

Body, Avatar, and Me: The Presentation and Perception of Self in Social Virtual Reality

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Self-presentation in online digital social spaces has been a long standing research interest in HCI and CSCW. As online social spaces evolve towards more embodied digital representations, it is important to understand how users construct and experience their self and interact with others' self in new and more complicated ways, as it may introduce new opportunities and unseen social consequences. Using findings of an interview study (N=30), in this paper we report an in-depth empirical investigation of the presentation and perception of self in Social Virtual Reality (VR) - 3D virtual spaces where multiple users can interact with one another through VR head-mounted displays and full-body tracked avatars. This study contributes to the growing body of CSCW literature on social VR by offering empirical evidence of how social VR platforms afford new phenomena and approaches of novel identity practices and by providing potential design implications to further support such practices. We also expand the existing research agenda in CSCW on the increasing complexity of people's self-presentation in emerging novel sociotechnical systems.

CCS Concepts: • **Human-centered computing** → **Empirical studies in collaborative and social computing**.

Additional Key Words and Phrases: self-presentation, online identity, social virtual reality, online interaction

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1 INTRODUCTION

In the past two decades, a large body of HCI and CSCW research has investigated the complexity of people's self-presentation in online social spaces and how these spaces afford and mediate such complexity. Many of them focus on social media systems such as Facebook and Twitter [2, 10, 22, 23, 33, 34, 42, 63] as well as popular online games and virtual worlds including *World of Warcraft*, *Second Life*, *EverQuest*, and *Audition* [12, 16, 17, 25, 69]. These studies have provided solid understandings of the creation and customization of self-presentation in well-established and widely recognized sociotechnical systems. They have also highlighted *selective self-presentation/performance* and the *proteus effect* [66, 67] (i.e., the phenomenon where people conform to their avatar and the mental makeup of their avatar) as important mechanisms of self-presentation online.

Yet, with the evolving social technologies and social needs, to what degree these findings can be applied to new research context and emerging technologies that have not been thoroughly studied

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is unclear. One such example is social virtual reality (VR). Social VR refers to 3D virtual spaces where multiple users can interact with one another through VR head-mounted displays (HMDs) [44, 45]. In contrast to other forms of media (e.g., social media and online forms) where users use text, images, and videos to create online profiles to present themselves, social VR introduces an entirely new form of self-presentation using the combination of one's physical body and avatar body. Compared to other similar avatar-based systems (e.g., MMORPGs and 3D virtual worlds) that mainly support avatar-mediated communication on screen, social VR offers full-body tracked avatars that allow for real-time and more embodied interaction that are similar to face-to-face communication, rather than merely looking at a computer screen. It also affords a broader spectrum of communication modes including both verbal and non-verbal interactions such as voice, gestures, proxemics, gaze, and facial expression.

However, despite all the above-mentioned novelties of social VR for creating and crafting one's online identity, how users experience and understand this mechanism and perceive others' self-presentation in these novel online social spaces is understudied. Therefore, we believe that an in-depth empirical investigation of social VR users' self-presentation practices is critical to identify and unpack the nuanced social dynamics forged surrounding this emerging technology. Specifically, in this paper we report our findings of an interview study of 30 social VR users to explore the following research questions:

RQ1: *What criteria do people use to construct their self-presentation in social VR?*

RQ2: *How do people perceive and approach others' self-presentation in social VR?*

RQ3: *How, if at all, does self-presentation in social VR affect people's understanding of their self?*

We thus make interlinked contributions to HCI and CSCW literature on social VR and self-presentation. First, our study provides empirical evidence of new phenomena and approaches of experiencing and practicing novel identity practices in social VR, an emerging interactive digital social space. This sheds light on the novel role of social VR in transforming how people understand themselves and interact with others compared to other forms of media (e.g., social media and online gaming). We also provide potential directions to inform the design of future social VR systems to better support such practices. Second, we expand a growing research agenda in HCI and CSCW on more nuanced presentations of identity emerging in sociotechnical systems and research contexts that have not been thoroughly studied [1, 8, 24, 31, 32, 49, 52]. We do so in three ways: 1) exploring a different aspect of *selective self-presentation* that emphasizes consistency and involves an interplay of body, avatar, audience, and conscious personal choice; 2) highlighting a more complicated dynamic to perceive and interact with others' self-presentation, which involves the essential role of voice in perceiving others and the intertwining relationships among different dimensions of identity presentation such as appearance, gender, race, and age; and 3) providing new perspectives of the *proteus effect* [66, 67] in emerging online social spaces, which points to new considerations regarding the body-avatar relationship and different levels of body ownership.

2 BACKGROUND

2.1 Self-Presentation in Digital Social Spaces

Prior work on self-presentation in digital social space have highlighted *selective self-presentation* or *performance* as an important mechanism through which online users construct, perceive, and experience their digital presentations. According to Goffman's metaphor of *theatrical performance* [20], self-identity is constructed in a collective and interactive process within different social settings; in doing so, it is important for performers (i.e., who endeavor to construct their self-identity) to identify audiences so as to adjust or customize their performance.

Many existing sociotechnical systems further complicate this practice. First, many social media systems support the creation of multiple separated profiles or "circles" to carefully "craft" which aspect of the self to be presented [29, 42]. Second, people can choose to construct different facets of identities across different systems [14]. Therefore, *selective self-presentation/performance* emphasize how self-presentation is portrayed and experienced as a combination of conscious personal choices and specific technological affordances of online social spaces. It sheds light on a number of practices and issues with regard to self-presentation online, including the authenticity and multiplicity of digital identities [11, 14, 23, 42, 53] and identity construction based on "the imagined audience" [33, 34].

Focusing on avatar-based systems such as online games and virtual worlds, a body of research has also pointed out that these digital spaces afford the experimentation of completely new identities (e.g., cross-gender play; see [25]) due to avatar-mediated communication. The majority of these studies focus on 3D virtual worlds such as *Second Life* and popular multiplayer online games (e.g., *World of Warcraft*).

As Manninen and Kujanpää [40] posit, the main difference between virtual worlds and the physical world is the need for an avatar as a proxy for the player and all his/her possible communication conducted in the virtual environment. In this sense, an avatar is one's interface to other human users, which requires a process of constantly reading and interpreting [18]. They act "as the nexus of virtual assets that the player collects and produces while exploring online game worlds" [40]. The expressions and movements performed by the players are translated through the avatar into the virtual game environment (i.e., avatar-mediated communication). In this sense, an avatar represents an online user's physical self and allow him/her to experience the activities and adventures of the virtual world via manipulating, crafting, and personalizing this "self" [13, 56]. By giving the avatar a sense of personality, unique behavior, intentions, and style, an online user starts to understand and attach himself/herself to the avatar as a second self, as something to protect and worry about, as one's role in the virtual world [18, 56]. This often leads to negative feelings of loss if one's avatar is under attack or dies [64].

Therefore, avatars play a central role in the communicative and self-presentation dynamics in virtual worlds [19, 26, 40]. They integrate several different social values such as gender roles and social norms [16, 17, 51, 68]. For example, Yee et al. found an effect of avatar gender on interpersonal distance in *Second Life* and concluded that social norms of gender in the offline world can transfer into virtual environments and influence self-presentation and interpersonal online communication [68]. Freeman et al.'s work on in-game marriage in *Audition* also highlight how the design of binary gender in an online game significantly affect players' self-presentation and avatar-mediated intimate experiences [16, 17]. In addition, avatars afford the experimentation of completely new identities (e.g., cross-gender play) or reaffirmation of existing identities (e.g., queerness gameplay) [25, 55, 69]. Ducheneaut et al. found that users of three virtual worlds (i.e., *Maple Story*, *World of Warcraft*, and *Second Life*) were motivated to customize their avatars in order to experiment with digital bodies that are often very different from theirs [13]. And others pointed out that users use gender swapping or performance to help form their developing self or to express and experience sexuality in a safe way [16, 25, 55, 69].

In summary, this body of work has highlighted the *proteus effect* [66, 67] as an important mechanism of self-presentation in avatar-based virtual worlds and online games. The *proteus effect* refers to the phenomenon where people conform to their avatar and the mental makeup of their avatar avatar, which may impact their behavior, perception, and cognition. This representation of self may be a different social identity [58], one without limitations of the offline world, which leads to an unrestricted expression of self [6, 30]. For example, embodying a black avatar may

potentially reduce racial bias [35, 54]. Or, using an avatar that resembles Albert Einstein may improve performance of cognitive tasks than using a regular avatar [4].

However, a unique type of emerging novel digital social spaces, namely, social VR, is dramatically transforming how people meet, interact, and socialize online. Its affordance of full body tracking, real-time and more embodied interaction as well as a broader spectrum of communication modes including both verbal and non-verbal interaction seems to mediate and support more novel and complicated relationships between online users and their self-presentation. To what degree does social VR further complicate how people construct, perceive, and experience their identity online? And to what degree does social VR extend our existing understandings of *selective self-presentation* and the *proteus effect* in digital social spaces? In this paper we especially focus on these concerns.

2.2 Social Virtual Reality

Over the past five years, social VR has risen as the next generation of VR, becoming increasingly popular digital social spaces where people meet, interact, and socialize in new and more immersive ways. It refers to 3D virtual spaces where multiple users can interact with one another through VR head-mounted displays [44, 45] and can be traced back to concept of collaborative virtual environments (CVEs) [5]. In particular, in most social VR applications users can create, craft, and customize their avatars to enter the virtual spaces and interact with others. Their avatars support full body tracking rather than merely being controlled by mouse, keyboard, or joystick on a computer screen (Figure 1).

Using such avatars, social VR users can conduct and enjoy real-life like social activities such as walking in public space, playing a game, watching a movie, participating in a concert, and having a party in highly realistic simulated 3D virtual environments. Examples of popular social VR platforms include AltSpaceVR, VR Chat, Rec Room, Facebook Spaces (discontinued in 2019), High Fidelity VR, and so forth. They tend to afford diverse activities and social atmospheres. For example, Rec Room focuses on VR gaming. VR Chat supports a wide range of creative activities and avatar customization. AltspaceVR is well known for its combination of various activities, including communicating with others through chat and attending events and professional development. Facebook Space emphasizes virtual interaction with people who are already friends. And High Fidelity VR highlights large-scale public events and performances [44].

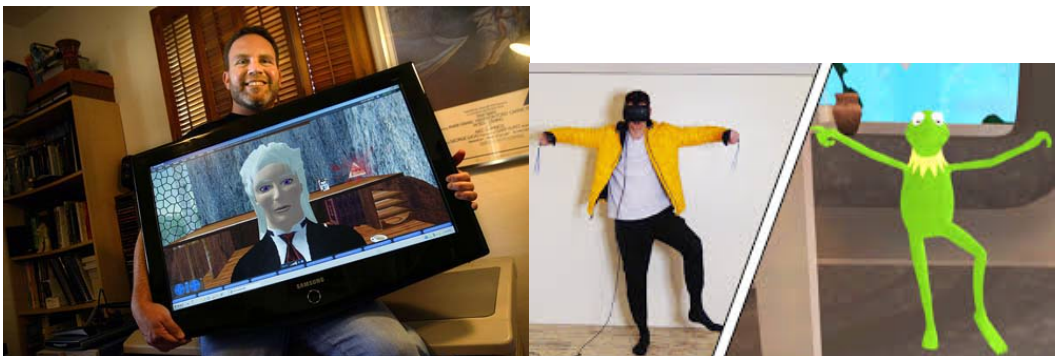


Fig. 1. Left: An on-screen avatar in Second Life (source: www.rcg.org). Right: A full body tracking avatar in VRChat (source:www.youtube.com)

The booming commercial social VR applications have led to an emerging research agenda in HCI and CSCW. Prior studies on social VR have focused on design strategies [27, 44, 57],

communication and interaction modes [3, 36, 39, 45, 48], long-distance couples' and children's experiences [37, 38, 70], and harassment and potential solutions [9]. They have also highlighted three main sociotechnical characteristics of social VR. First, It affords full body movements and gestures in real time, high-fidelity 3D immersive virtual spaces with 360 degree content. Second, it supports vivid spatial and temporal experiences and a range of emotional states that is similar to face-to-face interaction. Third, it mediates both verbal and non-verbal communication as well as a wide variety of social activities through embodied social interaction [44, 45, 48, 57, 70].

All the above-mentioned unique characteristics of social VR seem to introduce more immerse, real-time, and embodied self-presentation practices and experiences. For example, unlike social media platforms or online forums where self-presentation is mainly demonstrated by profiles using text, images, and videos, social VR users' self-presentation is grounded in a direct relationship between their physical body and avatar. In contrast to traditional online gaming or virtual worlds where users control their in-screen avatar by mouse, keyboard, or joystick to present themselves, social VR provides full body tracked avatars where the avatar's movements will correspond to the real time movements of one's physical body. However, still little is known about this nuanced self-presentation mechanism emerging in social VR and how it may affect social VR users' interactive dynamics. A recent study by Baker et al. explored how older adults used social VR and embodied avatars as communication medium [3]. Yet, they did not focus on the complicated role of self-presentation and online identity in social VR users' online social lives. They also did not investigate the diverse new practices, phenomena, and interaction consequences surrounding the self-presentation mechanism in social VR. This gap, therefore, leads to the three research questions that we proposed at the beginning of this paper.

In particular, we endeavor to explore the multidimensional self-presentation mechanism in social VR from three aspects: 1) how people construct their self-presentation in social VR (RQ1); 2) how people perceive others' self-presentation in social VR (RQ2); and 3) how the interaction and tensions between 1) and 2) may affect people's understanding of their self (RQ3).

3 METHODOLOGY

Data Collection This study was part of a broader research project on social experiences in social VR. It was approved by the University's Institutional Review Board (IRB) for research ethics. To recruit participants, we posted a recruitment message on nine popular online forums for social VR users (e.g., Reddit-RecRoom, Reddit-AltSpace VR, and Reddit-VRChat). We also directly recruited participants by entering popular social VR spaces (e.g., AltSpace and VRChat). All participants who responded to our requests and agreed to participate were interviewed. As a result, 30 semi-structured in-depth interviews were conducted. Interviews were conducted via text or audio chat through Discord, Skype, or Google Hangouts based on participants' preferences from October 2019 to November 2019. The average length of interviews was 60 min and participants were given a \$20 gift card after they completed the interviews. Interviews started with questions about basic demographic information and devices and social VR applications that participants use most. The main interview questions were related to participants' avatars, important interactive activities and social experiences they had in social VR, and their perceptions and understandings of social VR affordance.

Participants Among the 30 participants, 21 are cis male, five are cis female, and four are trans women. Of the 29 participants who shared their ethnicity, 20 are White, two are Black, five are Asian, and two are Hispanic. Participants aged from 18 to 65 (average age: 32.2) and with diverse experiences of social VR ranging from 5 months to 36 months (average: 18.7 months). Two participants (P26 and P27) self identified as persons with disabilities. Participants had also experienced a variety of popular social VR platforms including *Rec Room*, *VR Chat*, *AltSpaceVR*,

High Fidelity, Facebook Spaces, Vtime, Engagae VR, Mozilla Hubs, Sonoroom, Pokerstar, Oculus Rooms, Sansar, Anyland, and so forth. Table 1 summarizes the demographic information of the participants.

Data Analysis We used an empirical, in-depth qualitative analysis [59] of the collected data to explore people's diverse experiences of self-presentation practices in social VR. Based on McDonald et al.' [43] guidelines for qualitative analysis in CSCW and HCI practice, our analytical procedures focused on eventually yielding concepts and themes (recurrent topics or meanings that represent a phenomena) rather than agreement – because even if coders agreed on codes, they may interpret the meaning of those codes differently [43]. Therefore, we did not seek inter-rater reliability in our analysis but endeavored to identify recurring themes of interest, detect relationships among them, and organize them into clusters of more complex and broader themes.

Our coding and analytical procedures were: 1) both authors closely read through the collected data to acquire a sense of the whole picture as regards how people constructed their identity and perceived others' avatars in social VR; 2) both authors collectively identified thematic topics and common features in the data (e.g., criteria and preferences for self-presentation, perceptions of others' avatars, and influences of self-presentation in social VR on online or offline behaviors) for further analysis; 3) both authors also carefully examined and reviewed the thematic topics and developed sub-themes; and 4) both authors collaborated in an iterative process to discuss, combine, and refine themes and features to generate a rich description synthesizing social VR users' self-presentation practices.

4 FINDINGS

Using quotes from users' own accounts, in this section we present our findings as three parts. First, we identify main themes emerging in participants' experiences and practices with regard to how to present themselves in social VR. Second, we highlight important considerations for people to perceive and approach others' digital representations, which may significantly affect the interaction dynamics in social VR. Third, we explore how constructing one's digital representation and interacting with others' digital representations lead to complex influences on social VR users' understanding of their own identity.

4.1 The Demand to Create Consistent or Platform-Specific Self-Presentation

Similar to other online platforms (e.g., online gaming and virtual worlds) that support the creation or experimentation of completely different new identities, some participants expressed their preferences to construct a new self in social VR. For example, P9 (cis male, 24, ethnicity unknown) and P11 (cis male, 21, white) highlighted the fun of cross-gender play when constructing their online identity:

"Sometimes I just try female because I think it's funny. You're like the guy's voice coming out of like a little anime girl or something." (P9)

"It was like a joke. It's fun to switch the gender. I've gone in and feel like 'oh I'm a woman now. This feels so real.' That's crazy and super fun." (p11)

Some others explained that they would like to present themselves as non-human avatars in social VR. P29 (cis female, 21, Black) said,

"My avatar in social VR is just a blue bird. Sometimes if it's winter, I changed to a bird with a sweater and a hat. I think it's fun to really be a completely different species, something that has nothing to do with my real self."

For these participants, the freedom and creativity to experience self-presentation that differs from their offline self was one of the main reasons why engaging in social VR could be fun, engaging, and entertaining. It may also become a more engaging and embodied means for some users (e.g.,

Table 1. Demographic information of interviewees

ID	Gender	Age	Ethnicity	Experience (months)	Social VR platforms used
P1	Cis Male	19	White	12	Rec Room, VR chat
P2	Cis Male	23	White	18	Rec Room, VR chat
P3	Trans Woman	30	White	6	Altspace, VR chat
P4	Trans Woman	32	White	6	VR chat, Rec room
P5	Cis Male	29	White	30	VRChat, Altspace, RecRoom
P6	Cis Male	29	White	4	VRChat, Altspace, RecRoom
P7	Cis Male	18	Asian	10	Altspace, VR Chat
P8	Cis Female	27	White	12	VR chat, Rec room
P9	Cis Male	24	n/a	24	VR chat, Big screen, Altspace, Rec room
P10	Cis Male	20	Asian	n/a	Altspace, VR chat, Rec room, High Fidelity, Facebook Spaces
P11	Cis Male	21	White	5	Altspace, VR chat, Rec room
P12	Cis Male	49	Asian	24	VRChat, RecRoom
P13	Cis Male	46	Black	36	VR chat, Vtime, Big screen
P14	Cis Male	32	Hispanic	24	Altspace, EngageVR, Rec Room, Mozilla Hubs
P15	Cis Male	26	White	36	Rec room and VR chat
P16	Cis Male	65	Hispanic	24	Sansar, Altspace, Ectasia, Rec Room, Decentralized. High Fidelity, Sonoroom, Sonorome, Vtime XR
P17	Trans Woman	26	White	18	VR Chat
P18	Cis Male	55	White	30	Sansar, High Fidelity, VR chat, Altspace
P19	Cis Male	43	Asian	36	VR chat, RecRoom, Pokerstar
P20	Cis Male	20	White	24	VR Chat, Rec Room, Pavlov VR, Big Screen
P21	Cis Female	45	White	n/a	VR chat, Altspace, Omnium Space, High Fidelity, Room
P22	Cis Male	32	White	18	VR chat, Rec Room, Big Screen
P23	Trans Woman	21	White	24	VR chat, High Fidelity, Altspace, Rec Room, Big Screen
P24	Cis Female	27	White	6	Altspace, VR chat
P25	Cis Female	20	Asian	9	VR Chat
P26	Cis Male	30	White	6	VR Chat, Rec room, Altspace
P27	Cis Male	45	White	n/a	Altspace, Oculus Rooms
P28	Cis Male	48	White	24	VR chat, RecRoom, Altspace, Anyland, Sansar, Neos, High Fidelity
P29	Cis Female	21	Black	24	VR Chat
P30	Cis Male	43	White	36	Altspace, VR Chat, Big Screen, PokerStars VR

Note: n/a – participant preferred not to answer.

transgender users) to explore one's gender identity, which we will explain in section 4.3.2 in more details.

However, the majority of participants in our study described a different approach to present themselves in social VR. They had a high demand to either construct "consistent" self-presentation that is similar to one's physical self or build platform-specific self-presentation based on the social atmospheres afforded by the platform.

4.1.1 Presenting A Similar Self to One's Physical Self. Participants noted that they felt more engaging, intimate, and personal with their self-presentation in social VR compared to traditional virtual worlds and online games. As P22 (cis male, 32, white) explained, he felt that his digital representation in social VR was "*truly an extension*" of himself:

"With rec room, when you're creating the avatar, you're actually looking at it and you can move around and turn around. It's truly an extension of you. If it's in a normal game, it's not as engaged. I'll just find the first thing that's like kind of okay and go with it."

Many attributed this intimate feeling towards one's digital representation to social VR's affordance of full body tracking. For example, P11 (cis male, 21, white) highlighted the importance of movement correspondence to constructing and experiencing self-presentation in social VR:

"In a game you have avatars based on whatever game you're playing. So you are not like yourself but some character in the game. But in social VR, it's more than personal because it's like real life. In social VR your avatars' movements correspond to your physical body movements, whereas in a game you're controlling your avatars' movements on screen."

According to P11, avatars in games were simply "characters" while in social VR, they became "real life." The ability to not only see their body but physically feel how his avatar and himself "mirror" made his experiences of self-presentation in social VR appealing and intimate. P17 (trans woman, 26, White) also added,

"The more tracking you get, the more presence you can add to the experience. This definitely creates a much stronger attachments and understanding to the avatar that you've created. It's not like just looking at a screen and then controlling it via keyboard and mouse as in an online game. You have much stronger attachment. And all your movements are completely tied to it. It's very powerful."

For P17, constructing and experiencing one's identity in social VR seemed to be more valuable and powerful than in other online environments. Instead of the traditional mechanism of keyboard and mouse controlling, the body itself became the immediate and sole interface between the physical self and the digital self. This fostered a much stronger sense of presence, embodiment, and attachment.

Such an intimate connection between one's physical body and one's digital self in social VR, therefore, often resulted in the high demand to make avatars "personal" and similar to one's physical self. For example, P30 (cis male, 43, white) noted,

"I want my avatar to reflect my body type as much possible. I think I want it to be as close as it can be to my own image. I will always, always try to do this."

According to P30, similarity to his own image seems to be the most important, if not the sole, criteria he had for his self-presentation in social VR. In addition, P1 (cis male, 19, white) mentioned,

"I like to be similar to my real life self because I want to have a unique look that is different from everyone else. This makes me feel more like myself in social VR."

For P1, being unique was important to his self-presentation in social VR. Making his avatar look like himself was obviously the most efficient way to do so. This uniqueness, in turn, enhanced his feeling of presence and identity in social VR.

Similarly, P25 (cis female, 20, Asian) revealed,

"I always use small anime girl looking avatars as my digital representations in social VR. I always give them black hair and brown eyes so I feel that's really me and my body. I don't tend to use avatars that outlandishly differently with blue hair, red eyes anything like that."

For her, even small details such as hair and eye color were significant for her to have an immersive embodiment in social VR, making her feel "that's really me."

In summary, P24's (cis female, 27, white) and P5's (cis male, 29, white) accounts provide a concise description of the uniqueness of self-presentation dynamics in social VR compared to other online platforms:

"When I play games outside of social VR, normally, I'll just choose whatever I think looks coolest when I choose an avatar. But when I'm in social VR, I actually usually try to do something that looks more like me." (P5)

"I do tend to want my avatar to more represent me in VR. In a game like MMO, I just wanted to look what I would consider to be cool, but it doesn't have to be as much like me." (P24)

These quotes highlight participants' different perceptions on approaching their self-presentation in social VR and in traditional virtual worlds/online games. While "being cool" was one of the most important considerations for many to create digital selves in online gaming, "being myself" was central to constructing and present digital selves in social VR.

4.1.2 Presenting Platform-Specific Self. In this study, twenty-seven out of the 30 participants were experienced users of more than one social VR platform (see Table 1). For them, it was important to explore and experience different social VR environments as they afforded diverse social atmospheres, activities, and communities. For example, multiple participants shared how they often engaged in various social VR platforms depending on their specific moods and goals:

"I think where I go depends on what my goals are. I think RecRoom is great as it's right in between gaming and having fun. I also like VRChat or Altspace if I just want to have an informal way of meeting any type of people and chatting around the campfire." (P22, cis male, 32, white)

"Altspace has things you can do and the community is much nicer, more mature, and supportive. But I also like Anyland and VRchat if I want more casual social interactions. There are more people screaming and younger kids in those platforms." (P28, cis male, 48, white)

Therefore, considering how different social experiences that those platforms focused on, many participants tended to create platform-specific self-presentation. For them, it was important to customize their digital representations based on the platform so they could better "fit in." P24 (cis female, 27, white) described why she had a different criteria when presenting herself in AltSpace, RecRoom, and VRchat:

"In AltSpace and Rec Room, I just present myself as a normal humanoid avatar. She looks like me. She is white with blonde hair and green eyes. I do this because I want to make her like me and I think most people in AltSpace and Rec Room do so. You just look like yourself. You also do not have many options for customization. But VR chat is different. People are more creative there. They can also upload avatars and present themselves more dramatically, like for shows. So I just chose a female alien looking creature for myself. It is still me and match the general vibe of the environment."

P24's account is interesting because it highlights two aspects that both support and constrain how and why social VR users create their platform-specific self. On the one hand, it depends on the affordance of the platform itself - e.g., the customization options that are available to the users. According to P24, some platforms such as VR Chat seem to encourage customized self-presentation and give users more freedom to do so. In contrast, some others (e.g., AltSpace and Rec Room) focus more on supporting social events and activities and less on customizing avatars. This difference directly motivates users' decisions to create more customized self-presentations on some platforms and less creative ones on some others. Yet on the other hand, technological affordance alone does not determine one's self-presentation. Rather, the specific social atmosphere or "vibe" plays a significant role. In P24's case, she was well aware of such vibes and actively constructed her self-presentation

accordingly. In AltSpace and Rec Room, the vibe seems to be *"you just look like yourself"*. In VR Chat, the vibe appears to be *"more dramatic and creative but still you."*

However, despite the intention to customize their self-presentation to match the specific social atmosphere or vibe on a platform, our participants still endeavored to reserve, express, and present a similar self to their physical self. In P24's example, it was shown as her consistent efforts to create a female avatar, either as humanoid or in the alien form. In P30's (cis male, 43, white) account, it was demonstrated as his insistence in a "masculine" digital representation:

"I always present myself on the masculine side. My presentation in AltSpace is a normal human looking guy. In VR Chat, I'm more dressed up but still a human looking guy. I think the reason for that is because I want people to know I'm not trying to pretend to be somebody that I'm not."

For social VR users such as P24 and P30, they appreciated the flexibility of customization provided by some social VR platforms and were willing to craft their platform-specific self-presentation. In this way, they could better enjoy the unique social experiences and atmosphere offered in a specific social VR environment. Yet, their identity practices still complied with a fundamental criterion - be consistent to at least part of their physical self and not pretending to be somebody else.

4.2 Important Considerations for Perceiving and Interacting with Others

Not only how people present themselves but also how they perceive and approach others' presentations directly affect the interaction dynamics in social VR. In this section, we highlight four important aspects that social VR users often emphasize when perceiving and interacting with others.

4.2.1 Aesthetics Encourages or Discourages Social Interactions. Social VR affords diverse communication modes such as voice, gestures, and facial expressions. However, aesthetics such as the appearance of one's avatar are still what social VR users pay the most attention when interacting with others, at least when such an interaction just initiates. This is an interesting observation - physical appearance is still one (if not the only) of the most important factors that affect social interactions even in these nuanced online social spaces.

For example, P2 (cis male, 23, white) shared how being visually pleasant often made a positive first impression, which would benefit social interactions in social VR. He described,

"As a man I often don't pay attention to what I wear in social VR. But only recently people started complimenting me on my virtual clothes. I actually find this beneficial because people tend to be more friendly and more willing to talk with you if you wear nice clothes or look cool. I think I may play along with this more often."

P2 did not really care the appearance of his digital representation in social VR. Yet he had to acknowledge that wearing nice clothes often made people *"more friendly and more willing to talk"* with him. This seemed to lead to more positive and beneficial social experiences for him. It also motivated him to *"play along with this more often"* - e.g., paying more attention to the aesthetics of his self-presentation since other people do care.

Similarly, P3 (trans woman, 30, white) pointed to the importance of being cute:

"In VR chat, I am an average height female character who looks human but has rabbit ears and rabbit buck teeth. I've always been really into rabbits and think they are super cute. Apparently other people think so as well. People often just walk to me and say, 'omg you are so cute!' I often say, 'thank you!' and then we start a conversation. People see me as a very cute and friendly person because of my self-presentation. This definitely helps me make friends in social VR."

In P3's case, presenting herself as a cute human-like rabbit made others perceive her as a kind and friendly person. Being cute also acted as a catalyst to initiate social interactions with her, especially from strangers. As P3 mentioned, random people would just approach her and start a conversation because they were attracted to her rabbit-like self-presentation. The outcomes were often socially beneficial – it was easier for her to make friends in this way.

While visually pleasant and cute appearance may likely encourage social interactions, digital representations with less pleasant aesthetics works in an opposite way. P11 (cis male, 21, white) and P15 (cis male, 26, white) explained how strange or "crazy" appearance would lead to negative perceptions, which discouraged social interactions:

"If I see people with crazy outfits and stuff, I think they might be less approachable. I think what people look like in social VR kinda represents who they are. I just like a normal neutral level of appearance if I want to talk with someone because I want to talk with normal people not crazy people." (P11)

"I think looks do play a pretty big role in how people socialize with others in social VR. If you make an avatar with super obnoxious looking, I don't think people want to be around you. They'll want to either block you or they just won't engage with you at all. I think social VR is different from a fantasy game or something. People are supposed to look like themselves and behave normal, like in the real world. So why don't you just look normal?" (P15)

P11's and P15's accounts well describe how aesthetics closely relate to sociability and approachability in social VR. Being visually unpleasant (e.g., "crazy" or "obnoxious" looking) still attract others' attention in the same way as being cool or cute. However, such attention rarely leads to the initiation and development of social interactions. Rather, it often scares people away or encourages them to avoid interaction without even talking (e.g., "block" or "won't engage with you at all"). Especially, "being normal" seems to be a shared unofficial norm of how people should present themselves in social VR. Both participants mentioned their expectations for others to look and behave "normal" because they preferred to interact with people in a manner that was similar to the offline world. For them, engaging in social VR was more similar to living in the offline world than playing in a game-like fantasy world.

4.2.2 Diverse Perceptions of Gender. Similar to online gaming and traditional virtual worlds, gender plays a significant role in how social VR users perceive and approach others' digital representations. However, social VR platforms offer a more nuanced and accurate multimodal means to identify and verify the gender cues from one's self-presentation – e.g., as a combination of voice, appearance, and behavioral patterns. P30 (cis male, 43, white) explained this verification process:

"There is an interesting dynamic for identifying gender in social VR. I think people do care about if you are a guy or a girl. When I'm in Big Screen, I noticed that if you have a more feminine look, you tend to get spoken to by more men. But they would try to find out if you are a real woman or not by making you talk. So they can hear your voice. Once the voice comes along and it turns out you are actual a guy, they will be less interested in talking with you."

According to P30, social VR users often depend on voice chat to verify whether the perceived gender of one's digital representation (based on the avatar appearance) matches the actual gender of one's physical self. Yet, some users who do not want to present their gender may simply stay quiet or turn off the mic. For example, P25 (cis female, 20, Asian) noted,

"People will go ahead and assume that I am female because my avatar is female. They will approach me and start talking to me. I'll just stay quiet. I'll turn my mic off and just pretend I'm either a guy or that I don't have a mic."

In particular, participants expressed diverse perspectives of how gender should be perceived and presented in social VR. First, presenting gender was considered a natural way to draw attention. A few participants commented that social VR users tended to pay more attention to female digital representations just because they were female. For example, P4 (trans woman, 32, white) and P11 (cis male, 21, white) revealed,

"People just pay attention to you if you present yourself as female. It's just normal that they will pay attention to these secondary sexual characteristics, like if you are in a more slender look, in a hourglass shape, or boobs or whatever." (P4)

"It's the same as in the gaming world. Girls are more valued than guys because there are way more guys than girls in social VR or in the game world. So if I'm a male walking around, no one pays attention to me. But if I was like a girl, people would probably try to interact with me more." (P11)

Based on these two quotes, gender is always an important consideration when perceiving one's self-presentation in social VR because it gears social interactions. Due to the design of the avatars, it is naturally more likely for people to pay attention to or interact with people who are presented as female.

Second, presenting as female may lead to mixed social interaction consequences, such as better first impression and nicer treatment but also higher risk of harassment. Participants pointed out that presenting as female may encourage better social interactions because people tended to be kinder to female avatars. P3 (trans woman, 30, white) explained,

"In my opinion, people seem to be somewhat nicer to female avatars than male avatars. For example, I use a female avatar and my friend uses a male avatar. When we are in social VR, people will come up to me and be like, oh my god, you're so cute. This doesn't really happen with my friend. Sometimes people will even argue with him but just be very nice to me. I feel that it's because I looked like woman so I would not be mean in the real life."

We found P3's story insightful at multiple levels. She clearly explained how female and male digital representations could be perceived very differently by strangers and resulted in different social interaction consequences. For example, she was treated nicely and received compliments while her friend with a male avatar was basically ignored. In addition, people tended to be reluctant to engage in an argument with someone who presented as female but had no problem to do so with males. Lastly, without knowing her "in the real life" at all, people automatically considered her "not mean" simply because she presented herself as female. In this sense, presenting gender, especially as female, seems to lead to various advantages in social VR.

However, some other participants considered presenting gender (especially as female) a disadvantage in social VR because it may trigger more harassment. P1 (cis male, 19, white) expressed his concern based on his observations in Rec Room:

"As a guy I haven't encountered anything like harassment because I'm a man. But I definitely think and I have seen that people who present as women get harassed a lot more. They may use a female avatar or have a female voice so people figure it out. Hm it's a shame that such things happen to them."

P25's account (cis female, 20, Asian) also confirms such a disadvantage:

"Very often, if I'm talking to one of my friends, I notice that I will get more attention than usual because other people realize that I'm female. Then they'll tend to bother me or tend to talk to me. Even if I have shown that I'm uncomfortable, they will continue. A few times they will make sexual gestures towards my avatar even if my avatar is wearing normal everyday clothes."

In P25's case, the disadvantage of gendered presentation in social VR is obvious. Visually and audibly presenting herself as female did draw more attention to her, as many participants already mentioned. Yet such attention did not lead to a positive social experience. Instead, she felt *"uncomfortable"* and harassed because she encountered unpleasant social interactions such as *"sexual gestures."* What was worse, these unpleasant social interactions had nothing to do with what her avatar wore or if she expressed resistance. They occurred simply because she presented herself as female.

Yet not every participant considered harassment a risk for gendered presentation in social VR. P21 (cis female, 45, white), another female participant, highlighted that she had never encountered any harassment in any social VR platform based on gender:

I always use a female avatar no matter which social VR platform I'm in. Both male and female people talk to me. But I haven't sensed any way of harassment. I mean that all of them behave properly up to now. I didn't have any incident or feeling that I was intimidated or harassed because of my sex by someone else.

Third, expectations for traditional gender roles sometimes complicated how trans gender users' digital representations are perceived and understood. P23 (trans woman, 21, white) described such a complexity:

"Presenting gender in social VR is a weird thing for me. It is also more complicated for people like me than others because some people have very traditional expectations for gender. For example, if I'm in Rec Room and I'm wearing a dress, I will be harassed because people are like, 'hey, you got a man's voice but you're in a dress. What's up with that? What are you doing?' They think if you sounds like man, you shouldn't wear feminine clothes at all because it's odd. It's not what they have in mind about gender and they don't think about non-normative gender."

P23's challenge lies in the tension between her gendered presentation (e.g., wearing a dress) and how others perceive such a presentation. As we have mentioned above, voice is often used as an effective mechanism to verify one's actual gender in social VR. For P23, her presentation in social VR was consistent with her offline gender identity (i.e., trans woman). Yet for some other users, it was inconsistent with their expectations for traditional gender roles (e.g., only women can wear dresses and a woman should not have a man's voice). Both parties expressed their opinions on how gender should be presented in social VR. For P23, it should be grounded on one's understanding of his/her own gender identity. Yet for some others, it should be based on the traditional, binary gender roles. Such a tension did not lead to positive social interactions for P23 – she would be harassed because people considered her self-presentation *"odd."*

P3 (trans woman, 30, white), another trans woman, shared a similar story:

"People will just look at you and assume you are male or female and nothing between. They will come to me and identify me as 'she' even though I've not said anything about me being gender nonconforming or anything like that. I honestly don't know how to present my gender to them."

P3 was perceived as female in social VR. However, she was still frustrated by the fact that her self-presentation could not fully represent her gender identity nor allow others to perceive

her correctly ("*male or female and nothing between*"). In addition, there seemed to be no solution to address this frustration. Therefore, for participants such as P23 and P3, how transgender or any non-normative gender identity and/or sexual identity could be appropriately presented and perceived in social VR has become an urgent issue. Some chose not to use a human looking avatar, as P10 (cis male, 20, Asian) mentioned,

"For example, AltSpace allows you to choose a robot as your avatar. Robots do not have gender. So I know some LGBTQ users would use robots not a human as their avatar."

However, this is a compromise not a solution. These users still prefer the level of creativity, customization, and expression that a human-like digital representation embodies.

In summary, participants have demonstrated diverse perspectives of their gendered presentations and the resulting social interaction dynamics. Some suggested taking advantage of the gendered aspect of self-presentation to seek more attentive, positive, and friendly social interactions. Some paid attention to the higher risk of harassment. And some others noted the tension between traditional gender roles and the increasing demand for appropriately presenting transgender or any non-normative gender identity and/or sexual identity. Such inconsistency, therefore, points to interesting questions regarding how harassment and identity related to gender and sexuality in social VR are perceived, conducted, and experienced in various ways, which require future studies.

4.2.3 Presenting Ethnicity May Lead to Social Stigma. In addition to gender, ethnicity also emerges as an important consideration that may affect how users, especially non white users, are perceived and approached in social VR. Eight out of the nine non-white participants in our study reported that they intentionally created avatars that were consistent with their ethnicity in terms of skin tones, body shape, and facial features. For example, P10 (cis male, 20, Asian) mentioned,

"My avatar is an Asian guy wearing glasses. I did try different designs to make sure my avatar look like Asian because I am Asian and I want to make sure people know this. This is my personal brand."

For them, presenting ethnicity is fundamental to create unique self-presentation in social VR (e.g., "*personal brand*"). However, it may also lead to certain social stigma that jeopardized their social experiences. Such social stigma may very likely result from the fact that social VR is still a white/English-dominated world. Currently, the primary language used in most social VR platforms is English and the primary users often locate in North America and Europe. Non native English speakers and non white users, therefore, sometimes face perceptions and interactions that make them uncomfortable. P10 (cis Male, Asian, 20) explained such stigma as "*some kind of tribalism where people only want to hang out with people who speak the same language and who come from the same country, not you.*"

Such stigma may also lead to harassment or racism. P10 continued to describe his experience:

"I had two experiences of pretty bad racism against Chinese Americans in AltSpace. I was just standing there and two people approached me. They saw I had an Asian avatar so they started to make very racist comments about Chinese people and China. That was definitely a very awkward situation that I tried to remove myself as best as I could."

In P10's case, the two social VR users immediately initiated a negative social interaction with him after noticing his presentation of ethnicity. In this situation, P10 was perceived as an ethnic minority who could easily be subject to harassment and racism in social VR. Though presenting his ethnicity was considered essential to his online digital presence, it also triggered social interactions that he did not expect or desire.

Other participants noted that not only avatar design but also voice could help others perceive one's ethnicity. They especially highlighted the role of accent. For example, P16 (cis male, 65, Hispanic) said,

"People can figure out lots of things from your voice, like your race or where you are from. If you have an English accent, that's cool and people think you are white. But for people like me it is different. Just a few days ago, I was on AltSpace VR. From my accent, some guys might know I'm from Mexico or something. So they started to say all these nasty things about Mexico. It was a very Trump like language so I just muted him."

According to P16, even if people do not present their ethnicity or present a different ethnicity by crafting their avatar appearance, others are still capable of perceiving their ethnicity through voice or accent. This often lead to diverse interaction dynamics. As P16 mentioned, a perception of being a native English speaker or being white may lead to positive social interactions (e.g., being considered "cool"). In contrast, a perception of non-native English speaker or non-white based on certain accents sometimes leads to the opposite: some ethnic minority users felt being left alone because they did not speak the language as well as native speakers did. Some were even harassed or made fun of because their accent revealed their country of origin. For many ethnic minority social VR users, how to meet their fundamental needs to present and express their cultural identity while mitigating and avoiding negative perceptions of their presentation of ethnicity, therefore, has become a critical challenge.

4.2.4 The Presentation of Age Affects the Willingness to Interact. Most social VR platforms are open to anyone over the age of thirteen. Users above that age can create an account and engage in the virtual social spaces. It is common that social VR users may encounter others of different age groups, including children. In our data, how age is perceived can affect whether someone is willing to initiate or continue an interaction.

For example, P2 (cis male, 23, white) and P11 (cis male, 21, white) explained that older users generally would avoid interacting with younger users once they figured out the age difference: "I try to avoid people if they sound like they are really young. Like I wouldn't want to come up to a random kid in real life and say, we're going to be friends" (P2) and "I don't usually interact with random kids on the platform" (P11). For adult users such as P2 and P11, perceiving others' age was crucial to ensure a pleasant social interaction experience in social VR – as age might quickly convey the level of maturity and indicate the possibility of shared interests. For them, it was unlikely that older and younger users would share similar interests, making them unwilling to engage in such an interaction.

P6 (cis male, 29, white) also added:

"Well it's not like I say, I don't want to interact with you. It's more of like if they start talking about anime characters, start talking about sex, that instantly makes me want to take off because it gets really awkward. I'm not interested in making a bunch of friends who are under the age of 18. It makes me say, okay, bye."

According to P6, initially he was open to interact with people of different age groups. However, he quickly realized that he and the younger users did not share the similar level of maturity and interests based on the topic and content of their conversations. This mismatch made him feel "really awkward" and thus avoid making friends with people who were perceived as younger users.

Nevertheless, this does not mean that the presentation of age, especially a younger age, would always discourage interaction in social VR. For example, P12 (cis male, 49, Asian) acknowledged

the fact that social VR applications such as RecRoom would attract people of different age groups and suggested how to better communicate with younger users:

"RecRoom has grown and now has a lot of kids. So for me, I usually interact with them after a round of games in the lobby, saying good game or high five. Sometimes it's easier to talk with them this way rather than starting a random conversation."

For P12, it might be challenging to sustain a conversation or interaction that was meaningful, engaging, and productive for both adult and younger users. In this sense, it was understandable that some users may be reluctant to engage in such interaction after perceiving the other party's presentation of age. However, P12 also understood that it was inevitable to encounter users of different age in social VR and actively sought strategies to communicate with them – e.g., *"saying good game or high five."* For him, the presentation of young age did not discourage him to interact with such users but led to a different communication strategy.

Similar to the presentation of gender, participants also highlighted the importance of voice for both perceiving and verifying one's age. P4 (trans woman, 32, white) and P10 (cis male, 20, Asian) commented:

"When people are talking in chat or using foul language, you can hear their voice. It doesn't matter if they modulator higher or lower and you're like, that's probably not a kid older than 14 or 15." (P4)

"I think the biggest indicator from one's voice is age. Everyone's avatar can have the same height or have a beard. But if you hear their voices, then you can tell it's like a little kid." (P10)

According to these two participants, some social VR users were able to conceal their age or mis-present their age by manipulating the appearance of their avatars (e.g., using a tall avatar or adult-looking facial features such as beard). In doing so, they could present themselves as part of a more mature age group and engage in such a group. Yet the predominance of voice chat in social VR could easily convey hints of age - for example, a younger user may often have a high pitched voice. In this sense, voice plays a central role in not only directly presenting one's age (e.g., based on the pitch) but also effectively verifying age if one's avatar appearance and his/her behavioral patterns mismatch.

4.3 Influences on Understanding One's Self

Thus far we have presented a) how the construction of self-presentation and b) the perception of others' self-presentation collectively affect the interaction dynamics in social VR. In this section, we attend to the potential influences of the above-mentioned two aspects on social VR users' understandings of their own self. Specifically, we identify three main themes: an adventurous means to experience one's everyday self, an engaging approach to discover one's unknown self, and an embodied way to explore gender identity.

4.3.1 An Adventurous Alternative to Experience One's Everyday Self. As described in section 4.1.1, many participants expressed a high demand for presenting a similar self to their physical self. Therefore, some felt that their self-presentation in social VR did not affect how they understood their self because they would look and behave almost the same as in the offline world. However, they acknowledged that presenting themselves in social VR was still an adventurous means to experience their everyday self. For example, P13 (cis male, 46, Black) explained,

"Presenting myself in social VR doesn't affect the way I understand myself in real life. I'm still the same me, no more, no less. However, social VR is always kind of an adventure. I like to have the ability to put myself in such a new environment. It does

not change the real me per se but I appreciate the feeling of experiencing myself in an adventure."

For P13, presenting himself in social VR did not necessarily improve or hinder his understanding of himself or alter his offline behaviors. Yet, it did not mean that such self-presentation had no influence on him at all. Rather, he started to appreciate and enjoy a new and adventurous way of experiencing his everyday mundane self that was supported by the novel social VR technology. For him, it did not matter if he took advantage of social VR to improve himself or not. It did matter that he could experience his everyday self in a novel way regardless of any influences on his image or behavior online and/or offline.

P15 (cis male, 26, white) also shared how social VR offered him an alternative channel to demonstrate the creative part of himself:

"I'm happy that the creative side in me can just come out in social VR. It's not like I'm more creative. I'm probably equally creative in social VR and in real life. But It's nice to have a place where I can also be myself in that creative way or in that creative mindset."

Similar to P13, presenting himself in social VR did not make P15 more creative or productive than in the offline world. He was also uncertain if situating in social VR improved his creative skill/mindset in any substantial way. However, it was meaningful and valuable to him that he could expand the horizon to demonstrate his creativity – both in social VR and in the physical world.

In addition, participants highlighted that the anonymous and immersive social VR environment supported the free expression of their everyday self. For example, P15 (cis male, 26, white) and P17 (trans woman, 26, white) revealed,

"It's a very happy feeling that you can be yourself. You can be as wacky or as crazy as you want. And you really can do it because of the full body tracking. I mean, it's not like you discover new things about yourself. It's like you can just be yourself, like if you want to scream at the top of your lungs, then you can just do it." (P15)

"I feel like when I'm in the real world and around real people, I tend to curb my personality and express a lot more in line with what I feel like is socially acceptable and normal. When I'm in social VR, I feel more comfortable just being how I feel like at full blast. It's not like I know anyone there or I need to please anyone." (P17)

In both quotes, participants emphasized that though their self-presentation in social VR did not affect how they understood their own identity, it did make the free expression of their self much easier than in the offline world. Such an easement partially resulted from the anonymity of social VR, which was not different from any other anonymous online social spaces. However, with technical features such as full body tracking and voice communication, users had to physically conduct and mirror their behaviors in social VR to express themselves. This, therefore, may constitute a more immersive, realistic, and satisfying alternative to experience one's self than in other online social spaces.

4.3.2 An Engaging Approach to Discover One's Unknown Self. In contrast, some other participants did feel that their self-presentation in social VR affected how they understood themselves, especially regarding discovering part of their self that they did not know before.

A typical example is that self-presentation in social VR helps participants explore undiscovered potentials of themselves. P18 (male, 55, white) told a story about how he became good at talk shows:

"Through my avatar, I've discovered some interesting aspect of myself that I don't think I would have otherwise, like I never thought I would become a host of a show

on YouTube. But it feels so real when you do such things in social VR. That's I've discovered I'm really good at it."

For P18, this seems to be a mixed experience. On the one hand, he felt safe and confident to start new adventures in social VR because his presence and actions were mediated by his avatar. On the other hand, such an embodied experience was so "real" because he had to physically and vocally deliver such activities (e.g., hosting a show). Eventually, this mixed experience helped him discover some unknown talents about himself (e.g., good at talk shows). As he pointed out, without engaging himself in social VR, he may never have discovered this part of himself.

Participants also mentioned that presenting themselves in social VR made them more confident. For example, P3 (trans woman, 30, white) explained how engaging in social VR made her more confident about her dance skills both online and offline:

"One big thing that I've taken away from social VR is that social VR not only made me more confident there but more confident in real life. I was a prop dancer but I had never done traditional dance before until social VR came out. Since I have practiced traditional dance so much in social VR with people, now I am comfortable with doing that in front of people in the real life. I also think that social VR helps improve my traditional dance skills because I was indeed dancing using my body."

According to this quote, presenting herself in social VR improved P13's understanding of herself and made her more confident in two ways. First, she was situated in a highly immersive and realistic environment with other people. This mitigated her fear of doing a dance style that she was inexperienced of in front of audience. Second, performing dance in social VR required the exact body movements in the offline world ("*I was indeed dancing using my body*"). This directly helped her improve her actual dance skills in the offline world.

In addition, such confidence promoted participants' understanding of their cultural identity. P19 (cis male, 43, Asian) told his story,

"I have been minority in my entire life. I grew up in the Midwest so I was the only non-white person in all my high school classes and all my college classes. I was mostly OK with that but I was always aware of me being minority at some level. I've always wondered, 'what would it be like to be a majority?' So I have used white avatars in social VR. That did not end well. But surprisingly, that experience actually made me more confident and had a better understanding of who I was. I am Asian American and I don't need to be white."

P19 seemed to be somehow confused and concerned about his identity due to his life experience - being the only non-white person for the majority of his life. Though he did not share more details, he indicated that this experience made him sensitive about his identity ("*I'm always aware of me being minority at some level*"). It also motivated him to use white avatars in social VR to experience how the life of not being minority might look like. However, presenting himself as white did not damage his self-identification but instead confirmed and reinforced his understanding of being minority - he became more confident about his unique cultural identity ("*I am Asian American and I don't need to be white*").

As we have shown, many participants considered using social VR to discover their unknown self mostly positive. Nevertheless, it should be noted that some regarded it "scary." P14 (cis male, 32, Hispanic) explained why:

"It's kind of discovering part of a new you but looking it in fear. It feels like in a different plane of existence. Yes it is me and it looks like me. But is it just part of my digital footprint or is it also part of me in the real life?"

This description raises an interesting question about how social VR users approach the discovery of their unknown self in different ways. In P14's opinion, there should be a disconnection or a fine line between one's social VR self and the offline self. For him, these two aspects of self could even operate on different levels ("*it feels like in a different plane of existence*"). Therefore, it is unclear whether new aspects of self that are revealed through social VR should be counted as part of one's physical self.

4.3.3 An Embodied Way to Explore Gender Identity. In section 4.1.1, we have pointed out the direct connection between one's physical body and his/her self-presentation in social VR. This aspect is especially influential for social VR users who struggle with their gender identity.

In our study, all four trans woman participants highlighted that social VR provided them with an embodied way to explore their gender identity. For example, P3 (30, white), a trans woman, described that how experiencing a female avatar in social VR helped affirm her gender identity and encouraged her to make real life changes:

"Using a feminine avatar makes me confident not only in VR but also in real life. I feel like that would be actually more real than the real you in real life. Because in real life, you're stuck with what you were born with. But in VR, you can be what you truly feel like you are inside. This experience actually gave me confidence to start my [transgender] procedure in the real life."

P3's account pinpoints one of the most important advantages of social VR for users who endeavor to explore their gender identity: the sense of immersive and realistic embodiment - e.g., "*you can be what you truly feel like you are inside*." In the offline world, P3 was constrained by her physical body. It was impossible for her to know how having a body of a different gender may feel like. Even in other digital social spaces such as online games and traditional virtual worlds, cross-gender play would be limited to on-screen avatars. Yet in social VR, she was able to experiment and experience a female body in a more nuanced way - "*I feel like that would be actually more real than the real you in real life*". This feeling was so powerful that it motivated her to start her transgender procedure in the physical world.

P17 (26, white), another trans woman, further emphasized the importance of the full body embodiment for creating a powerful and embodied way to discover her gender identity:

"By using a feminine female avatar, I found that I was just more comfortable with that body, and it's kind of what I learned about my identity. That was the evidence to myself to consider which direction I wanted to take my actual body outside of the VR. If I found I was happy in VR about my body and I was not happy with my body outside of the VR, why not change it?"

In P17's case, her self-presentation as a female avatar in social VR provided her with a safe and low cost opportunity to fully experiment a female body. It was invaluable for her to have such an ability to fully immerse in a different body and behave through it. Similar to P3, this powerful dynamic made her reconsider and re-evaluate her physical body and gender identity.

Some participants were still uncertain about their gender identity or were unclear about whether they would like to make real life changes. Yet they also found social VR beneficial for immersively experiencing the gender space in an open manner. P4 (trans woman, 32, white) and P23 (trans woman, 21, white) both explained this flexibility:

"I'm kind of physically male. I'm also married. I kind of self identify as trans but not as trans as other people. So it's a big gray area that people are all over the place. But I definitely enjoy inhabiting in the female space in social VR. That's a huge appeal

of social VR to me. I'm still not sure what I will do about my gender in the real life but I kind of just want to be there and gain that feminine experience." (P4)

"It's very complicated and stressful to be trans in the real world. I'm talking about drugs, procedures, clothes, and of course pressures from family and friends and the society. So I was just trying to relax and make something that I want in social VR. I do not want anything masculine. I just want something more feminine or be in charge of something that make me realize what I want for myself." (P23)

In both quotes, participants expressed various challenges and pressures for them to present themselves as trans woman in the offline world. For P4, such challenges came from her uncertainty about trans as "a big gray area" and how she would like to approach this area. For P23, such challenges emerged in complex medical concerns and social pressures. However, they both found relaxation and easiness in social VR because they could navigate through these challenges in various ways, such as simply "inhabiting in the female space" or taking charge to realize what they actually wanted for themselves.

5 DISCUSSION

In summary, our findings have the following highlights. First, social VR users construct their self-presentation based on two main criteria: creating "consistent" self-presentation that is similar to one's physical self; or building platform-specific self-presentation based on the social atmospheres afforded by the platform (RQ1: *What criteria do people use to construct their self-presentation in social VR?*). Second, aesthetics, gender, race, and maturity are four important aspects that social VR users often emphasize when perceiving and approaching others' self-presentation (RQ2: *How do people perceive and approach others' self-presentation in social VR?*). Third, the construction of self-presentation and the perception of others' self-presentation collectively affect social VR users' understanding of their own self in three ways: as an adventurous means to experience one's everyday self, as an engaging approach to discover one's unknown self, and as an embodied way to explore gender identity (RQ3: *How, if at all, does self-presentation in social VR affect people's understanding of their selves?*).

Now we attend to how these findings shed light on more nuanced identity practices in emerging sociotechnical systems and expand existing CSCW knowledge of the complexity of people's self-presentation in online social spaces. Based on these findings, we also discuss potential design implications for further supporting users' self-presentation practices in social VR.

5.1 A Self-presentation Mechanism that Emphasizes Consistency

While some social VR users enjoyed performing a new or different self (e.g., cross-gender play) in a more immersive way, one highlight of our findings is that the majority of our participants expressed a strong preference to construct consistent self-presentation that was similar to their physical self. Such preference was also true even when they needed to somehow craft a platform-specific self-presentation. In this sense, social VR users seem to promote a different aspect of *selective self-presentation* – they choose to emphasize consistency.

Why did this happen? One potential reason can be *the direct connection between one's body and his/her avatar* in social VR. As we mentioned earlier in this paper, in social media systems, online users are allowed to create multiple separated profiles or "circles" to carefully "craft" which aspect or facet of the self to be presented [14, 29, 42]. What is unique in social VR is that one's physical body becomes the immediate and sole interface to construct and experience self-presentation via full-body tracked avatars: one's avatar's movements in social VR are consistent with one's offline physical movements in real time. As our findings show, it feels more natural to present a consistent

self in social VR because people inherently follow what their physical body can do. Therefore, our participants seemed to have a stronger identification with their avatars in social VR than in other platforms. Consistent with prior literature on avatars in traditional virtual worlds and online gaming [13, 16, 17, 19, 25, 26, 40, 51, 55, 68, 69], avatars in social VR still demonstrate similar social functions. Social VR users communicate through avatars, create their avatars based on diverse social values, and use avatars to experience and/or experiment new or existing identities. They showed strong desires and great efforts to make their social VR avatars similar to themselves and often considered that their avatars were indeed themselves, not merely presentations of themselves. In contrast, such desires seemed not to be evident in traditional virtual worlds and online gaming.

Another potential reason for this different self-presentation mechanism may lie in *the realistic social atmosphere that many social VR platforms provide*. As our findings have shown, participants endeavored to present themselves in a way through which they could fit in the social norms or implicit community standards (i.e., "vibe") of a given social VR platform. Some platforms such as VRchat tend to focus on uniquely designed virtual rooms (e.g., spaceship and Japan Shrine) and sophisticated avatar customization. This affordance may encourage users to create more fantasy based self-presentation. However, many existing social VR applications tend to foster social atmospheres that are similar to offline face to face interactions. For example, AltspaceVR is well known for the diverse events that it offers, ranging from open mic night, mediation classes, C programming classes, and professional development workshops. By engaging in these events, users are allowed to reflect on the future direction of their career and practice necessary professional skills. In this sense, AltspaceVR seem to server as a promising collaboration and meeting space for the future of work in the offline world. Similarly, RecRoom offers many games that can be played in offline face-to-face interactions (e.g., paintball and basketball). Users can create their own private rooms. They can also venture into a central hub called the RecCenter and from there go into different rooms for gaming. Situating in such social atmosphere that is similar to the offline world, users may also tend to behave similar to their physical self rather than presenting a different or new identity. This affordance, therefore, encourages self-presentation that is consistent with the physical self.

We believe that this unique self-presentation mechanism for consistency in social VR worthy of research attention in HCI and CSCW. As in other sociotechnical systems such as social media sites and online gaming, social VR users are well aware of their audience (i.e., other users surrounding them). In fact, they may be more aware of their audience due to the predominance of voice chat and an enhanced sense of embodiment. Theoretically, this strong awareness can facilitate the emergence of *the imagined audience* (i.e., someone's mental conceptualization of the people with whom he or she is communicating; see [33, 34]), which may encourage users to craft a new identity. However, what our findings show is that many social VR users intentionally chose to present their virtual self in a way that was similar to their physical self as much as possible, rather than crafting their self based on the audience. This interplay of body, avatar, audience, and conscious personal choices makes self-presentation in social VR quite unique. It also points to the importance of investigating the evolving complexity of people's identity practices in emerging novel sociotechnical systems.

5.2 A More Complicated Dynamic to Perceive and Interact with Others' Self-Presentation

Similar to traditional virtual worlds and online games, avatar representations in social VR act as *social lubricants* or *social deterrents* [41, 46, 47, 51]. This means that the representation (e.g., appearance, gender, and race) either invites or discourages interactivity. How one perceives these representations also governs the social outcome, as one may choose to interact with another user based on their perception of one's appearance, gender, or race, and so forth.

However, our findings highlight a more complicated dynamic to perceive and interact with others' self-presentation in social VR. Regarding gender, Yee revealed that in World of Warcraft, women were *tokenized* and sought after due to their avatar and must make substantial efforts to validate their gender identity [65]. Such special attention towards women also occurs in social VR but acts as a double edged sword. Compared to traditional online games where women were sought after and represented by hyper sexual characteristics [15, 65], in social VR presenting as a female can lead to better first impression and nicer treatment because people tend to be kinder and more tolerable to female avatars. Therefore, social VR seems to afford a more friendly and open social atmosphere for gendered presentations. Yet, our findings also show that harassment towards female avatars and misunderstandings about trans gender users' digital representations could be more severe in social VR due to the popular use of voice chat, the challenge to create a gender non-normative humanoid avatar, and the overall expectations for traditional gender roles. All these constitute a confusing mix for those who focus on creating an accurate gender representation of themselves in social VR.

In addition, avatar race in traditional virtual worlds are often disproportionately represented as white [60]. Yet the majority of our non-white participants pointed out the importance of creating an accurate representation of themselves (e.g., by skin tone and facial features). This sentiment of identity matching for diverse users is common but not always facilitated in traditional virtual worlds [28]. In this sense, social VR platforms seem to better support diverse users' needs to freely and accurately represent their race and culture. Nevertheless, this also invites certain social stigmas such as racism and exclusion based on race/culture. Accents, dialects, and other forms of identification of non-native English speakers through voice create natural social barriers as well. Similarly, while most social VR platforms open to and welcome users of any age, they also make age and level of maturity significant factors in perceiving and interacting with others, and generally discourage older users from interacting with younger users.

With all these concerns, it is in fact unclear whether social VR promotes or hinders diversity and inclusion by supporting more sophisticated mechanisms to present and perceive gender, race, and age. Such complexity may lie in the prevalent use of *voice* as a main method to perceive and verify another user's identity, combined with the multidimensional representation of either appearance, gender, race, or age. Therefore, voice plays an important and powerful role in further complicating the interaction dynamic in social VR - it erodes *anonymity* but subsequently creates *trust* in some ways [61, 62]. For example, recognizing a female user by their voice can lead to unwanted attention or initiate a friendly conversation. Having an accent can lead to social exclusion or social acceptance. And showing a young person's voice can lead to an unwillingness to interact or a way to find playful friends. These new phenomena and tensions, thus, call for more research on nuanced identity practices and interaction dynamics in evolving online social spaces, including how to better unpack the essential role of voice in perceiving others' self-presentations and the intertwining relationships among different dimensions of identity presentation such as appearance, gender, race, and age.

5.3 New Perspectives of the *Proteus Effect* for Understanding Identity

Another highlight is how *proteus effect* [66, 67] regarding the impacts of immersive virtual avatars on one's own understanding of self was demonstrated in social VR. On the one hand, *proteus effect* can be experienced in a more powerful and embodied manner in social VR due to the direct connection between one's body and his/her avatar. This effect was especially evident on our trans woman participants, all of whom conformed to their avatar's identity and were even motivated to pursue real life changes regarding their gender identity. On the other hand, many participants also clearly stated their preference for delineating the VR self from the physical self.

These observations point to several new perspectives of the *proteus effect* in social VR. First, the consistency between physical body movements and avatar movements both promotes and hinders the *proteus effect*. While communication is still carried through a virtual avatar in social VR, it is realized by "mirroring" physical body movements due to full body tracking. Such an involvement of both the physical body and the avatar often leads to a more natural and realistic feeling of self-presentation, which may heighten the proteus effect (e.g., conforming more to the VR self). However, this feeling may also cause people to be more attached to their physical self and therefore more conform to their behaviors, perceptions, and cognition in the offline world (e.g., a preference for delineating the VR self from the physical self).

Second, the *proteus effect* seems to be more influential on certain behaviors than others in social VR. For example, it was powerful in terms of experimenting and exploring a different gender identity but was not very evident when improving creative skills. While both activities involve immersive embodied experiences (e.g., experiencing a female avatar's body or conducting physical body movements to paint), why people choose to conform to their avatar in one but show no preference in the other leads to an interesting question concerning the transferrability of the *proteus effect*.

Third, some social VR users show a strong resilience towards the *proteus effect*. They clearly stated a preference to draw a fine line between the "social VR self" and the "physical self." For them, bypassing this boundary may lead to confusions and even fear. From our data, it is unclear how and why they developed such a resilience. Yet a potential explanation may still relate to the direct connection between one's physical body and avatar – this intimate relationship may be felt as positive and beneficial for some but as a chaos for others, especially if they regarded blurring social VR and the offline world as a potential risk.

In summary, our study explicates an evolved self-avatar mechanism in social VR, which highlights new perspectives of the *proteus effect* for understanding online identity. Interestingly, this mechanism also raises questions about avatar realism and the impacts on social interactions in virtual reality. Social VR platforms afford both a direct connection between physical body and avatar and a variety of avatar representations ranging from realistic (e.g., humanoid) to non-realistic (e.g., cartoony, fantasy-based, and non-humanoid). How, if at all, do these representations intertwine with the new body-avatar relationship? And how do these representations further affect different levels of body ownership? As social VR platforms continue to pursue increasing realism and more natural interactions, these questions may lead to new considerations regarding co-presence[50], rapport [21], and social presence [7] in these virtual spaces.

5.4 Implications for Social VR Design

Grounded in our findings, we identify three potential design implications for further supporting users' self-presentation practices in social VR. These implications are neither complete or exhaustive as they are mainly directions emerging in our participants' accounts. Yet, we consider that they may benefit developers/designers who endeavor to improve and advance nuanced social dynamics and identity practices in VR.

Avatar Design for Presenting Cultural Identity and Gender Identity. Our trans woman and ethnic minority participants expressed their expectations for more personalized avatar design that could appropriately present their cultural identity and gender identity. For example, valuable additions for ethnic minority users would be higher level of personalization to craft their avatar facial features and options to wear their traditional outfit. Trans users would appreciate more flexible and fluid gender settings rather than a binary choice. As they still prefer humanoid avatars rather than those with no gender (e.g., robots), it would be useful to provide them with less gender specific accessories, outfit, body type, and facial features for avatar creation.

Platform Embedded Voice Modulators. Voice chat is the main method through which social VR users interact with one another. Yet it also discloses much information regarding one's gender, ethnicity, country of origin, and age, which may or may not benefit how people are perceived and approached in social VR. Therefore, platform provided voice modulators, which make users' voices anonymous and generic, would allow users (such as women, trans women, and non-native English speakers) not to include voice as part of their self-presentation. In this way, they would be able to avoid certain inappropriate perceptions and behaviors toward them based on their voice.

Alternatives to Full Body Tracked Avatars. Full body tracked avatars are directly related to how social VR users experience the *proteus effect*. While some enjoy it, some others consider it a chaos and would like to better distinguish their VR self from the physical self. Therefore, it seems to be valuable to allow these users who show resilience towards *proteus effect* to control their avatars without physically "mirroring" their bodies in the offline world. In this way, they still can take advantage of the immersive experiences in social VR while remaining a fine line between VR and the offline world.

5.5 Limitations and Future Work

A few limitations of this study should be noted. All interview participants were recruited from online forums or social media. There is a potential bias towards social VR users who maintain an active social media account. Another limitation is the lack of even distribution between participants and the platforms they use. While our participants reported their use of diverse social VR platforms, they mainly focused on mainstream commercial platforms including Rec Room, VR Chat, and AltspaceVR, future work should aim to recruit a broader participant pool with more diverse social VR platforms to capture a more comprehensive picture of the interplay of self-presentation and technological affordance of specific social VR platform. Future work should also focus on recruiting a more diverse sample (e.g., more LGBTQ, minority, and disabled users) to further investigate what type of behaviors and identity practices are more easily affected by their embodiment in social VR. In addition, interview data mainly focuses on self-reflection. There is a possibility that participants' self-reflections of their identity could potentially be skewed. Therefore, other forms of data (e.g., surveys, observations, and logs) could be collected to further verify findings from the interview study.

6 CONCLUSIONS

As commercial social VR applications continue to rise in popularity, how do these novel online digital spaces afford new forms of identity practices and embodied self? Our investigation has yielded three key findings. First, social VR users tend to present themselves consistently with their offline identity, even when they sometimes construct platform-specific self-presentation. Second, four aspects (aesthetics, gender, race, and age/maturity) are important for social VR users to perceive, approach, and interact with each other. Third, the process of constructing and perceiving identity in social VR allow social VR users to experience their everyday self in a new way, discover one's unknown self, or explore alternative gender identity.

Therefore, we suggest that the nuance of self presentation in social VR sheds light on 1) the potential of consistent digital representation; 2) a more complicated interaction dynamic regarding avatar representation involving the essential role of voice; and 3) new perspectives of the *proteus effect* regarding the body-avatar relationship and different levels of body ownership. Based on these findings, we also propose three potential design implications for further supporting users' self-presentation practices in social VR: avatar design for presenting cultural identity and gender identity; platform embedded voice modulators; and alternatives to full body tracked avatars.

We believe that our focus on self-presentation in social VR contributes to CSCW literature on social VR and nuanced self-presentation in emerging novel sociotechnical systems. We also hope that these insights and findings may inform potential directions for designing more meaningful, thought provoking self presentation experiences and identity practices online.

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