likely controlled by the student they met in the briefing, they relaxed and enjoyed the Elele experience. Again, it needs to be mentioned, that the sample size is too small to say it is a gender issue, and this result could have happened by chance.

Prior experience

The theme of prior experience describes experience or knowledge that participants mentioned that seemed to affect the experience of *Elele*. This prior experience consists of the subthemes *Knowing the person* and *VR-affinity.* the intensity participants experienced Elele. More specifically, it did affect the immersion, as participants were more aware of Elele being only an artificial environment. This prior experience differed in its subthemes

Knowing the person

This subtheme describes possible differences that knowing the person that you get connected to could have on the participants on how they perceive the hands and would act in Elele. Monique (FG2) perceived the environment as a not-safe space due to not knowing the experience and what happens in it: “It was like there was no safe space there because I was confused.” This changed for her when the hands appeared she immediately connected them to the other participant: “And then when the hands showed up and I knew it was her and I felt actually really safe.” She felt safe the moment she realised that the hands that appeared belonged to someone she knew. Naomi (FG2) further elaborated that knowing the person behind the hands impacts how the hands are perceived: “I think just knowing who is there, it does change how you like to look at the hands.” For Monique, it would make it less safe and scary if she did not know the person controlling the hands: “I think it would be less safe. […]. I would probably still feel safe knowing it is an actual person, but not knowing the person

that's behind the hands would be maybe a bit scary." Group 7 had a similar response. Noortje did question the other hands' intention and was more cautious: "If it would have been somebody else, I feel like that could have made me also feel a bit more like, 'Oh, why are you, like, coming with your hands so close to me?" Clara would also expect a more repulsive response from herself: "If it was some other participant, maybe I would be like, 'What are you doing here?!'" This did change the moment she realised that it is her friend on the other side: "Indeed, putting together that it was her with the hands made the whole thing kind of like I'm like oh now I am relaxed."

Therefore, not only knowing that the hands belong to the person next room but also to someone they feel comfortable with, helps them to relax and not perceive the hands as a threat. In situations where they do not know the person behind the hands, they become more avoidant and cautious, and expect the interaction to lead to a negative outcome

VR-affinity

VR-affinity talks about the experience participants had with VR. This can be the regular usage of a VR headset, but also affinity with programming, especially about VR environments. This seemed to play a role in the intensity participants experienced Elele. More specifically, it did affect the immersion, as participants were more aware of Elele being only an artificial environment. Regular VR usage seemed to decrease the intensity with which the participants would experience the environment. Emiel (FG4) described a lower immersion compared to other participants and explained that due to previous exposure to VR, he is more aware of the technology and did not experience the world differently:

> No, because I think that this is because of my previous experience with the technologies already, like I had a bit of the, oh the cameras are able to recognise my hands because it's like one of the most sophisticated VR versions I've ever used. But it was not like a shock moment for me.

In this statement, it also seems like he deconstructs the experience, thinking about the realisation of the environment instead of fully immersing himself in it. Especially for people with a programming background, it seemed like they tended to mentally deconstruct the environment and try to understand how it was developed rather than fully immersing themselves in the environment. This was experienced by Sarah (FG9), who is into programming and was more amazed by the work behind it than by the environment itself: "I know that at certain points I was like 'Oh that must have been really fun to program this'"

She states that due to her technological background, she often questions how it works and what is behind it which could be attributed to other users in that field:

> I have noticed with a lot of courses, whenever we just see something, we question 'Oh how does this work' and want to see what it is like in the background. […]. I can imagine that other people might be the same.

To summarise, familiarity with virtual reality (VR) decreased the intensity of the experience, and knowledge of programming had studied or worked related to programming did mentally deconstruct the environment instead of fully immersing themselves in the virtual world.

Summary

To conclude the results and the presented quotes, a summary of each theme is presented in the order above. Looking at connectedness, participants experienced connectedness to oneself, to others, and to the wider world. Being alone in an environment and being positioned in the centre of the experience created a sense of self-connection. This was supported by immersion through music, intuitive movement of the hands, and the artistic scenery. Experiencing shared activities through collaboration, shared creation, social interaction, but also the mere presence of another person created a sense of connection to others in which participants had fun and could explore the experiences. This helped participants to connect and improve their bonds. But also experienced loneliness, caused by the lack of competing stimuli, helped to facilitate a stronger connection to someone else. Regarding connection to the wider world, the changing aesthetics, and the immersion in Elele created the sensation of being part of something bigger similar to a spiritual feeling. Generally, it led to a state of happiness and made negative experiences seem smaller and more manageable.

Looking at well-being in the different phases, positive feelings were experienced during Elele including strong feelings of happiness, connectedness, calmness, excitement, and curiosity were reported. Experiencing the beauty of the changing environment seemed to elicit these feelings. After experiencing Elele, participants experienced an improvement of their well-being as they felt less worried and stressed than before and experienced a heightened mood. It was described as an escape from the real word and compared to a meditation. Beyond the experience, participants experienced a shift to a positive outlook on the rest of the day. Problems and pending work were viewed less negatively and challenging

than before. Participants also reported to be more open to upcoming social situations.

The negative perception of prompts, included the reaction to the question and to the other pair of hands. The question caused participants to question their environment and led a brief stress reaction in some women. The other pair of hands caused brief negative reactions in some female participants. Not knowing who was controlling the hands and their intentions caused some female participants to expect bad intentions. Rationalising the situation and being aware that the hands are controlled by the other student, helped them to relax and enjoy Elele.

Finaly, prior knowledge included knowing the person and VR-affinity. Knowing the person behind the hands helped participants to relax, while not knowing the person caused participants to be more avoidant and cautious and expecting a negative outcome from the interaction. When it comes to VR-affinity, being familiar with VR seemed to decrease the intensity of the experience for some participants and having knowledge in programming seemed to cause participants to think more about the creation of the experience than experiencing it.

Discussion

Using an explorative-qualitative study design, this study was concerned with two research questions:

RQ1: How do participants feel a sense of connectedness during their exploration of the artistic immersive virtual reality application Elele?

RQ2: How do participants feel about Elele ‘s effect on their well-being?

For the first research question, findings suggest that participants experienced connectedness in Elele in three components, consisting of a connection to the self, a connection to others, and a connection to the wider world.

Connection to oneself was facilitated by different means. By putting participants alone in an environment, creating an environment in which the user was the centre (solitary environment), and creating an environment that helped participants to fully immerse themselves. This was mostly done through music, intuitive movement of the hands, and artistic scenery.

Connection to others was characterised by closeness to other participants. Giving participants a shared space in Elele created a sense of connection to the other person. Loneliness experienced due to the lack of other competing stimuli increased the need for interaction and hence the importance of connection to others. A stronger feeling of connectedness was achieved by creating shared activities that engaged participants through

exploration and cooperation. The shared creation in Elele not only intensified the feeling of connection but also improved the aesthetic experience, causing participants to associate beauty with cooperation. Furthermore, being able to mirror someone's actions created a deeper understanding of each other and connection with each other.

Connection to the wider world was influenced by the environment and experienced in different ways. Some participants experienced the spiritual part of it, being a part of a larger entity. This was the result of a changing scenery, where the environment became clearer, but also through the immersion.

Overall, in regard to the first question, connectedness was experienced in these three components, facilitated by the first being immersed in the environment alone, then through the shared activities, and lastly the scenery.

In relation to the second research question, Elele's influence on well-being was divided into three parts**:** positive feelings during the experience, improvement in well-being compared to before experiencing Elele, and a positive outlook on the future that went beyond the experience.

During the experience, the beauty of the environment did elicit a feeling of happiness. Furthermore, the presence of others did create a calming effect during the experience. The change in well-being after the experience is the result of longer exposure to positive feelings in the environment. It gave participants the feeling of an escape from real life. Elele created sensations similar to the experience of meditation. Lastly, Elele did change participants' outlook on the day by creating a buffer to problems in real life, making them seem less overwhelming after the experience. A general openness to experience which enabled participants to approach the rest of the day more positively.

Regarding the prompt in Elele, it negatively affected the well-being of some female participants. These related to the transition from phase one where you were alone to phase two where participants were connected to the other participant. The question "Are you alone", used to make participants question their reality, could cause initial stress in female participants. In line with this, the lack of perceived control over the unknown pair of hands that appeared caused avoidant reactions in some female participants.

Finally, it was found that prior experience could play a role in the efficiency of VR experiences. It seemed that experience with the usage of virtual reality and/or programming impacts the level of immersion negatively.

Understanding Elele's usage of connectedness and its effect on well-being

The experiences of connectedness in Elele align with the connectedness definition of

Watts et al. (2018). Elele did elicit a sense of connectedness on the three defined levels, a sense of connection to the self, a connection to others, and a connection to the wider world. These results are comparable to Watts et al. (2017) study with psychedelics in which he researched to what extent connectedness is experienced in a different reality. His participants perceived this different reality as pleasant and experienced connectedness to the self, others, and the wider world. Elele was attempting the same, creating an alternative reality for the user to explore. The findings on Elele's effects on well-being could be explained by the Basic Psychological Needs Theory (BPNT). According to the BPNT, humans require autonomy, competence, and relatedness to increase adjustment and flourishing (Ryan, 1995).

Regarding well-being, during the experience, Elele made participants feel happy and relaxed. After the experience, participants felt that their well-being improved significantly compared to how they felt before participating in the study. Furthermore, their positive outlook described after the experience had an impact beyond the experience itself, as they felt more capable of overcoming the upcoming challenges. This aligns with the increase in adjustment and flourishing described by Ryan (1995). It could be that Elele does not only elicit connectedness, especially in the sense of relatedness and feeling connected to someone else but additionally gives participants a sense of autonomy and competence. Participants had full control over their hands in the environment and created the visuals in Elele during the first and third phases. Participants expressed that after getting acquainted with Elele, they started to feel more relaxed. This might be an indication of the development of competence during the first stage. Hence, users were able to experience autonomy, competence, and relatedness through Elele. This could explain the negative reactions some female participants had towards the prompts. It seems like the moment the question and the other hands appeared, participants felt less in control of the situation as they did not know what was happening. Hence, they may feel not competent enough to adapt to what is happening. When they rationalised the situation as safe and connected the other pair of hands to the other participant, they felt more relaxed and happier. This might indicate a momentary loss of competence and thus the brief psychological stress. However, it does not explain the difference of experience between the genders. Another explanation could be offered by Fetchenhauer and Buunk (2005). They found that women were generally more fearful of all kinds of events that might imply a physical injury. This combined with the immersion could lead to female participants worrying more about possible harm in a situation where they feel physically present but do not have control. For all these cases explanations it needs to be mentioned that it cannot be concluded that this is a gender issue, and other factors e.g.

personality could play a role in this.

Another point is the importance of a connection to others, also called social connectedness. The study of Lee and Robbins (1998) showed the importance that social connectedness has on well-being. This study followed this narrative as all focus groups did mention that they did experience social connectedness. The moment participants realised it was a social setting with someone they knew, they felt connected to the person and described it as calming. It could be that knowing the person helped participants to experience the environment as a safe space. Furthermore, knowing that you are doing this with someone you trust, could help by feeling more confident in overcoming possible problems. Especially working together gave them a strong feeling of connectedness. These seem to be represented in the changes in well-being perceived by the participants. Specifically, the moment participants did realise that they connected to someone they knew, they experienced an improvement in well-being. They felt more relaxed, calm, and at ease. However, while they indicated they felt better because they knew the person behind the hands, there are no comparable experiences with strangers.

Limitations

This study had some limitations. The experience created in this study did not have the means to replicate the Elele experience exactly as the artist intended. This was due to the limited available facilities that offered us to perform the study. These did not resemble what the artist created. Sjoerd van Acker presented Elele in an exhibition setting that offered him two separate entrances for participants interested in the experiences. This allowed him to prevent participants from seeing each other. Furthermore, he kept it a secret from the audience, leading participants to expect a solo experience. Additionally, he used a curtain to reveal the shared experience to the participants. In this study, it was impossible to prevent the participants from seeing each other as they would use the same entrance. Furthermore, studies needed two participants and therefore participants already assumed that they were not completely alone in this experience. Performing this study in the ideal intended setting could have changed the experience. Considering the negative reactions towards the hands in the second part of Elele, it could have caused the experience to be more intense and less relaxing for women. Female participants who did experience a negative reaction towards the other pair of hands relaxed when they realised that the hands belonged to the person who was part of the study. This awareness did play a big role in how they overcame that negativity. Not being aware of another person being there might have diminished the calming effect and worsened the experience. Furthermore, in this study, they were aware that it was a fellow student and

they experienced it in a university setting. This added a sense of safety through familiarity with the participant and environment. However, while a public venue might increase the uncertainty experienced by users, it needs to be considered that a public venue might also attract a different audience with different expectations and thus be a more desired experience.

Future directions

The practical recommendation depends on the three parties that need to be considered: the artist, the setting it occurs in, and the participant's expectations. While the artist wants his participants to question the reality, the negative effect could have been not clear until after this study. The artist should revise to what extent this brief negative reaction benefits the experience itself. Hence, it would be recommended to remove the question to avoid these negative reactions to improve the experience for more inexperienced users. He could also consider a provision for women that includes a warning or guides them more through the experience. However, if it is kept in an exhibition setting, a different audience is attracted that might not react negatively to it.

This study is innovative as research with artistic immersive VR is still limited and the applications on how VR could be beneficially used are still rather unexplored. Furthermore, this study added an understanding of how connectedness is experienced in VR. This can be valuable as it gives indications of how a sense of connectedness can be created in VR settings. It could be very relevant for future projects e.g. the creation of interventions for mental health problems that want to use positive benefits of connectedness on mental well-being. Finally, research into the complexity of Elele offers an understanding of how immersive VR can have positive effects when it is combined with an experience that implements connectedness. This should encourage further research into it.

While this study offered insight into the experience of connectedness, it still lacks a comparison of the experience if it did not focus on connectedness. Hence, it would be valuable if future research would investigate the impact connectedness has on the perception of immersive virtual reality experiences. This could be achieved by having a control group that would experience Elele without the elements that created a sense of connectedness. To see the difference between these two groups could add understanding to the role of connectedness. Another point would a study looking into differences in genders and personalities in experiencing Elele to find an explanation for the negative reaction towards the prompts by solely women in this study.

Conclusion

To conclude, participants experienced connectedness in three different ways.

Participants feel more connected to themselves in Elele through the means of an immersive environment supported by music intuitive movement of the hands, and an artistic calm scenery. They felt more connected to others by the means of a shared space. Furthermore, joint exploration and working together created a sense of connection between the two participants. Finally, by creating a sense of a real world that evolves, participants experienced a sense of connectedness to the wider world, comparable to a connection to nature, but also to a spiritual experience.

Moreover, Elele seems to improve participants' well-being in three different ways: an improved mood during the experience, a decrease in levels of perceived stress from before to after the experience, and a positive outlook on things outside the experience. However, while Elele intends to create a strong sense of connectedness in participants, it cannot be concluded that the improvement in well-being is due to experienced connectedness. Hence, this needs to be further investigated in future research. All in all, the current findings of the experience of Elele facilitated a deeper understanding of connectedness and well-being in VR and together with suggestions for future research could inform its development for possible therapeutic use.

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Appendix

Appendix A: Interview Questions Elele

Initial Experience

●What were your initial thoughts and feelings as you first entered the virtual realityenvironment?

●What were your initial thoughts and feelings as you started the two phases of the experience?

- ○ Phase 1, experiencing it yourself.
- ○ Phase 2, being connected to another.

Awe

Initial Awe-inspiring Moments:

●Can you recall any specific moments during the virtual reality experience that were specificallyspecial or left you in awe?

- ○ Did you feel in awe of the experience?
- ○ What was it about those moments that stood out to you?

Personal Shifts in Perception:

●Did the virtual reality environment lead to any changes in the way you perceive the world oryourself?

●Were there instances where you felt a sense of awe that influenced your perspective on anything?

Comparison to Real-life Moments:

●How did the virtual nature of the experience contribute to or differ from any awe-inspiringmoments you might have encountered in real life?

Positive emotions as a result of Awe?:

●How do you feel after the virtual experience?

●Did you experience any positive emotions during the virtual experience? (Or negativeemotions)

- ○Which emotions did you experience?

Connectedness

*Introduce the construct “connectedness”: a state of feeling connected to self, others, and the wider world” based on The Watts Connectedness Scale

Connectedness to yourself:

•How did you experience yourself and your hands?

•To what extent do you feel more connected to yourself?

Connectedness to others:

•How did you experience the other pair of hands?

•To what extent did you feel more connected to others?

Connectedness to the world :

•How are you connected to the world around you?

•How does it differ from what you experience outside of VR?

Self-transcendence

Initial Impact:

●How did the VR experience influence your initial perception of yourself and your surroundings? Can you describe any immediate thoughts or emotions that stood out to you?

Expanded Awareness:

●Did the VR installation contribute to a sense of expanded awareness or a connection tosomething beyond your usual experience? If so, could you elaborate on that experience?

Shift in Perspective:

●Did the VR environment shift your perspective on yourself or the world around you?

●Were there any moments where you felt a sense of transcendence or a departure from your everyday mindset?

Other ideas:

●Can you describe a situation in which you felt deeply connected to others in the installation?

- ○Ask first if there were any moments in which the hand was closer or more distant to theparticipant, then ask about the how and why.
- ○Take a 3 person's perspective. Prime the question in a way: How would you explain to aclose friend how you felt here?

Debriefing

Overall Impressions:

•How would you describe your overall experience with the virtual reality installation and theinterview process?

•Were there any aspects that stood out to you, positively or negatively?

●What are your thoughts on the visual and audio aspects of the VR experience? Did the qualitycontribute to or detract from your overall enjoyment?

●What is your overall impression of the experience?

Long-term Reflection:

•How do you anticipate the impact of this experience on your thoughts or feelings in the long term? Are there aspects that you think will stay with you, or that you may continue to reflect on?

Suggestions for Improvement:

•Are there any aspects of the virtual reality experience or the interview process that you thinkcould be improved?

•Do you have any suggestions for making the overall experience more effective or engaging?

Additional Comments:

- Is there anything else you would like to share or discuss that wasn't covered in the interview?Do you have any additional thoughts, reflections, or insights you would like to express.