Vibing Together: Dance Experiences in Social Virtual Reality

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ABSTRACT

Dancing is a universal human activity, and also a domain of enduring significance in Human-Computer Interaction (HCI) research. However, there has been limited investigation into how computing supports the experiences of recreational dancers. Concurrently, a diverse and sizeable dance community has been emerging in VRChat. Little is known about these dancers' experiences, motivations, and practices. Yet shedding light into these could inform both VR technology development and the design of systems that better support embodied and complex social interactions. To bridge this gap, we interviewed participants active in the VRChat dance scene. Through thematic analysis, we identified six central facets of their experiences related to freedom, community, dance as an individual experience, dance as a shared experience, dance as a performance, and self-expression and -exploration. Based on these findings, we discuss emerging tensions and highlight beneficial impacts of dancing in VR as well as problems that still await resolving.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in collaborative and social computing**; **Virtual reality**.

KEYWORDS

social VR, dancing, VRChat

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1 INTRODUCTION

Dance is a physical, social, and creative activity enjoyed by many people worldwide [69]. It is known to have strong effects on physiological and psychological well-being, combining the benefits of physical exercise with heightened sensory awareness, cognitive function, creativity, inter-personal contact and emotional expression [24, 69]. However, the global pandemic has drastically limited opportunities for social dancing. On the other hand, the advent of commercial VR technologies affords opportunities for bringing social dancing to *virtual* public spaces, such as VRChat, thereby providing new opportunities for creating social dancing experiences.

There is a wealth of research on technologies to support and facilitate dance within HCI and related fields. The bulk of it has been focused on systems centered around professional/formal dance, such as performance [2, 91], creativity and teaching [91], or exergames [4, 15, 86]. Social VR as well has received ample attention with inquiries into, for example, avatars [48, 51] and self-presentation [27], social interaction [57, 61], as well as motivations [83] and meaningful activities [54]. Dancing in social VR bears relevance to both dance related systems and social VR in general. However, in terms of academic literature, currently there is little to be found on the nature of dance experiences in VR. On the commercial side, there is a variety of dance games for VR, but even those are for the most part relatively simplistic and focused on a single player experience. Thus, how to best facilitate compelling dance experiences in VR that actually feel like dancing remains an open problem. Furthermore, there are to date no explorations of the free-form *social* dancing that is afforded by and emerging on social VR platforms. For instance, there is an active dance community on VRChat, which encompass club dancing to more exotic styles such as pole dancing.

Understanding these early emergent experiences of dancing in social VR may offer insights into many facets of social and dance-focused VR applications. Dance as a physical activity pushes the capabilities of current VR technologies due to the range of movements that far exceeds what is required in everyday tasks or more traditional game-like VR applications. Additionally, the social setting of virtual dance clubs allows for investigating complex social interactions in VR, with dancing in itself offering ample potential to examine non-verbal communication and expression. Understanding these experiences can help highlight the limitations of current systems as well as reveal future opportunities to facilitate and enhance social interaction in VR. These insights may then direct development of VR dance applications to make them more enjoyable and approachable and deepen the understanding of important issues related to social VR in general.

This in mind, we set to explore what kind of experiences people currently have with dancing in social VR. In particular, we wanted to find out what gets people dancing and motivates them to keep at it, how the social facets contribute to the experience, and what kind of concerns or areas of improvement people have in mind. To address these questions we interviewed 17 participants on their experiences of dancing in VRChat, and conducted thematic analysis to identify themes central to their experiences. From this, we identify points of tension and discuss their relevance to facilitating dance in VR in a way that is not only enjoyable but also supports well-being.

Our main contribution is exploring and building an understanding of the emerging dance community on social VR. Large scale

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VR communities have become feasible only recently, and by investigating dance experiences in VR we are able to discover new opportunities and unsolved problems for future research, for instance, how HCI may support transitioning in and out of immersive dance experiences. We also contribute to the social VR literature [e.g., 54] by highlighting aspects that currently make these experiences enjoyable and meaningful. Our results also clearly indicate that dancing in VR and being a part of the surrounding community can have potential mental and physical well-being benefits for some users. For instance, the experiences of our participants indicate the VR dance community has provided a social lifeline for many users, especially during the ongoing COVID pandemic. Due to the domain of social dancing, we contribute to both dance-specific perspectives as well as social VR more generally.

2 RELATED WORK

In general terms, this paper investigates and describes an emerging phenomenon of technology use. In recent years, HCI research in the same vein has provided accounts of topics such as Pokemon Go [20, 68, 80], video game streaming [79], and eSports [28, 29, 33]. More specifically, we focus on dancing in social VR. In the review below, we first outline the landscape of social VR research in general, and then continue to dance-specific research in VR and related contexts such as exergames. For more extensive overviews and categorizations of the present landscape of social VR research and applications, we refer readers to Maloney et al. [56] and Jonas et al. [39]. More broadly, research on VR dates back several decades and spans a wide spectrum of subdomains. The interested reader may find review papers and books dedicated to topics such as navigation techniques [9], educational games [17], sports [67], data visualization [23], and training for high-risk tasks such as surgery [89].

2.1 Social VR

Large-scale social VR has only recently become a possibility with the proliferation of low-cost consumer hardware like the Oculus Quest. In academic research, a considerable body of work on social VR research predates the present boom, although the term "social VR" was coined only recently [56]. Earlier research typically refers to Collaborative Virtual Environments (CVE:s) [6, 7, 19]. CVE:s were social VR environments primarily aimed at work settings. For instance, Benford et al. [6] define a CVE:s as a *"multi-user virtual reality systems which explicitly support co-operative work"*. Early work on CVE:s also attempted to maximize accessibility through allowing people to join using a wide variety of embodiments and hardware, ranging from text-only terminals to state-of-the-art VR systems [6]. In contrast, currently the term "social VR" typically refers to multi-user applications where people interact socially through head-mounted VR displays (HMDs), such as in the work of McVeigh-Schultz et al. [61]. In other words, the range of devices considered is narrower, but the range of interactions and activities is wider.

Thus, even though social VR is a long-standing topic of interest in HCI and related fields, earlier research was largely focused on solving technical problems and exploring the design space through constructing and evaluating CVE prototypes [6, 7, 19], rather than studying use "in the wild". Presently, although research topics such as avatar/embodiment and interaction design are still active [48, 51, 61, 62, 72–74, 84], many key problems have been solved, and large communities of consumers now interact and experiment with commercial social VR platforms. Enabled by this, social VR research has expanded from technical problem solving to studying users from a psychological and anthropological perspective [8, 54, 55, 57]. However, this line of study is still quite limited and there remains a lot to be explored in terms of users' experiences with social VR, for example, what makes it important or meaningful, and what are the challenges or downsides of social interactions enabled by it. Our work contributes in this vein, building on Maloney and Freeman's study on meaningful social VR experiences [54]; only one of their informants was a VR dancer. Our interview data also provides a complementary point of view into themes discussed in previous work, e.g, non-verbal communication and the presentation and perception self [27, 57]. For example, we highlight how the extreme physicality of some dance styles pushes social VR technology to its limits, prompting users to develop hardware and software modifications to mitigate the problems.

2.2 Dancing in VR and HCI

Augmenting and supporting dance through technology has been a topic of interest within HCI for years. Recently, Zhou et al. [91] reviewed HCI dance literature focusing on how advances in motion capture and computer vision have facilitated the recognition and analysis of expressive qualities of dance movements, as well as how computing has supported creating (e.g., choreographing [13]) dance performances or may augment the expressive potential of dance (e.g., involving drones to encourage movement improvisations [25]). Creating new multisensory experiences to encourage novel expressive movements had also been explored in many ways, for example, through music [1] and virtual avatars [70]. They suggest that future systems along these lines could provide and intensify novel and different multisensory experiences [91].

Their review, however, remains largely silent on how technology shapes the experience of leisurely, non-professional dancing. Yet people are motivated to engage in recreational dance for various reasons, including fitness and mood enhancement, gaining self-confidence, socialising, and escapism [59]. The fact that many people enjoy recreational dancing is also reflected in the popularity of dance-based movement games. From Dance Dance Revolution (DDR) [35] to Just Dance [14], people have reported benefits on their health from playing these games, as well enjoying the social connections facilitated by them. Hoysniemi [35] specifically addressed the motivations of people playing DDR, which included entertainment, health benefits and challenging oneself. However, for the most part the experiential aspects of people engaging with dance games have rarely been studied (beyond including enjoyment as a measure). Primarily, the relevance of dance-related applications is reflected in the health and fitness end of the motivational spectrum. The majority of dance game related literature centers around using such applications for medical rehabilitation (e.g. [22, 87]) or exergames for more casual use. In terms of dance exergames, the focus has typically been on how to support learning dance, for example through different types or movement tracking solutions [66]

and visual interfaces [16], and on the other hand how to improve the health benefits of playing such games [15, 30, 85]. Nonetheless, social aspects of dance games have received limited scholarly attention; maybe because supporting meaningful social dancing is more challenging when dealing with screen-based systems, as the focus is primarily on the screen rather than the other people.

In response to the heavy focus in existing research on performance and motivation, there have been recent calls to consider bodily interaction in games and other interactive systems from an experiential perspective [e.g., 34]. One approach to this is to center the "body as play", rather than viewing the body purely as an instrument and focusing predominantly on physical abilities [65]. Dancing, with the variety of motivations why people enjoy it [59], seems particularly well aligned with this perspective. The suggestion of Márquez Segura et al. [60] to deliberately include the physical and social context to the design space when designing bodily games is also relevant when it comes to dancing - after all, dance can be enjoyed in a variety of contexts and is often a shared social activity.

Along these lines, there has been some interest in how to leverage computing to support dancing beyond chiefly screen-based applications and how to emphasise exploration of movement or social aspects of dance. An early example of such an approach has been put forward by Isbister [38], who designed a social dance game that incentivised looking at the other players instead of the screen by rewarding synchrony between players and utilising auditory cues for communicating relevant information to the players and audience. More recently, Allen and Holzer [4] devised a dance game based solely on motion tracking and auditory feedback, in which the players were moving to find musical "puzzle pieces" in the play space and combine them to form the complete music piece.

Besides this kind of novel interfaces and methods of interaction, VR has gained interest as a platform for embodied games and dancing. One example is the work by Zhou et al. [92], who developed Astaire, a mixed-reality dance game in which one player is in VR and another can see the game environment through a screen set-up. The game was designed to foster interdependent play and shared dance experiences by requiring collaboration from the players. However, their focus was on creating an enjoyable asymmetrical game, rather than a system optimised for dancing. In general, research efforts on dancing in VR have overwhelmingly focused on individual dance experiences. There are works on virtual partners for dancing [64], as well as on teaching and learning dance. Also some of the teaching approaches have included practicing with a virtual partner to learn couple's dances [43, 76], while others have focused on evaluating and giving feedback on individual performance [3, 42]. Thus, for the most part recreational free-form (social) dancing has not been taken into account when it comes to VR. Especially with the increasing availability and accessibility of social VR platforms, this overlooked area is becoming more pertinent, as well as easier, to investigate.

3 METHOD

The aim of this study was to gain a rich understanding of the dance experiences people are currently having in social virtual reality. None of the authors were deeply familiar with this scene, thus the data was collected through semi-structured interviews to get a well-rounded and in-depth view of the topic. We devised an initial set of questions based on online discussions and accounts of people's experiences with dancing or clubbing in VR. This ensured we covered the main relevant aspects with most interviewees. However, the semi-structured format left us room to follow unanticipated facets of the experiences emerging during the interviews. Participants were recruited from VRChat communities as there exists a sizeable and well organised dance club and rave scene on the platform. It also supports full-body tracking, which is important for a full-fledged dance experience. NeosVR has arguably better support for tracking with more tracking points than VRChat, and it seems there are some dancers on that platform as well. However, it has a considerably smaller user base and does not appear to have similarly organised dance community as VRChat (at least one that would be easily found and accessed by an "outsider"). Altspace and RecRoom on the other hand do not seem to cater to enthusiastic dancers due to their more limited tracking and avatar design options. That said, we did not specifically set out to only recruit people using VRChat, rather it turned out to be the platform where most of the dancing was happening.

3.1 Procedure

The first author conducted all interviews. Interviews took place online either via voice or video call over Zoom, or text-based on Discord, according to each participant's preference. Notably, some participants chose to attend the interview as their VR avatar. The interview duration was scheduled to take about 45 minutes, but individual interviews ranged from 30 to 90 minutes. At the beginning of the interview, participants received the privacy notice and consent information for the study. They were given as much time as required to familiarise themselves, and encouraged to ask questions or request further clarifications. The actual interview started once understanding of the information, consent, and willingness to participate were verbally confirmed. First, participants were asked to describe their VR set-up, which games or platforms they used for dancing, and what kind of dancing they did in VR. Next, the bulk of questions focused on different experiential aspects related to dancing in VR. For example, we asked participants to recount their most recent dance experience in VR, as well as to describe their avatar and its significance to dancing. We also asked about negative experiences and potential wishes or concerns regarding the technologies, platforms and community at large. The full list of questions can be found in the supplementary materials. Demographic information was asked last, after which the participants were offered compensation in the form of a 15€ gift card to the Steam online game store. Afterwards, the interviews were transcribed by the first and third author. The anonymised transcripts are included in the supplementary materials.

3.2 Participants

Seventeen (N=17) participants were recruited from two VR dance-related Discord servers. Originally, 19 participants were interviewed, but one had to be excluded due to a corrupted audio recording file, and one due to being a minor. All participants received the compensation (except for five participants who declined). Being at least

18 years old was the only restriction to participating. The number of participants was determined following the suggestions by [12]; within the pragmatic limitation of available time we deemed this sample size to provide a rich enough data set for the scope and purpose of the study, i.e. our research questions had been answered to sufficient breadth and richness.

The age of participants ranged from 21 to 40 (M=27), with the majority identifying as men (N=11), three as genderfluid and/or non-binary, two participants identified as women and one as a transwoman. Most of the participants were based in the US (N=13), with three Europeans (UK, France, Belgium) and one from Australia. Participants' experience with VRChat and dancing in VRChat ranged from a few months to several years, and the frequency of dancing in VR ranged from once a week to almost daily. Some were occasionally using also other social VR platforms (mainly NeosVR), but VRChat was the main platform for dancing for everyone. Participants reported frequenting a variety of clubs and events, some of the more popular ones including Rizumu, Shelter, Ghost Club, and DDVR. Many of the participants were actively involved in the community, for instance, by organising events and volunteering for clubs, working as security, or performing as DJs or dancers.

3.3 Thematic Analysis

For our analysis, we conducted a modified inductive thematic analysis, adapted from [11]. Our analysis was guided by three research questions: (1) What are participants' motivations to dance in VR? (2) What benefits (if any), do participants gain from engaging with the VRChat dance scene? (3) What are the challenges and tensions (if any) our participants contend with? We were chiefly interested in exploring the quality and variety of experiences and thus did not analyse how or whether different experiences were associated with different demographic features.

The first and third author were both involved in reviewing the data, the code generation process, and forming the final themes through reading and discussion throughout. Accordingly, each researcher first repeatedly read the transcripts to familiarise themselves with the data. Next, both authors manually developed a set of initial research codes. Codes pertained to the semantic content of the data (i.e., what participants said rather than their underlying assumptions), examples include "no judgment", "breaking immersion", and "seeing one's virtual body". We then discussed these codes and together collated them into eight provisional themes. These themes were then applied to the entire data set to determine their fit. Consequently, the initial themes were further refined, resulting in 6 final themes and 141 codes.

4 RESULTS

In examining the practices and experiential facets of dancing in VR, the following six themes are presented: (1) freedom; (2) dance like no one is watching; (3) community and genuine connections; (4) vibing together; (5) expressing and exploring oneself; and (6) dance like someone's watching. Note that the themes were not mutually exclusive (e.g., a quote about customising one's avatar could be coded as both "freedom" and "expressing and exploring oneself"). Each theme is discussed below with illustrative quotes, labeled by participant number. The sections follow a general structure of presenting the positive experiences related to a theme first, followed by any potential challenges and barriers undermining the positive outcomes.

4.1 Freedom

One of the defining themes of our analysis was the sense of freedom our participants experienced. This sense of freedom manifested on various levels, ranging from freedom from practical concerns and judgment, over freedom to present oneself in individual and different ways, to the freeing experience of dancing in VR. These experienced freedoms were partly facilitated by the felt safety of the environment, where VR afforded feeling safe from physical harm and allowed leaving the environment in case of discomfort. On the other hand, the freedom afforded by the virtual world also presented some dangers. Additionally, in some cases this sense of freedom was undermined by technical limitations.

Regardless, many participants explicitly voiced their appreciation for the liberating experience in VR, and the freedoms afforded by that environment also facilitated many of the experiences described in the other themes.

> "For me VRChat in particular is just this very liberating environment [...] You can just kind of be whatever you want to be. And being able to exist as someone or thing that feels right to be, and then just to be able to cut loose, as it were, on the dance floor is real nice." (P15)

Moreover, participants appreciated VR as a nearly limitless space for creation and sharing one's creative output:

> "VR is a very freeing place and I think right now the most, probably, free place on the planet [...] it's a magical place where if you want to do something, you can make it, you can organise it, and just do it. There is no one there to say you can't, there's no one there to take any bit of it for themselves. It's just any creativity you have, you can just put it out there" (P6)

On a personal level, participants described how VR reduces barriers to successful social interaction. Consequently, interacting with others through an avatar helped reduce feelings of anxiety and self-consciousness and "freed" participants to dance and move their body:

> "I don't usually dance in real life - I don't know if that's just a self-conscious thing or what - but the fact that I can do that in VR and not care, because, you know, I'm not putting myself on the line, I'm just some random avatar online. So it doesn't really matter. Doesn't have the same impact." (P7)

Another participant, along the same lines, noted how the freedom to self-present made it easier for them to connect with others: "*I'm a full believer that in a space where we can be under a different name and we can look however we want, it opens the door for us to open ourselves up, and be more ourselves with complete strangers. We're not worried about how people think about us*" (P9). In general, participants considered the VRChat club scene a judgement-free environment, where "*you just go in, no one even asks you like, who*

are you with, are you drinking with everybody else [...] no one really kind of pushes you in that sense." (P11).

A different sense of freedom was apparent in the ways our participants noted how VR had made music events and clubbing more accessible, freeing them of "*all the negative things about going to events, like having to get there, paying the income fee, and like sweaty people.*" (P13). Lack of easy access to interesting events in real life was a concern that VR had remedied for several participants, e.g. P6: "*So if I want to listen to any electronic music, any live performance, I usually have to go like 6-7 hours away [...] So being able to every night, listen to the music I like and also dance to it is something I really like.*".

The freedom to retreat into the comfort of one's home was also valued, as, for example, P11 described: "*you feel safe, because you know, if at any time you feel like you're tired or that your eyes are hurting or maybe something happened, you can just leave and come back, you know, no questions asked.*" Participants also emphasised how VR provided physical safety from sexual harassment, especially when engaging in overtly erotic contexts: "*I can, without getting my ass clapped, be able to show and express my passion for lap dancing*" (P9). Some participants also mentioned how using VR provided them the freedom to safely experiment with substances without having to worry about getting home: "*if you're drinking, you're already home. So you don't have to worry about getting home or safety or anything like that, you're just already here.*" (P6). For some participants these benefits were grounds enough to consider VR over real life events:

> "I'm wondering now at this point if I would still like going to real shows. Because I love the safety aspect, I love the fact that there's no sweat smell. There's no waiting at the booth for an hour just to get in there. Plus since there are so many DJs playing at once. If I get tired of a set, I can literally just hop a world and them I'm back in it somewhere else. Entirely different set of DJs." (P16)

On a broader level, our participants emphasised how the VR club scene liberated them from restrictions imposed by the COVID pandemic, by providing them a safe space for socialising and physical activity. As such, several participants expressed their gratitude for how dancing in social VR offered a much-needed escape from the confines of their home and personal environment:

> "The very changed landscape that the world lives in, the world we live in, has led me to be sitting at my desk a lot more. So it's something that gets me up, moving and active. [...] the ability to go anywhere in the sense of a virtual space [...] has helped a lot with the feeling that I'm stuck in a house a lot." (P15)

> "I hit quarantine depression hard and I was just trying to find some kind of escape from it. And escape from - I love them dearly, but goddammit, I can't stand my family right now because I'm stuck, I'm still stuck in the same house as them. I still love them to death, but I just needed a way to kinda just unplug and maybe find some new friends, maybe find some really fun things to do." (P9)

The ready availability of VRChat also meant that "*there's always something going on, somewhere, some country [...] it could a Monday night it could be a Thursday night, it doesn't matter, it's not just a weekend thing anymore.*" (P7). One participant reported having "*a stretch during quarantine where I was spending 40 hours a week or even up to 80 hours a week in VR, between dancing and working at venues.*" (P5). For the most part, our participants had primarily good things to say about these freedoms afforded by VR. However, one participant cautioned against potential dangers of this unbridled freedom, where the constant party opportunities could turn into addiction, maladaptive escapism, and even substance abuse:

> "The party never really ends sometimes. [...] I see a lot of times it's all that some people do. They get involved with the non-stop party aspect where it's so easy to dissociate and like that bit of escapism, especially with the alcohol and stuff. And being in the headset. It's hard to remember what's going on on the outside [...] I see people pass out. [...] It has that unchained aspect to it, where it's like an never-ending barrage of music and innovation. There isn't much you can do without regulation." (P16)

Participants also noted several technical limitations that risked undermining their sense of freedom. The main problem in that regard was the performance of VRChat. Performance issues impaired participants' dancing experiences (e.g. P6, P8, P9, P10, P11) with regards to the fidelity of avatars or worlds, how many people can log onto the same world instance, or simply interfere with their enjoyment of dancing. To counter this, most clubs had rules in place to limit allowed avatars by performance rating or, for example, a restricted selection of avatars for an event to ensure compliance. Participants also noted some physical constraints to their sense of freedom, including lack of space, bumping into furniture in real life, as well as wires and VR equipment getting in the way, which in some cases resulted in material damage or physical injury (P1, P9).

As a potential freedom-limiting near future development of VR technology, some participants were also concerned about the introduction to advertisements to VR headsets:

> "The whole point of this place is that it's free expression in 2D, 3D, audio, visual. You can express yourself in any way you want. Seeing what they're doing with the Quest, where they can incorporate advertisements into the game. Whereas they can literally pause you from playing. [..] Whereas sometimes you don't even realize you are in an advertisement, you know?" (P16)

4.2 Dance like No One Is Watching

The dance experiences described by our participants typically reflected one or multiple of three distinct "flavours": dancing as a personal experience, dancing to perform, and dancing as a social, shared experience. This section concerns the first, and the aspects that were central to it in particular. These personal dance experiences were characterised by a focus on movement, music, and shutting out distractions. Immersion was also central for facilitating such focus; hence issues disturbing immersion made enjoying dancing more difficult and are included in this sections as challenges for personal dance experiences.

In general, the sense of freedom afforded by VR provided our participants with a space to fully focus on the music and dance without distractions: "*Just listening to a song, really getting in to it, just letting it move you. That's one of the things I find so fun about it.*" (P3), with some participants becoming completely immersed in the moment: "*When I'm really into it, the world almost falls away. I tend to close my eyes almost without realizing and just move with the music.*" (P10)

The lack of and ability to limit distractions was crucial to enable such immersive dance experiences. For instance, some participants would mute other players to enjoy the music: *"[U]nless it's a particular type of music I really, really, really like and don't get to hear often. Then I'll just straight up tell people like, "hey I'm gonna basically just turn off all the voice volume so I can't hear anyone", so I can listen to just the music and dance."* (P6). Others described, how in contrast to dancing in real life:

> "[In VRChat] I found I didn't have to constantly worry about how I appeared to other people. That, plus the whole quasi-anonymous aspect of it, greatly reduced distracting anxieties and allowed me to dance like no one is watching." (P10)

People also sought to actively increase the immersion, for example by optimising their avatar to fit their body measures: "*Between taking care of + working on my IRL body and customizing my avatar it is at the point that they are almost exactly 1:1 if I set some of the male blendshapes. I can put my hands on my knees, hip, shoulders, head, and it all lines up, which is very immersive.*" (P10). Occasionally, participants' tactics or wishes to enhance immersion extended to real life. P7, for example, suggested it would be nice to have the lights in his home blink in sync to the music playing in the virtual world to stay immersed while out of VR for a break. Other participants described measures they took to get into the right headspace before entering VR (P16), or matching their real life clothing to their avatar's outfit (P6, P10).

> "I'm prepping as if I were going on a night out sometimes. I'll take like a nice long shower, put on some decent clothes, and instead of going out I'm going here inside. It kinda adds to the, I guess, the word escapes me. – (interviewer) Immersion? – Exactly! Whereas it puts me back into that old headspace." (P16)

> [A]t this point I've got, I think six different outfits [for their avatar], and they all match actual outfits I own in real life. And I usually will actually kind of - I try to wear the same outfit that I'm gonna wear for that night in real life. 'Cause then like, even when I take the headset off and I look down it kind of looks the same. It's kind of just a little thing to increase immersion, I guess." (P6)

Participants often mentioned issues related to tracking technology as disruptive to their sense of immersion. Most participants either had full-body tracking or were planning to get it, and lack of immersion when using "half-body" to dance was often mentioned as a motivation to upgrade: "*[A]t the time I was usually just kinda dancing alone, and it was like, looking down and not seeing your legs follow your actual legs was pretty, it would break your immersion. It didn't really feel right. So it was like, I wanted to have my body fully represented properly when dancing.*" (P6). However, there were also participants that were compelled to dance despite incomplete tracking:

> "I did use to dance before I got the trackers. But yeah that was just because, you know, when you hear something you've gotta move even if nobody can see you." (P8)

> "It doesn't really affect how it feels to dance for me, because when I'm listening to the song, the music just takes me at that point. I'm there to have fun regardless of whatever" (P11).

However, even with full-body tracking, the current technologies pose some physical limitations to what kind of movements are possible. This requires people to adapt their natural movement and dance style to work around the technology to avoid injury or breaking equipment. Workarounds to enable a larger diversity of movements included, for example, attaching feet trackers to specific types of shoes (P2, P8), adding a chin strap to the headset (P9), and modifying wireless adapters (P2).

> "I do dance in heels as well, just because it's a lot easier for having a tracker pack in underneath where the heel is itself. So it's not on top of your foot, 'cause if it's on top of your foot it does tend to get caught on the pole when you're doing certain moves." (P2)

In addition to tracking, other technology-related issues included performance problems and lag: "*Currently in a full venue (80 people) even cutting edge hardware struggles to get much more than 30 frames per second (keep in mind most VR headsets are intended to run at 80-120 fps). As I mentioned previously, this makes dancing less enjoyable and can cause motion sickness for some people.* " (P10)

4.3 Community and Genuine Connections

Many participants valued the community of the VRChat dance scene most. Many had also had at least some negative experiences, but in general felt these were well mitigated through community actions. While it was typical for our participants to venture into VR on their own, it was almost as common that they found their place in the community and made friends quickly after finding their way to the clubs and raves. Some participants mentioned they knew most other people going to the same clubs. Community connections were also the main channel to learn about new places within the VR scene in the first place, starting from the way people reported VR bringing people together and creating connections:

> "I love just the people coming together [...] they're just there for the experience, and then you get that opportunity to meet other people that love what you enjoy as well. And that's the main thing, just coming together with people. Just so many people come out of nowhere and you can makes friends easily through that, just through music." (P12)

> "Even though it's virtual, it's very real, as in the people are very, how do I word it (..) very genuine, caring people at all these places. [...] When you come to these kind of events in these clubs and it's like, lots

> of people having real conversations and even deep conversations. Then also people just dancing and not worrying about anything else. It's a pretty unique thing to see. " (P6)

Indeed, many participants had gained meaningful and genuine friendships during their time in VR. Besides spending time and dancing together in VR, people frequently stayed in touch also outside VR, communicating over Discord or even meeting in real life:

> "I've met multiple people from within the dance scene, like we've flown out to meet each other. [...] usually I'll voice call them, from at work or something and just chat with them. They're about as good a friends as any friend you'd have in real life." (P6)

The friends and connections made in VR were especially meaningful for participants, who in real life had struggled with social connections and now felt empowered to socialise more freely in VR:

> "I always struggled with socializing growing up. I didn't really have many friends, and I'm not very good at talking to people. So it wasn't until three or four years ago when I started doing VRChat that I started having a lot of friends. But genuinely good friends, like meaningful interactions with people and meaningful friendships." (P14)

The VR dance community was frequently described as "supportive" and "accepting". Several participants recounted how this social support provided a space for self-exploration or significantly contributed to the development of social skills, which in turn improved their well-being and happiness:

> "Another aspect of it is the friends I've made in the game. Everyone is mutually supportive of one another and they've done a lot to build up my confidence and assuage concerns I have about looking "dumb" or "goofy". [...] I think VRChat, and social VR in general, is a groundbreaking technology in that it seems to have a similar effect on a lot of people, especially those with social anxiety, self esteem/confidence issues, and/or neurodivergent conditions. This community provided a judgement free, accepting space that helped me to realize a lot about my gender and sexuality, and I am a lot happier as a result. So that, and the benefits to my anxiety, etc. are really valuable to me." (P10)

This pronounced sense of community also inspired several participants to become actively involved in community-building activities such as worldbuilding, DJing or dancing for clubs, or volunteering to host and organise events. Some explicitly said they want to "*give back to the party community*" (P8). Notably, many of our participants were enthusiastic about spreading awareness of the club scene and get more people to join; "*Because more times than not, you're not gonna regret it, and you're gonna come out with amazing experiences, maybe even, maybe small little thing may be impactful for the rest of your life.*" (P9)

According to our participants, VR generally helped form genuine and empathetic interaction and communication, such as facilitating the reading of body language and increasing player sound volume to make talking more audible over the music. One participant, however, described feeling ambivalent about the ability to hide or explicitly control their facial expressions, which impeded genuine social interactions:

> "That is actually something I don't like about VRChat in general. It's very easy for people to hide their emotions. In a way that you would not be able to in real life. You could be crying under the headset and you could just mute yourself and put on a happy emotion face on your avatar. You have that sort of control, you have that filter that allows you to express yourself. But I think also it's a detriment when you need to be real with people." (P14)

On the flip side, most participants also have had negative social experiences, with some facing harassment or other "toxic" behaviour. The milder cases were for example people not respecting the common etiquette or situations where it was not clear whether uncomfortable behaviour was intentional or due to a glitch or lag. On the extreme side there were encounters with hackers or "crashers", racism, and sexual harassment:

> "Yeah, there's definitely been a fairly significant share of [negative experiences]. [...] I mentioned phantom sense earlier, that's the, that's what most people associate with it is, you know, your avatar gets touched and you feel it. [...] There is no collision between players, you can walk right through someone. That's uncomfortable. [...] The reason this is relevant is it makes sexual assault in VR a huge issue. Having someone come and start groping or trying to look underneath skirts or whatever is disturbing, to say the least. So that I have, I've been both the victim of stuff like that and had to police it at events, and it's never fun to deal with." (P5)

In dealing with these negative situations, participants were mostly left to their own devices, having to resort to either leaving and avoiding the situation, or blocking the offender. In light of the limited options, some participants were quite pessimistic about VRChat's involvement in managing a healthy community:

> "Any time I hear stuff that I just don't wanna be involved in I'm just like, "no, gone", just completely block out of my system. I wish there was an easier way to report people, especially, like, offenders versus just like - it's one thing to be annoyed by a child, it's another thing to have somebody to go off on a racist rant, so... I guess VRChat doesn't really give two shits about getting involved, it rather you just block them and not deal with it." (P7)

That said, the club community on VRChat was overall regarded as welcoming, and many participants mentioned that negative experiences had usually taken place elsewhere on VRChat. This may be due to the community-implemented methods to manage the

situation. The first line of defence for the events is Discord and requiring people to join a server to get access to the event:

> "Discord is also used as a way to white list and black list people within the community, and it's used as a form of safety basically for the clubs. Because like it is with the crashers, sometimes they'll get into these events and just crash the event and ruin the event for everyone. And then the organiser will have to scramble to get it set back up again. So for the communities the Discord servers act as a way they, 'cause the invite links and stuff like that get posted on the discord, so if you're not on the discord you can't really get into these events." (P2)

Beyond this initial screening, participants actively involved in event organisation sometimes had to step in between club attendees: "*Because I spend so much time staffing events in VR, sometimes I have to deal with those negative experiences as - for someone else, to help moderate what's going on.*" (P5). Some clubs also implement technical solutions for blocking malicious crashers or preventing them from re-entering, which VRChat does not support. Moreover, some participants noted concerns how these solutions conflict with VRChat's terms of service, which carries the risk of getting the event organisers banned from VRChat. Nevertheless, these measures were viewed as a necessary risk to keep the clubs running.

4.4 "Vibing Together"

Most participants particularly valued that VRChat afforded them the opportunity to dance in a social setting: from dancing one-on-one to raving shoulder to shoulder in a small club packed with dozens of people. Some participants also recounted weird or awkward dance encounters, which were mainly attributed to technological limitations or disturbances in non-verbal communication. Regardless, generally shared experiences were felt as powerful and enjoyable, and sometimes the reason someone started to dance in the first place.

The enjoyment of sharing an activity was present in most accounts, and often especially one-on-one dancing together emerged almost coincidentally: "*[A]nd they'll just be excited too, like oh my god you're really enjoying it too, really and then we're just hanging out all of a sudden, we're just busting moves.*" (P11). On the other hand, sometimes the dancing would be planned and for exercise and fun:

> "...we'd go into the Just Dance world and we would just for an hour, two hours, or however long everyone wanted to be we would go there, it wasn't socialising [...] it's literally just dancing and sweating and exercising, and it's been a lot of fun and I've met a lot of cool people that way." (P4)

Other times it was described as simply enjoying the music together: "*then a lot of people fed off of that energy and [...] we all started just headbanging together, just loving the music*" (P12). Group energy in particular was mentioned several times as an integral part of dancing in a group, but there were also various other reasons why people enjoyed it, as described by P10: "*The feeling of community. Jamming out together. Seeing everyone's personal styles and how they react to the music. Playing off each others' energy. Feeling like I belong.*"

The (temporary) connections forged while dancing together were experienced intensely: "*Just like seeing someone else like just go on with you and dance, like you don't even know them. Or just hype you up and all that. It's an insanely fun feeling.*" (P19). For some participants the uniqueness of the experience even left them struggling to describe their satisfaction:

> "You can't really describe it. You can describe it, but you can't quite define it. [...] It's like, from an outside perspective you're just in your room dancing to no music, with a monitor strapped to your head. But to you, there are so much more aspects to it. There's the aspect of community, there's the aspect of feeling like you're with other people, even though... [...] That means you have 90 people all over the world with monitors strapped to their heads, all dancing alone in their room. But they all feel like they are together. And enjoying each others' company, even though they may be however many millions of miles apart. And that's the kind of thing that I love about it." (P14)

Since the experiences were generally regarded as very positive, some participants were also active in inviting or encouraging others to join the dancing. However, the sentiment that understanding the appeal of the experience might be difficult if you have not experienced it was shared by several participants: "*It's honestly really... At first I was like "Why would I do this? I don't really get it." But then now that I'm actually doing it, I understand how... just how fun it is.*" (P19). For some, the attraction of dancing and having fun together had been enough to push them over the initial awkwardness of dancing:

> "I didn't really even know how to shuffle [...] another friend of mine he kinda like showed me how to kick my feet, I was like "you know what, screw it, I'm just gonna go for it", and that's the thing too, is like when you're around all these great people and you're enjoying the music, you kinda let, it's like I let the music take control." (P12)

However, all the experiences of dancing together were not purely positive. There was occasional awkwardness and uncertainty, often exacerbated or caused by difficulties due to lack of full-body tracking, lag, or other technical issues. Most of the time the awkwardness was also related to one-on-one situations, which were considered more intimate than group settings, as described by e.g. P10:

> "I also sometimes will dance with people, either in a circle (which I love) or 1 on 1 with a partner, but I find I still get anxiety with the latter just because it's a lot more intimate and I start getting self-conscious. I think the slight latency between people exacerbates this because sometimes I can't tell if someone is trying to get closer to dance really intimately or if it's just mistaken thumbstick flick and/or lag. I'm really uncomfortable when people get inside my personal space uninvited / unwelcome and I'm scared of / want to avoid doing that to others / making them feel uncomfortable as much as possible." (P10)

How strongly the technological limitations affected the dance experience varied among participants. Lag and network delay were the most common complaints, and even that appeared to affect people differently. One person mentioned that "*the delay is too [big] to do type of dances like, I don't know which but let's say tango for instance. So couple's dance are something I'd like to see in VR more.*" (P1), but most of the time it came up in the context of awkwardness of interaction or as a general disruption to the experience.

When it comes to haptics and the lack of touch in VR, the opinions were even more divided. One person (P5) had a haptic vest and really enjoyed the experience with that, some participants were missing the physicality of being and dancing together in the real world, and one participant (P7) stated not missing that dimension of the interaction at all. For some of the people who found that aspect important, phantom sense provided some sort of substitute for actual touch. However, not everyone experienced that, and regardless, very precise touch was difficult due to lag and lack of synchronisation between players. For example, P1 explained how holding hands while dancing was generally not possible even to the extent of making the avatars hold hands - until he had created a graphical workaround that allowed doing just that:

> "I made a system that allows me to hold someone else's hand. 'Cause you can't do that, because of network delay between players. So if one player's hand is here, other person is here and we try to synchronise we can't hold our hands together. [...] I manage to create a system that would do that on the graphics card, which is maybe a bit surprising but that allows me to overcome the network delay. So it virtually puts my hand on someone else's hand" (P1)

4.5 Expressing and Exploring Oneself

The VRChat club scene afforded our participants many opportunities for expressing themselves in a variety of ways, as well as exploring and experiencing themselves and their bodies in new ways. First, participants recounted relating to their avatars in differing ways. Some enjoyed having a recognisable identity - one participant (P12) joked how he is now "stuck" with his avatar because that is who other club attendees recognise him as. For others, the variety and option to switch avatars was important: *I've spent a lot of time customizing [my avatar] so that they have multiple costumes, interchangeable outfits, and body morphs so that I can swap between more masculine and more feminine expressions.*"(P10). That said, most participants emphasised the importance of the avatar feeling "like me" or otherwise "right": "*the avatar has to feel right for me, for me to be comfortable wearing it*" (P5).

Second, several of our participants described how their avatar(s) allowed them to express themselves. P9, for example, chose his avatars to express his mood: "*I've used many, many different avatars for dancing and it just makes it easier for me to express how I'm feeling that day, or what kind of energy I wanna show to the people I'm expressing myself to.*" (P9). For other participants, avatars not only afforded an opportunity for self-expression, but also allowed them to present themselves as they want to be be seen:

> "I don't like how I look in real life, you know. Like it's not really indicative to me of who I really am, because I'm transgender. So at least in VR I'm able to present myself how I want to be presented and people see me for who I really am [...] It's, you know, it's just a fictionalised version of myself, but it's also just kind of, a version of myself that I want to be. That I wish I could be. [...] this is just who I want people to recognise as me." (P11)

Importantly, embodying different avatars enabled participants to experiment with and explore what different bodies feel like: "*It's a really good feeling though. About just like, positivity about the body that I have in that virtual space. And how it feels to be something that is, like, affirming to exist as, I guess is a good word for it.*" (P15). For P10, who now identifies as genderfluid, avatars provided an additional avenue for exploring their gender identity and gender expression:

> "Seeing myself in the mirror with a female body was an enlightening experience. I felt really comfortable and it kind of kicked off the start of me thinking seriously about my gender identity and also spurred me to start taking care of my physical self. [...] it has provided a unique, safe opportunity to try out more feminine clothing (which I can simultaneously wear a matching set of IRL for a really immersive experience), expressions, and even dance styles." (P10)

Indeed, participants' exploration also extended to experimenting with movement. P9, for example, who identifies as male, explained how dancing in VRChat provided him an opportunity to explore movements typically coded as feminine; something which he was not comfortable in experimenting with in real life:

> "I like female dancing, it just feels more comfortable for me and I can properly express myself as a female dancer. IRL I am male, and I don't really fit the kind of body type for more female dancing, I fit more of the body type of a very, of a male dancer on the more masculine side" (P9)

Many participants described how these different means of self-expression and -exploration helped them to become more accepting of themselves and otherwise improve their quality of life. For instance, participants reported becoming more self-confident, learning that they actually enjoy being social, or starting to engage more in self-care. Especially people who were shy, self-conscious or had anxiety around dancing or socialising in general seemed to find VR a low-stakes environment that allowed them to practice and gain self-confidence (e.g. P10, P14, P16). A few examples of these experiences include:

> "Well it's been a big motivator to me to kind of to get more into exercising and losing weight and all that. Because it's, you know, all that kind of stuff is really gonna help me so that I can keep dancing more and get more controlled movements, more just being able to a lot more than before. So that's kind of a good motivation for myself, getting into dancing and just trying to improve more overall." (P3)

> "As I got better at dancing through regular practice and attending events, and as I improved my social

> skills from conversing with so many different people from different background and different perspectives, I gradually gained more self confidence, and have noticed a significant reduction in those anxieties in my IRL interactions with people." (P10)

However, while in principle anyone can have any avatar, and many avatars are freely available for VRChat, participants noted that it was difficult to find an avatar that feels right. Many of our participants therefore resorted to buying and customising avatars, creating one from scratch, or commissioning a custom made one:

> "I have been having trouble, you know, even with the avatars that are floating around, I'm just, like, ah, they don't really feel like me, and I really wanna get one that feels like me. And I gave up after searching, so I was just like, let me just commission somebody already." (P11)

As such, a fitting avatar required a considerable financial investment or required participants to acquire the necessary 3D modeling skills to create their own, which excluded participants who do not currently have the time or financial means: "*because of how VR is and immersion, I had a very hard time using avatars that didn't feel like me. So I couldn't just go and pick any old avatar and be happy with [it]*" (P5). Performance issues of VRChat and consequent restrictions put in place by clubs posed another obstacle to self-expression through avatars, where participants had to limit the amount of detail to keep the avatar compliant:

> "That was more like a latex look on the clothing, had a jacket - I actually had to take that off in order to stay below the "very poor" poly count and keep this avatar medium. 'Cause there's a limit to how many faces of a 3D-object you can have on an avatar in VRChat without getting marked as "very poor", and I wanted to stay outside of "very poor", so jacket sadly had to go." (P5)

Overall, most participants had chiefly positive feelings about the options for self-expression in VRChat. However, one participant was concerned about people becoming used to seeing themselves as perfect avatars, resulting in body image issues in real life:

> "And for avatars, they're drawn, they're anime characters, a lot of them - I feel like that might affect people's body image at some point. Like, if you were growing up doing that and, you know, you viewed yourself as this VR character. And then you're looking at who you actually are and it doesn't match up. That might be an issue, I don't know if that makes sense." (P4)

4.6 Dance like Someone's Watching

In contrast to "dance like no one is watching" and "vibing together", our participants were also interested in the optics of dancing. In some situations the concern of looking silly detracted from the experience, but some people also learned to overcome that feeling in VR. For many participants, looking good while dancing was also a motivating factor. Specifically, participants emphasised how they were "*focus(ed) on my technique, and how my avatar moves, and admire the dancing and avatars of others.*" (P10). Indeed, many participants appreciated having an audience or receiving compliments for their dancing: "*I really like just dancing and just having a good time, but I also feel more encouraged if someone is watching or is saying that I'm doing good or something*." (P3). Some participants mentioned that they actually derive the most enjoyment from performing and entertaining other club attendees:

> "My friend took me to my very first lap dancing event, and that's what really got the ball rolling for me to want to be on stage and express myself and just spread smiles around and have fun." (P9)

Several participants described how they wanted to "show off" (P3) and "put on a show" (P5) whenever they notice someone watching, which motivated them to learn new moves and practice dancing in and out of VR. To this end, participants sought out YouTube videos, observed and copied the moves of other club attendees, or participated in VR dance classes – particularly to train lap or pole dancing. Participants were also eager to figure out how actual movements could be translated to avatar movements; some explained that they tend to make use of mirrors that many clubs have or watch DJs or other people's live streams to get a sense of how their dancing actually looks in VR:

> "So, you know, I spend a lot of time in the mirror trying to figure out, you know, based on how I actually move versus how the avatar moves so there's a lot of practice that goes into that – making sure everything looks cool." (P3)

To augment their dancing experience, a few participants had created small accessories to use as a props. For example, floating objects like a ball that lights up (P3) that the player can control through a spring attached to the avatar, or optimising avatar outfits for dancing:

> "I love to add cool costumes that I think will look cool in motion / while dancing. I've even come up with some stuff that is entirely my own (except the base mesh and texture), such as a set of folding fans that I can open and close, throw like boomerangs and have orbit / rubber band around me which have been really fun to try to incorporate into my dancing." (P10)

Some participants, however, felt very self-conscious knowing that other club attendees might watch them move. For some participants, the prospect of looking goofy, or conversely, that no one can see their dance moves, was the main motivation for getting full-body tracking:

> "Mostly because it does get a little awkward, like, you're jamming, you're having a lot of fun, and then you see yourself in the mirror [...] and then you see your legs doing () weird things. It's not really connecting to what you're doing, and you kinda look a little bit like a goofball." (P11)

> "[W]hen you're not in full-body and you're shaking your butt, you're doing a specific move, you can't - the only thing you can see are your arms. And it's like you couldn't do kicks or anything and it was kind of like what's the point, if you can't see it and nobody else can see it, like, why are you doing it." (P4)

In the same vein, participants were sometimes frustrated with the lack of fidelity of the current full-body tracking. Several participants wished for more tracking points or better tracking for hands. The consensus was that a more accurate tracking system would improve their experience and allow them to stage a more captivating performance:

> "VR gloves. I'm really excited for that because then I can really, I can even further express things with simple finger gestures. Like yes, I have the Index, I have full finger tracking, but it's not as good as it could be. Where with VR gloves, it can really capture all the smaller movements of my fingers [...] put my fingers into it to like really sell that effect." (P9)

To compensate for tracking issues, participants put a lot of effort into practicing moves, as well as coming up with specific moves in VR by doing something different in real life. P3, for example, noted:

> "A lot of chest movements type of stuff isn't gonna translate over. But if you bend your head over to the left, then your chest moves over to the side. So you kind of have to learn different movements like that to make it look like how you want to."

Sometimes the supportive community was a factor that helped people to overcome fears of looking silly. P10 for instance stated how everyone being supportive had "*done a lot to build up my confidence and assuage concerns I have about looking "dumb" or "goofy"*". This care occasionally extended also to world design, with some venues implementing structures to hide the legs to mask the weird movement meant to help people who are self-conscious because they have to dance without full-body tracking:

> "I can take off the cover of that pool and that'll, depending on how tall your avatar is, hide everything from a certain level down. [...] Interestingly, I've seen people that are upset with how they dance in half-body because people can't see them moving that way. But you throw that pool there, and they'll dance with the best of them because who cares what the lower body is doing, nobody can see it!" (P5)

5 DISCUSSION

Dancing is a domain of great interest to HCI, as it melds movement, technological innovations, creativity, and social interactions. Additionally, dance and dance games as health interventions have been studied for years (e.g. [5, 82]), and extending the inquiry to VR as it gains in popularity seems warranted. As our results illustrate, dancing in social VR is a similarly multifaceted experience. In contrast to much of previous HCI research on dance [91], participants' engagement in the VRChat club scene was not primarily about learning technique or mastering a game. Rather, the focus was experiencing the music, feeling immersed and belonging to an accepting community, or exploring ways of self-presentation and movement. These fall more under the experiential perspective of viewing body as play [65], providing a complementary view of dancing in VR.

Next, we discuss our results from three points of view. First, we identify motivating factors and well-being benefits and relate them to literature on well-being and dance. Second, we highlight some technical challenges that our participants were currently experiencing and how they had adapted to deal with them. Finally, we outline opportunities for how HCI might better support these motivations and benefits, connections to previous research, and where potential points of tension might lay.

5.1 Motivations and Well-being

Two of our main questions with this work concerned people's motivations to dance in social VR and how the "social" in this context relates to the "dance". What we found were multiple and multifaceted motivations that are reflected in the themes presented in the results section. The most important aspects that kept our participants coming back were related to dancing and immersion, as well as self-expression and exploration, with the social facets interlaced with both. How much significance was placed on the social side of things depended on personal preference; for some it was the core of the experience, for others less central but still an important aspect facilitating dancing or self-expression. The interplay of socialising and self-exploration in social VR emerged also in the work of Maloney and Freeman [54]. Our point of view of placing dance in the centre brings in additional nuance in looking at the role this physical activity plays in connection to both.

Perhaps unsurprisingly, the motivations we identified are in close alignment with the observed health and well-being benefits of dance [78], such as community involvement, physical activity and associated health benefits, and general improved quality of life as positive consequences associated with frequent dance activities. All of these were clearly reflected in our participants' accounts. Furthermore, these general positive outcomes have been theorised to result from lower level neural and biobehavioural functions of dance for people [18]. Christensen et al. [18] suggest six such functions: flow, emotional experiences, imagery, communication, social cohesion, and self-intimation. While we did not set out to identify these functions, the connections are clear enough for the functions to be a useful way to structure a closer examination of the central aspects and potential associated benefits that we identified from our data. We feel this is especially important, since even though similar motivations and positive outcomes of social VR engagement have surfaced in previous research [27, 54], they have not been explicitly discussed in the context of well-being before.

Flow and emotional experiences are more closely related to the self-focused experiences reported by our participants. While the term "flow" was not explicitly mentioned by any of our participants, flow-like states of being immersed and caught up in the dance and music were described, such as in the case of P10 telling how sometimes "*the world almost falls away*". Emotional experiences on the other hand were reflected in our results as people mentioning dancing to release stress and escape feelings of quarantine isolation, finding a venue that plays music that matches their mood, or appreciating other people dancing.

On the social side, experiences related to social cohesion and communication surfaced as well. Dancing with other people was appreciated and enjoyed, this shared experience and energy bringing people closer and evoking feelings of togetherness and belonging. Similar experiences of social connectedness have been previously

reported also in the context of other social VR activites [54]. Our participants also mentioned "*talking with body language*" (P1) while dancing, particularly in spaces dedicated to dancing that had limited vocal communication. Dancing in VR was also described to be an emotional outlet and expression, not only as an individual experience but also in the context of performing for others. Non-verbal communication in social VR has been investigated before by [29], where they separate dancing as "social grooming" from dancing as entertainment. However, they do not really address the more abstract emotional communication potential of dancing.

Self-intimation as defined in [18], that is, higher self-awareness of one's body and mental state, was less clear in our results. However, Borowski [10] deems self-intimation as one factor supporting the development of social and emotional competence, including self-confidence and social skills. Indeed, improvements of those were widely reported by our participants. Whether they were due to dancing specifically is unclear - maybe the combination of VR, the context and social setting as a whole are conductive to such development. However, some people reported being empowered to move in ways the would not in real life, whether it was dancing at all in the first place or exploring new types of moving, such as more feminine expressions while identifying as male. Sometimes also the ability to embody an avatar that felt comfortable and "matching" to the movement style helped with this.

Imagery, which refers to imagining visuals or remembering memories related to or triggered by the dance, did not come up in our results in the way Christensen et al. [18] address it. However, we did not ask any questions very closely related to it, so this does not necessarily imply that it would not be an aspect of the experience. After all, some people found the creative freedom of VR important. This was the case especially for participants who enjoyed performing rather than just dancing in a crowd or for themselves. They would incorporate creative accessories or props to their dancing or coordinate the appearance of their avatar to match the mood of the performance and express specific emotions or stories. For this kind of creativity and extending the dance to one's environment, VR appears to provide an unrivalled environment of possibilities.

Taken together, the interview results indicate there might be tangible well-being benefits to recreational dancing in VR. Given that we easily identified themes related to the functions of dancing that have been theorised to facilitate well-being, a question is raised whether dancing in social VR contexts could promote well-being on similar level than dancing in real life. This would be especially significant, since our results also indicate that dancing in VR could in some situations be more accessible than dancing in real life. As highlighted in our results, VR can remove practical barriers of social dancing such as the need to travel, as well as help with social challenges and motivate people to move more, especially in a social setting. Based on the experiences of some of our participants, dancing in social VR could also aid as a coping mechanism in terms of relieving stress, offering a supporting community, or an immersive escape from a difficult situation. This is in line with previous findings of video games fulfilling a similar role in coping with difficult experiences [36]. The COVID pandemic and resulting quarantines have especially highlighted the relevance of such outlets, where gaming not only supported mental well-being and facilitated social connections but also functioned as a substitute for suddenly curtailed real-life activities [44]. Similar functions were reflected also in our results, with participants enjoying rich and embodied social interactions and dancing in VR when it had not been possible in real life.

Particularly noteworthy in terms of the potential well-being benefits was that for some participants, the VRChat dance community was the first space where they found an accepting and like-minded community and, facilitated by the full-body tracking, were able to bond and express themselves in a bodily fashion. Meaningful online relationships and communities are not not a new phenomena but VR might have specific advantages or challenges as compared to non-immersive online environments, especially due to the ability to communicate and connect through body language. Some work toward this has already been made, for instance, by Maloney et al. [57], who investigated non-verbal communication in social VR. Harassment in VR has also been addressed [8]. However, the role and impact of "enhanced" embodied communications has received limited attention, i.e. ways to interact that utilise body language but also the virtuality of the space to extend the realistic communication and expression. This could be, for example, in form of augmented shared attention as proposed by Roth et al. [73].

5.2 The Needs and Problems of VR Dancers

One of our goals was to identify and inform possible future research directions: What needs might VR dancers have that should be addressed by researchers and designers? From this point of view, the various problems reported and workarounds developed by users are particularly interesting.

A need that is clearly highlighted in our data is robust and nuanced full-body tracking. For instance, P1 reported that while people do dance without full-body tracking in virtual clubs, the dancer friends of P1 mostly use full-body tracking. P1 was also worried that the popularity mainstream devices like Oculus Quest—that only tracks head and hands but not the lower body—might lead to the needs of VR dancers to be neglected. We find this a real problem, especially as devices like the Quest use computer vision tracking based on machine learning, and dancing movements are not well represented in even the most extensive movement data sets for machine learning like AMASS [53]. The way P9 stresses the importance of finger gestures also poses a challenge for computer vision—for instance, the Oculus Quest's vision-based finger tracking only works when the hands are in front of the user and visible to the headset cameras, which is reasonable for many manipulation tasks but not for a dancer who, e.g., holds a hand up in the air while making a finger gesture. However, while full-body tracking was a must-have for most of our participants, it also came up (P3) that the limited fidelity of the current tracking solutions was helpful for novice dancers. Every body movement not translating perfectly had the effect of masking small mistakes, which de-emphasised the importance of skill for some people. Hence making it easier to dance even with limited confidence in one's technique. This highlights how the optimal tracking requirements might vary based on the skill level and motivations of the dancer.

The level of tracking was not the only challenge with the trackers and equipment in general. The comments of P9 also highlight how

the extreme physicality of some dance moves violate the expectations of VR hardware designers: A chin strap may not be needed for the average user, but P9 had to add one to his Vive Pro Eye headset to prevent it flying off his head mid-dance, when doing a back roll and whipping his head up. P9 also comments on the physical size of present VR trackers:

> "[W]ith tracking can't wait for trackers to be even smaller and lighter [...] Where I do get on my knees, the trackers do get in the way, so I have to turn my foot in weird way and it can be uncomfortable [...] There's a lot of advancements that I'm looking forward to for VR and would actually really help people express themselves with these improvements."

Outside the core technical problem of tracking, our data highlights the importance of avatar design and customization in allowing people to express themselves through dance. On this front, a potential future research topic is how to support dance motivation and enjoyment through avatar design. Outside dancing, researchers have experimented on virtually enhancing a body-tracked avatar's movement abilities such as running speed, jumping height, and flexibility [31, 32, 37, 40]. The results suggest that such avatar manipulations can positively affect motivational aspects such as the feeling of competence [31, 37], which is also central to physical activity enjoyment [63, 75]. The effect of avatar visual appearance attributes such as muscularity on physical activity has also been investigated [46, 47]. Future work should evaluate and extend such avatar manipulations in the context of dancing. For example, it seems a reasonable hypothesis that if an avatar manipulation makes one appear more skilled, it could mitigate the social anxiety of dancing in public. While our participants did not report major issues in this regard, some mentioned meeting people who were reluctant to dance even in VR due to perceived lack of skills.

Another problem mentioned by many in our sample is the risk of injury because of limited physical space. Although consumer VR systems provide various warning mechanisms to alert the user of the proximity of real world obstacles, it might be that in dance movement, one needs more extensive safety margins. This calls for at least some application-level control of the warning mechanisms, instead of simply relying on them to be implemented by the VR platform. A way to mitigate the problem could be provided by VR interaction and rendering techniques such as 3PP-R [26] that allow natural body movements while navigating a large virtual space such as a stage. 3PP-R could be a good fit for dancing, as it allows seeing one's avatar from a 3rd person perspective, similar to the virtual mirrors our participants report utilizing. However, unlike a mirror, 3PP-R allows seeing oneself even when pirouetting around. An option to switch to 3rd person perspective could be particularly beneficial if combined with the avatar manipulations discussed above, as the manipulations would become more visible to both the user and the people around. On the other hand, 3PP-R and related approaches such as redirected walking [71] have not yet been extensively evaluated in the context of dancing. In our sample, P9 mentions testing redirected walking but becoming nauseous, but we do not know the specifics of the implementation of the approach and the space P9 tested it in. There might also be some trade-offs in terms of feelings of social closeness if switching to a 3rd person view. Thus, further research could investigate user preferences in different dance and social contexts.

Some of our participants had also devised their own ways to increase immersion. These related primarily to their avatars or strategies to boost immersion while out of VR. For the former, two means that were mentioned were matching the avatar's proportions to one's own body and wearing the same clothes in real life and on the avatar, creating continuity between real life and VR. This kind of extension of the immersion to real life was present also in the suggestion of P7 to implement synchronisation between the music in VR and the lights in the real space they play in. Ways to blend the two realities were relevant because taking breaks to cool off, get a drink, or go to the bathroom required getting out of the headset. Even though previous research has looked into transitions between real life and the virtual world, the focus has been mostly on starting [88] and ending the VR experiences [45, 81]. Our results on the other hand highlight the significance of moments of taking breaks from VR with the intention of continuing the experience. In these situations the optimal experience is likely to be different in comparison to completely exiting VR. Some previously suggested strategies for exiting VR could still be useful even if the goal is to sustain immersion, such as exiting the virtual space through a door [81]. Knibbe et al. [45] also found that sensory similarity between the environments could help with the transition, which coincides with the light synchronising suggestion of P7. Similarly, bringing, for example, the music or other audio from VR to the real life space could provide such sensory continuity.

Finally, many of our participants noted problems around interaction latency, which have already been acknowledged in early CVE research [e.g., 6] and are extremely hard to solve, as all layers of the social VR technology stack contribute to the latency. That said, for dancing, an illusion of improved latency may be achieved through what Benford et al. [6] call "subjective variability", whereby each user locally applies modifications that make latency less apparent. For example, P1 noted that latency prevents holding another dancer's hand, which they solved by writing code that virtually places their hand on someone else's hand. Although VRChat only allows scripting using a custom visual programming language that limits this kind of modifications of other users, P1 was able to implement the code as part of the their own avatar's visualization that is only visible for them but not for others. We believe this kind of subjective variability is a potential topic for future work, both in terms of exploring possible solutions, and understanding how they might affect social VR experiences. For example, it might be worth investigating if more latency is actually better in dancing, e.g., hiding latency by delaying user A's perception of user B's movements so that it matches the beat of the music, but one full bar later than experienced by B. This would not work for styles like tango mentioned by P1, though. Another possible use of subjective variability in a social VR context might be to make every user perceive the space as if they were taller than others, which could enable a better view of a virtual stage and might make it more enjoyable to bounce and dance as part of an audience of a virtual concert. On the other hand, considering the comments of our participants about avatar size, it could make human-to-human dance interactions awkward.

5.3 Tensions in Social VR Use

In addition to the reported benefits and challenges, our results revealed some underlying tensions that might curtail the benefits or cause negative outcomes if left unattended. These topics are also related to the facets central to well-being and include potential trade-offs or critical points for balancing benefit on one hand, and risks of delving to negative use patterns on the other. Furthermore, they seem to be connected to social VR more broadly, rather than being specific for dancing in VR.

One of the most influential opportunities of VR for our participants was the ability to freely choose a personally comfortable self-presentation. The freedom of self-presentation and the ability to control one's facial expressions were attributed as part of what allows for easier and more genuine social interaction in the space, due to alleviated self-consciousness or discomfort with one's body. Similar experiences of the felt freedom of self-expression have been reported in the context of social VR before [27], where people mainly reported using avatars consistent with their real-life appearance. Curiously, this tendency was not very prevalent in our sample, even though the importance of the avatar *feeling* right was emphasised.

Another positive outcome of choosing one's appearance was that it allowed for self-exploration. This happened in terms of new interests such as music or dancing, social identities due to overcoming shyness and social anxiety, as well as gender identity and expression. These benefits are congruent with previous research on social VR [27], where self-discovery and exploring gender identity were identified as outcomes of constructing one's self-presentation freely. Looking further into how to facilitate such self-exploration and -understanding could help design experiences that more deliberately support growth and self-discovery. One area of research to draw from here could be works exploring how novel multisensory experiences can inspire movement in professional dancers [91]. Linking back to the well-being benefits of self-intimation, experiencing new types of movement could reveal new insights to one's body and identity. This perspective to self-exploration has not been explored in previous research on social VR, though [27] draw connections to the proteus effect (a term coined by Yee and Bailenson [90]) and how it affects interactions within social VR. We on the other hand suggest that this self-exploration through experimenting with different self-presentations and consequently, different ways of moving, might have well-being effects extending to real life.

Regardless, a thing to consider on the flip side of freedom in embodiment are potential adverse effects on body image in real life. One participant (P4) expressed concern over children especially being immersed in an environment where they are seeing and embodying avatars that do not match with their real life body. Children's experiences in social VR have started to garner researchers' attention (e.g. [55]), but its effect on children's body image or related issues has not been yet explored. This issue was also brought up by Dewe et al. [21], who looked into agency and body ownership of children in VR and highlighted body image issues as a potential risk for children.

More generally, body-image and its relation to embodying different virtual bodies have been studied, and there is even some evidence that body-swapping could help correct distorted body-image [41, 77]. However, these are from purpose-built interventions and utilise multisensory (visuo-tactical) feedback to enhance the body illusion [41, 77]. Thus, the effect of a self-selected avatar in social VR could be very different. This is acknowledged by Kruzan and Won [50] who reviewed literature related to embodiment and body-image in VR and more traditional social media platforms. While the issue of body-image remains largely unexplored in the context of social VR specifically, they speculate that focusing on "*the phenomenological experience of the body*" [50] rather than visual appearance or modifications could be conductive of well-being. They also point out how the effects of virtual embodiment are typically modulated by the self-relevance of avatars, meaning that higher self-relevance intensifies potential effects. The way this ties into our results is twofold. First, the avatar appearance and personal fit was very important to most of our participants, which likely indicates the self-relevance is high and thus any effects, positive or negative, caused by "switching bodies" would be greater. Second, the fact that many people seem to prefer highly self-relevant avatars and that they deem the relevance important to best enjoy dancing, could complicate the avatar design for social dance experiences in VR. As of now the potential negative effects of avatar appearance are largely unknown, but should any be revealed the problem becomes balancing the enjoyment of high self-relevance on one hand and more intense negative effects on the other.

Much like the freedom in designing avatars, also the ability to control expressions was not seen purely as a positive. This was recognised by one of the participants in particular, who was concerned that the ability to hide emotions could be a "*detriment when you need to be real with people*" (P14). Despite this, our participants overwhelmingly felt that the ability to show yourself as they want to be seen led to more openness and genuine connections. In a similar vein, in a previous study people also reported willingness to share personal experiences and emotion [58]. Investigating this balance of disclosing and hiding one's genuine self and expressions could yield insights in how to manage this tension and encourage openness when hiding could lead to detrimental outcomes. Another related aspect that did not surface in our results but was relevant in the work of Freeman and Maloney [27], is the effect one's self-presentation in social VR has on how others treat them, as this could arguably incentivise self-presentation in a way that is not conductive of genuine social connections.

Similarly, the combination of factors that makes social VR dancing and clubbing so impactful and important for people can in the worst case lead to harmful consequences. The account of P16, who talked in depth about the darker side of the dance scene, gives some indication that this might be the case at least for some people. He was concerned that for some, the VR club space became too much of an escape from the realities of the real world; a party that never ends, a space where it is easy to get immersed and forget to take care of yourself. Associated with the party aspect comes also substance use and potential abuse. These mirror the challenges with social media and games more general, where such online communities can both facilitate meaningful friendships and community participation as well as affect users' well-being negatively, depending on how they are used [49, 52]. Thus, looking into these more problematic

ways of community engagement is crucial to facilitate experiences that facilitate well-being rather than impede it.

VR as a technology also has some unique issues in this regard. For example, one interesting point of conflict is the desire for immersive dance experiences with as little reminders of the real world as possible (as mentioned by P16), and the simultaneous need to discourage excessive escapism. Thus, a balance is needed to explore ways to improve the experience in VR through smooth transitioning into VR and maintaining immersion through breaks, while also facilitating healthy disengagement with the technology. Soret et al. [81] explored a solution for transitioning out of VR with this kind of purpose; they successfully used a door transition to facilitate return to reality while preserving as much of the positive influence of a well-being supportive VR experience as possible. Nonetheless, even the most perfect exit transition is likely ineffective if the user completely wants to shut the real world out. Thus, the importance of exploring how to facilitate moderation in a way that preserves the agency of the user and does not unnecessarily disrupt the immersive experience cannot be understated.

All in all, paying close attention to potential negatives of social VR seems to be in order. In our case, as in a previous exploration of activities in social VR more generally [54], the reported experiences were almost exclusively positive. Even when we specifically asked about negative experiences, those were typically related to technological issues or somewhat downplayed as not very impactful in the overall view of things. Participants enjoyed embodying fantastical or idealised avatars, the physical and social activity, and distraction from real life issues. However, from a small number of participants we also uncovered concerns related to these very things: the danger of getting too immersed in the virtual world, whether it means getting too used to the perfect virtual body, partying until passing out still in your headset, or just enjoying the escapism to the extent of neglecting properly taking care of yourself in real life. The rarity of these negative accounts may indicate that overall, the experiences are positive and the danger of problematic use is low. However, it might just as well mean that people are not very good at recognising these risk if they are related to factors that enhance the experience while in VR.

5.4 Limitations and Future Work

As we have discussed in the previous section, there are many open questions regarding dancing in VR as well as social VR more generally, ranging from technical problems to balancing benefits and potential risks. Further research is required to investigate the details of specific problems, and as the VR space keeps gaining further mainstream popularity more diverse experiences from the social dancing space are likely to emerge. For example, it was our impression based on the interviews that at the time, the VRChat dance scene was quite heavily male-dominated. This may be because VR technology has up to until recently not been a very mainstream interest, thus limiting the user pool to people who already have VR headsets for other reasons. Additionally, we did not select participants in a way to ensure diversity but rather recruited people on a first-come-fist-serve basis; hence e.g. comparing experiences of people representing different demographics is left for future work. It could also be valuable to follow along as people get introduced to the scene, for example to reveal any issues that might turn potential users away from staying active in the scene and community.

Even in the current VR dance scene, one limitation to this study is that the participants were recruited from two Discord servers related to dancing in VRChat. While the participants were typically active in multiple clubs, they were all mainly using VRChat for dancing. Thus, there might be some differences to experiences on other social VR platforms. One participant for example mentioned that NeosVR supports more tracking points - one further point of interest could thus be how the experience of dancing varies across platforms. Another aspect related to the participants is the cultural homogeneity: all of the participants were from the Western VRChat club scene, majorly the US. A few participants remarked that there are differences in cultures between the US/EU scene and the Eastern (Japanese) one, so looking closer at these could be a topic for further research. The method of recruitment may have also limited the participants to people who are most active on the Discord server, leaving out people who are less involved with the community. Recruiting participants within VR or using other methods such as observation could in the future help include people who are not big Discord users, or partial to openly sharing their personal experiences in an interview. Observational studies or more in-depth ethnographic approaches could also reveal other facets that might not have surfaced in our interviews. Especially as we were not deeply familiar with the VR dance scene and community, there may have been something relevant we did not know to ask about and the participants did not realise to share unprompted.

6 CONCLUSION

In conclusion, we present an in-depth account of current social dance experiences on VRChat. In doing so, we shed light on an emergent social VR activity that has attracted an enthusiastic and active community. The motivations and present challenges central to these experiences provide focal points for potential future research. Given the presence of immersion-breaking technical issues, it is clear that efforts to improve the foundational user experience are still needed. However, it is also apparent that fully utilising the opportunities of a virtual space and taking social interactions beyond of what they can be in real life can help facilitate impactful experiences. This is especially true for matters related to self-expression, whether in terms of appearance, communication, or physical movement. Notably, the self-reported well-being improvements indicate there can be benefits to engaging with this topic that go beyond user entertainment. At the same time, it is important to stay aware of the underlying tensions.

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