

Disturbing the Peace: Experiencing and Mitigating Emerging Harassment in Social Virtual Reality

GUO FREEMAN, Clemson University, USA

SAMANEH ZAMANIFARD, Clemson University, USA

DIVINE MALONEY, Clemson University, USA

DANE ACENA, Clemson University, USA

Harassment has long been considered a severe social issue and a culturally contextualized construct. More recently, understanding and mitigating emerging harassment in social Virtual Reality (VR) has become a growing research area in HCI and CSCW. Based on the perspective of harassment in the U.S. culture, in this paper we identify new characteristics of online harassment in social VR using 30 in-depth interviews. We especially attend to how people who are already considered marginalized in the gaming and virtual worlds contexts (e.g., women, LGBTQ, and ethnic minorities) experience such harassment. As social VR is still a novel technology, our proactive approach highlights *embodied harassment* as an emerging but understudied form of harassment in novel online social spaces. Our critical review of social VR users' experiences of harassment and recommendations to mitigate such harassment also extends the current conceptualization of online harassment in CSCW. We therefore contribute to the active prevention of future harassment in nuanced online environments, platforms, and experiences.

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

Additional Key Words and Phrases: online harassment; social virtual reality; marginalized tech users; online social interaction

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1 INTRODUCTION

Harassment has long been considered a severe social issue due to its serious and negative effects on the target individuals' well-being, including anxiety, lower self-esteem, distress, suicidal attempts, and so forth [1, 40, 75]. Yet, harassment is also a culturally contextualized construct, meaning that it can be defined, perceived, and responded to differently in various cultures [96]. In the U.S. culture, unwelcome conducts that are based on race, color, religion, sex, national origin, age, disability, or genetic information are often considered as forms of harassment [21].

Authors' addresses: Guo Freeman, guof@clemson.edu, Clemson University, Clemson, South Carolina, USA, 29834; Samaneh Zamanifard, szamani@clemson.edu, Clemson University, Clemson, South Carolina, USA, 29834; Divine Maloney, divinem@clemson.edu, Clemson University, Clemson, South Carolina, USA, 29834; Dane Acena, dacena@clemson.edu, Clemson University, Clemson, South Carolina, USA, 29834.

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In the offline world, many people in the U.S. have experienced harassment or witnessed someone being harassed at least once in their life [43, 44]. In the online world, harassment can happen to any online user on any platform, including social networking sites [69, 74], online forums [58], online gaming [23, 31, 61], and virtual worlds [71]. Based on the perspective of harassment in the U.S. culture, online harassment may even be more severe for individuals who are considered marginalized in tech spaces due to various social, economic, physical, and cognitive reasons [7, 19, 29, 30, 41]. Such communities may include women, LGBTQ, racial/cultural minorities, persons with disabilities, persons with a serious and persistent mental illnesses or cognitive impairments, and people who face economic and social disadvantages (e.g., prisoners) [90]. Therefore, existing HCI and CSCW studies have highlighted the need for research to enhance our understanding of the complex variations, dimensions, and social consequences of harassment online [74, 87, 88]. They have also called for continuous efforts to investigate new and potentially more severe forms of harassment emerging in novel online social spaces and develop nuanced strategies and designs to prevent such harassment.

Following this call, in this paper we examine new characteristics of online harassment emerging in social Virtual Reality (VR) - novel and increasingly popular 3D virtual spaces where multiple users can engage in immersive 360 degree virtual content and interact with one another through VR head-mounted displays [62, 63]. As a 3D avatar-based virtual environment, social VR is comparable and relevant to virtual worlds and online gaming. However, social VR also offers a more immersive and embodied multi-user virtual environment with a heightened sense of presence. Rather than merely looking at avatars on a computer screen, social VR provides full-body tracking avatars (e.g., one's avatar movements correspond to one's offline body movements in real-time), synchronous voice conversations, and simulated touching and grabbing features. These novel characteristics may lead to greater instances of harassment and potentially more destructive consequences compared to traditional 3D virtual worlds/online gaming or single-user VR.

In particular, in this study we also attend to marginalized social VR users' experiences of harassment since research suggests that they are commonly and more severely the target of online harassment in the U.S. culture [22, 48]. Though marginalized users in tech spaces include a wide range of marginalized groups, in this paper we consider women, LGBTQ individuals, and ethnic minorities marginalized in social VR because: 1) social VR platforms are generally considered English and male dominated, making these users underrepresented [12, 70]; and 2) these populations are already often perceived as vulnerable and marginalized in online gaming and virtual worlds in the U.S. culture [14, 31, 38, 61, 77, 79, 80, 85] and thus may face additional challenges in social VR, an even more nuanced online virtual space. Therefore, we believe that an in-depth empirical investigation of emerging harassment in social VR is of interest of HCI and CSCW researchers concerning with designing and developing safer and more inclusive online social platforms, especially for these often marginalized tech users.

Specifically, using 30 interviews of users of different social VR platforms, we explore the following research questions:

RQ1: *What are the new characteristics of online harassment emerging in social VR?*

RQ2: *How do social VR users, especially those who are already considered marginalized in the gaming and virtual worlds contexts, experience these new characteristics of online harassment?*

RQ3: *What are social VR users' strategies and recommendations to mitigate these new characteristics of harassment?*

We as CSCW researchers are well aware of the culturally sensitive nature of harassment and acknowledge that our investigation of harassment in social VR is situated in the perspective of harassment in the U.S. culture (see [21]). Our analysis is also both empirical and critical: we distinguish our own views and stance of harassment in social VR from those of our participants

throughout the paper. In doing so, we hope to understand their account on its own terms as experiencing and mitigating harassment in social VR and using that account as an object of critical inquiry for further investigation.

This research contributes to a growing research area in HCI and CSCW on harassment in social VR (e.g., [12, 81]) in three ways. First, we provide empirical evidence of new characteristics of harassment in social VR platforms. We especially highlight *embodied harassment* as an emerging but understudied form of harassment in novel online social spaces. In this context, harassing behaviors are both conducted and experienced through a sense of embodiment about one's virtual body, such as a higher awareness of body ownership and more physical and transformative/interactive experiences. Our critical review of social VR users' experiences of harassment and recommendations to mitigate such harassment also extends the current conceptualization of online harassment in CSCW. Second, we attend to marginalized tech users' (e.g., women, LGBTQ, and ethnic minorities) struggles for dealing with harassment in social VR and point to the importance to design future social VR technologies to better support these users. Third, we explicate potential design implications to protect users from harassment in social VR, including platform embedded voice modulators, more robust reporting in-the-moment that involves contexts and documentation, and the need to build trust between moderators and users in more nuanced ways. As social VR is still a novel technology, our proactive approach not only adds to the growing body of literature on social VR but also contributes to the active prevention of future harassment in nuanced online environments, platforms, and experiences.

2 RELATED WORKS

Our focus on emerging harassment in social VR is grounded on the interlinked strands of research in CSCW on online harassment, marginalized tech users' experiences of harassment, and the unique technical and experiential characteristics of social VR.

2.1 Online Harassment and Marginalized Tech Users

Extensive CSCW and HCI research has explored harassment in various online social spaces (e.g., social media, online gaming, and virtual worlds). In the U.S. culture, such online harassment often include acts or behaviors via emails, instant messages, social media, online forums, or any type of digital communication platforms to threaten, annoy, dox, and offend an individual or group of individuals [27, 39, 46, 82]. Like offline harassment, online harassment can lead to disruptive social consequences. First, the *anonymity* of online social spaces may foster looser ethical and social norms, making users more prone to hostile behaviors [47]. Second, harassers in the offline world can generally be identified via physical features. Yet, it is challenging to track and identify online harassers due to the lack of physical presence [4, 57]. This makes online users more vulnerable and suffer excessive emotional distress [15, 20, 73]. In addition, compared to 2D social media sites or online forums, virtual worlds and online gaming may lead to even higher risks of online harassment due to the use of 3D avatars (e.g., through avatar customization and avatar-mediated communication) [23, 28, 31, 61, 71, 79].

Though all online users face risks of harassment, it is more likely for individuals who are considered as marginalized in tech spaces to experience online harassment [22, 29, 48, 56, 92]. Marginalization, broadly defined, refers to the inadequacy of power in society, economy, and policy [8, 9]. In tech spaces such as the U.S. gaming culture, women, LGBTQ individuals, racial/cultural minorities, and persons with disabilities are often considered as marginalized due to various social, economic, physical, and cognitive stigmas [14, 31, 38, 61, 77, 79, 80, 85]. Prior research has highlighted that women not only encounter more harassment but also experience "wider variety of online abuse" in online gaming [31, 48, 61, 92]. LGBTQ and ethnic minorities also encounter more

harassment compared to non-LGBTQ or White communities [56]. For example, one-in-four black users experience online harassment because of their race [29]. Trans users often encounter online harassment when they disclose their gender identity [24, 76, 80]. In online gaming and virtual worlds, such risks are even higher [14, 24, 38, 76, 77, 80, 85].

Therefore, a large body of CSCW and HCI research has explored strategies, mechanisms, and technical features to protect users from online harassment in diverse online social spaces [74, 87, 88]. Examples include reporting mechanisms through which a user can describe another user as a harasser [2, 11, 26, 86, 88], algorithms that detect certain types of harassing language and text [25], Twitter's block list [41], participatory design for cyberbullying mitigation and prevention solutions [3, 66], automatic frameworks in online games such as issue warnings and muting or banning a player [84], and content moderation on live streaming and online forums [41, 78, 91]. Strategies that are specifically designed for marginalized users in tech spaces have also been identified, such as gender specific coping strategies for women in gaming (e.g., not playing with strangers and gender camouflage [23]). To further understand and mitigate new forms of harassment in emerging online social spaces, we now introduce social VR, a novel and increasingly popular technology that may lead to new challenges for understanding, interpreting, and preventing online harassment.

2.2 Social Virtual Reality and Harassment

Virtual Reality (VR) refers to computer modeling and simulation that enables users to interact with an artificial three-dimensional visual or other sensory environment. In VR, the illusion of being in the created environment (i.e., telepresence) is accomplished by motion sensors that track the user's movements in real time.



Fig. 1. Social VR users talking to each other [68]



Fig. 2. AltspaceVR, a popular Social VR platform

VR has only recently become available on the mass consumer market due to the increasing popularity of social VR in the past five years. Social VR refers to 3D virtual spaces where multiple users can engage in immersive 360 degree virtual content and interact with one another through VR head-mounted displays (HMDs) [62, 63]. It can be traced back to the concept of collaborative virtual environments (CVEs) [10] and has become a popular digital social space where people meet, interact, and socialize in new and more immersive ways. Social VR users can conduct and enjoy real life social activities such as walking in public space, playing a game, watching a movie, participating in a concert, and having a party in a highly realistic simulated 3D virtual environment through full body tracking (i.e., one's avatar body actions correspond to their physical body actions in real time) (Figure 1). Examples of popular social VR platforms include AltspaceVR (Figure 2), VRChat, Rec Room, Meta Horizon, High Fidelity VR, and so forth. They also tend to provide diverse activities and social atmospheres. For example, Rec Room focuses on VR gaming; VRChat supports a wide range of creative activities and avatar customization; AltspaceVR is well known for its diverse types of event and professional development; Meta Horizon emphasizes virtual interaction

with people who are already friends; and High Fidelity VR highlights large-scale public events and performances [62].

The boom of these commercial social VR platforms has led to growing HCI and CSCW literature on social VR. These studies have focused on design strategies [42, 62, 83], communication modes and interactive activities [33, 34, 49, 54, 63, 64], long-distance couples' and children's experiences [51–53, 95], and self-presentation and avatars [5, 6, 36, 37]. How social VR may introduce unique opportunities and challenges to understand and mitigate new forms of online harassment has also become an increasingly important research agenda [12, 81]. Compared to avatar-mediated communication on screen (e.g., in traditional online gaming and 3D virtual worlds), social VR offers full-body tracked avatars that allow for real-time and embodied interaction similar to face-to-face communication, rather than merely looking at a computer screen. It also provides a broader spectrum of communication modes, including both verbal and non-verbal interactions such as voice, gestures, proxemics, gaze, and facial expression. These unique characteristics not only support new forms of immersive interaction experiences but also lead to potential risks of online harassment beyond the traditional text or voice based harassment in online social spaces [11].

It has been reported that the sense of presence, body tracking, synchronous voice conversation, and the simulated touching and grabbing features in VR could risk potential harassment [12, 32, 93]. Compared to traditional VR that largely focuses on single-player games or applications, harassment that occurs in social VR may be felt even more immersive and thus destructive due to social VR's focus on supporting open virtual worlds, simulating familiar social contexts (e.g., multi-user events), and attracting a broad range of users. For example, Shriram and Schwartz's survey highlighted the concerning fact of increasing harassment in social VR: two out of seven women and 21 out of 99 men reported that they had experienced harassment in social VR, and 42% of participants said they witnessed someone else being harassed [81].

Grounded in prior work on online harassment, marginalized tech users' experiences of harassment, and the uniqueness of social VR, we consider it important and necessary to empirically investigate emerging harassment across different social VR platforms for three reasons. First, social VR's unique focus on embodiment and immersion may lead to new characteristics of harassment that harm social VR users' online experiences (RQ1). Yet, prior studies on harassment in social VR tend to either focus on just one social VR platform or only use surveys. For example, Blackwell et al.'s interview study reported findings of harassment in Facebook Spaces (now discontinued) [12] and Shriram and Schwartz reported findings of a survey without providing in-depth qualitative insights of how users of various social VR platforms may perceive, experience, and cope with harassment.

Second, compared to other populations, individuals who are often considered marginalized in tech spaces (e.g., gaming in the U.S.), including women, LGBTQ users, and ethnic minorities, may experience higher risks of harassment in social VR (RQ2). For example, the high cost for purchasing a high end VR headset (which is required for fully experiencing a social VR space) such as a HTC Vive automatically creates marginalization among its users to a certain degree based on who can afford the device. This makes social VR still a Westerner/English-dominated world as these users are more likely to afford a VR headset [12]. In addition, women are underrepresented in social VR because they are often concerned about safety and the potential harassment [12, 70]. However, existing work has not paid specific attention to these users' experiences and their unique challenges in social VR.

Third, traditional methods for mitigating harassment in other online social spaces (e.g., reporting) may not work well in the more novel and nuanced social VR spaces. In previous studies, moderators and community-led regulations have been proposed as a potential solution for preventing and mitigating harassment in social VR [12]. Nevertheless, how users may react to these recommendations

and/or propose other new strategies and design directions would still require an in-depth empirical and critical analysis (RQ3).

3 METHODOLOGY

Recruitment. 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. All members of the research team received appropriate training in the protection of human subjects in research. At all times, protecting participants' privacy and confidentiality were the standards for data and metadata format and content in this project.

As mentioned at the beginning of this paper, we endeavor to explore new characteristics of harassment that all social VR users may face. We also especially attend to social VR users who are already often considered as marginalized in tech spaces, such as gaming in the U.S. (e.g., women, LGBTQ users, and ethnic minorities), since they are the common targets of online harassment. Therefore, we used several recruitment methods to reach both general social VR users and those who may be considered as marginalized in social VR spaces. First, we posted recruitment messages on nine popular English online forums for general social VR users (e.g., Reddit-Recroom, Reddit-AltspaceVR, and Reddit-VRChat) to recruit participants who had frequently engaged in any social VR platforms/applications/environments. Second, we directly recruited participants by entering popular social VR spaces (e.g., AltspaceVR and VRChat) to ask random users whether they would be interested in participating in this study. Third, we posted recruitment messages on LGBTQ focused English online forums (e.g., Reddit - LGBTQ and Reddit - Queer) to recruit social VR users who self-identified as LGBTQ. We also used a snowball sampling method to recruit social VR users who self-identified as women and/or ethnic minorities. All participants who responded to our requests and agreed to participate were interviewed (N=30).

Participants. Among the 30 participants, 21 self identify as cisgender men, five as cisgender women, and four as transgender woman. Of the 29 participants who share their ethnicity, 21 self identify as White, two as African American, four as Asian, and two as Latino. Two participants (P26 and P27) self identify as disabled users. In total, 17 out of the 30 participants in our study self identify as individuals who are often considered as marginalized in tech spaces (e.g., women, LGBTQ, and ethnic minorities).

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; SD=10.7). Three participants only exclusively used VRChat and 27 participants were frequent users of more than one social VR platforms to explore different social activities – e.g., VRChat for creative activities and experimenting avatars, Rec Room for playing VR games, and AltspaceVR for workshops and meetups. Platforms that participants had frequently used include Rec Room (N=27), VRChat (N=27), AltspaceVR (N=17), High Fidelity (N=5), Facebook Spaces (N=1), vTimeXR (N=1), Engage VR (N=1), Mozilla Hubs (N=1), Sonoroom (N=1), Pokerstar (N=1), Oculus Rooms (N=2), Sansar (N=1), Anyland (N=2), Echo Arena (N=1), among others (N represents the number of participants who mentioned a given platform).

They spent 5 to 80 hours on these platforms per week (average: 16.3; SD=17.9). Participants also reported that they typically owned rather than borrowed or rented their VR headset(s). Only one participant mentioned that he did not own a personal VR headset but had frequent access to such devices through work. Popular VR headsets that participants owned include desktop based high end VR headsets such as HTC Vive (N=13) and Oculus Rift (N=10), stand alone VR headsets such as Oculus Quest (N=15) and Oculus Go (N=5), VR headsets for mobile phones such as Gear VR (N=2), and low end headsets such as Google Cardboard (N=2) (N represents the the number of participants who mentioned a given device). Table 1 summarizes the demographic information of the participants.

The majority of participants in our study ($N=25$) also reported that they often constructed and used their primary social VR avatars in a way similar to their physical self regarding gender, ethnicity, skin tone, facial features, and so forth. They explained that they were motivated to do so because they felt more engaged, intimate, and personal with their avatars in social VR compared to traditional virtual worlds and online games due to full body tracking and more immersive experiences. Five participants mentioned that they occasionally used avatars of a different gender or non-human avatars (e.g., a robot or a bird) for fun. These insights have been reported in our prior works [36, 37]. These information also provide an important context for this study: these participants' gender and ethnicity in the offline world can often be identified in social VR due to the close similarity between their avatar presentation and physical self, which may lead to potential harassment.

Interviews. We conducted semi-structured in-depth interviews with the participants. 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 as well as devices and social VR applications that participants used most. The main interview questions were related to their social interactions and relationship building in social VR, important activities and social experiences they conducted in social VR, and their perceptions and understandings of social VR's unique technical and experiential characteristics.

All participants were asked the same set of interview questions regardless of their demographics. Interview questions were designed to both cover people's overall experiences in social VR and capture the unique challenges for individuals who are considered as marginalized in these virtual spaces. Example questions that were relevant to this study included "*Have you ever encountered harassment in social VR?*", "*Is racism or sexism common in social VR?*", "*What do you usually do when you encounter harassment in social VR?*", "*What social VR features help you deal with harassment?*", "*What new features do you think we need to protect people from harassment in social VR?*". We understand that harassment is a culturally sensitive construct and social VR may lead to new characteristics of online harassment that have not been extensively studied before. Therefore, in the interviews, we did not offer a specific definition of harassment but encouraged participants to freely recount and share as much detail as they felt comfortable and appropriate regarding what they personally perceived, understood, and experienced as *harassment* in social VR.

Data Analysis. We used an empirical, in-depth qualitative analysis [18] of the collected data to explore how participants experienced and dealt with harassment in social VR. Our analytical procedures focused on eventually yielding concepts and themes (recurrent topics or meanings that represent a phenomena). We endeavored to identify recurring themes of interest, detect relationships among them, and organize them into clusters of more complex and broader themes. Therefore, we did not seek inter-rater reliability in our analysis – because even if coders agreed on codes, they may interpret the meaning of those codes differently [60].

Our analytical procedures included the following steps. First, two of the authors closely read through the collected data to acquire a sense of the whole picture as regards how social VR users perceive, experience, and handle harassment. Second, these two authors highlighted interview questions that were relevant to each RQ and identified a set of initial thematic topics and sub-themes (e.g., perceptions, experiences, strategies, and outcomes) emerging in participants' answers to these interview questions. These themes focused on new characteristics of online harassment emerging in social VR (RQ1), how participants, especially those who are considered as marginalized in social VR such as women, LGBTQ individuals, and ethnic minorities, experience these new characteristics of harassment (RQ2), and diverse strategies to mitigate these emerging harassment in social VR

Table 1. Demographic Information of Interviewees

ID	Gender	Age	Ethnicity	Experience (months)	Usage Frequency (hours per week)	Social VR platforms used
P1	Cis Man	19	White	12	7	Rec Room, VRChat
P2	Cis Man	23	White	18	30	Rec Room, VRChat
P3	Trans Woman	30	White	6	20	AltspaceVR, VRChat
P4	Trans Woman	32	White	6	7	VRChat, Rec Room
P5	Cis Man	29	White	30	10	VRChat, AltspaceVR, Rec Room
P6	Cis Man	29	White	4	10	VRChat, AltspaceVR, Rec Room
P7	Cis Man	18	Asian	10	20	AltspaceVR, VRChat
P8	Cis Woman	27	White	12	15	VRChat, Rec Room
P9	Cis Man	24	n/a	24	4	VRChat, BigScreen, AltspaceVR, Rec Room
P10	Cis Man	20	Asian	n/a	5	AltspaceVR, VRChat, Rec Room, High Fidelity, Facebook Spaces
P11	Cis Man	21	White	5	3	AltspaceVR, VRChat, Rec Room
P12	Cis Man	49	Asian	24	30	VRChat, Rec Room
P13	Cis Man	46	Black	36	5	VRChat, vTimeXR, BigScreen
P14	Cis Man	32	Hispanic	24	5	AltspaceVR, Engage VR, Rec Room, Mozilla Hubs
P15	Cis Man	26	White	36	20	Rec Room, VRChat
P16	Cis Man	65	Hispanic	24	7	Sansar, AltspaceVR, Rec Room, Decentraland, High Fidelity, Sonoroom, vTimeXR
P17	Trans Woman	26	White	18	20	VRChat
P18	Cis Man	55	White	30	15	Sansar, High Fidelity, VRChat, AltspaceVR
P19	Cis Man	43	Asian	36	5	VRChat, Rec Room, PokerStars VR
P20	Cis Man	20	White	24	12	VRChat, Rec Room, Pavlov VR, BigScreen
P21	Cis Woman	45	White	n/a	n/a	VRChat, AltspaceVR, Somnium Space, High Fidelity
P22	Cis Man	32	White	18	8	VRChat, Rec Room, BigScreen
P23	Trans Woman	21	White	24	3	VRChat, High Fidelity, AltspaceVR, Rec Room, BigScreen
P24	Cis Woman	27	White	6	10	AltspaceVR, VRChat
P25	Cis Woman	20	Asian	9	6	VRChat
P26	Cis Man	30	White	6	10	VRChat, Rec Room, AltspaceVR
P27	Cis Man	45	White	n/a	4	AltspaceVR, Oculus Rooms
P28	Cis Man	48	White	24	10	VRChat, Rec Room, AltspaceVR, Anyland, Sansar, NeosVR, High Fidelity
P29	Cis Woman	21	Black	24	20	VRChat
P30	Cis Man	43	White	36	7	AltspaceVR, VRChat, BigScreen, PokerStars VR

Note: n/a - participant preferred not to answer

(RQ3). Third, a shared spreadsheet was used to document, combine, and refine these themes and sub-themes per research question by color coding. Fourth, all authors collaborated in four rounds of an iterative coding process using the shared spreadsheet to discuss, combine, and refine themes and features to generate a rich description synthesizing participants' perceptions and experiences of harassment in social VR.

4 FINDINGS

In this section, we divide our findings into three parts to report our participants' experiences of harassment in social VR as well as their coping strategies and recommendations for designing future social VR platforms to better mitigate potential harassment.

4.1 New Characteristics of Emergent Online Harassment in Social VR

In our interviews, participants acknowledged that they were somewhat uncertain about the standard expectations for appropriate behaviors in social VR due to the lack of clearly defined social norms in these nuanced virtual spaces. P2 (cis man, White, 23) describes, *"you can clap, you can handshake, and you can hug. It is very realistic. But can you slap people or go to hug everyone? I don't know and no one told me yes or no. Some people may think it is just like a game but some people may think it's real because it's so realistic."*

As a result, when answering questions about how they experienced harassment in social VR, participants tended to describe *any interaction or experience that intentionally upset them and cause harm, aggravation, anxiety, and instability* as harassment. Collectively, they highlight four main characteristics of harassment across different social VR platforms: 1) physical behaviors aiming to disturb others can be a form of harassment due to social VR's physicalized nature; 2) forced attention can be a form of harassment due to the predominant use of voice chat in social VR; 3) invading personal space can be a form of harassment because of social VR's focus on embodied interactions; and 4) children can harass adults because of the complex interaction dynamics between different age groups in social VR.

4.1.1 Physical Behaviors Aiming to Disturb Others as Harassment due to the Physicalized Nature of Social VR. Social VR creates an immersive social world by providing 3D graphical fidelity similar to the physical world. With full body tracked avatars and six degrees of freedom – a combination of rigid body and full-body tracked movements, social VR users are able to engage in activities and experiences that resemble face-to-face interactions in the physical world (e.g., dancing, playing basketball, and racing). While our participants appreciate the physicalized nature of social VR, they also note that this novel feature may lead to new characteristics of harassment compared to social media or traditional virtual worlds where physicality is absent. They point out that simulated physical behaviors aiming to disturb others, such as running around, shouting, and blocking views could be new forms of harassment in social VR for two reasons. First, these behaviors intentionally undermine the overall social atmosphere in social VR by ruining all nearby social VR users' ongoing social interaction. Second, they may evoke particularly destructive consequences for certain users.

For example, about half of the participants report that they feel harassed when someone intentionally disturbs everyone in social VR by running around and shouting, as such behaviors threaten everyone's social experience. P23 (trans woman, White, 21) and P18 (cis man, White, 55) share their experiences in VRChat:

"I've seen friends getting harassed. I've seen people trying to ruin others' days by running around shouting horrible things. Some people just want to mess with you. They just target you for no reason. Social VR should not be like this." (P23)

"I have experienced harassment in social VR. There are random people who are just trying to be obnoxious to everyone all the time and all at once. They just run around screaming slurs. They are not screaming at me but all the people in general. That's pretty much harassment and it's one of the worst. " (P18)

In P23's case, she feels harassed not because such behaviors specifically aim at her but because they disrupt the overall social atmosphere in the VRChat community where she is part of. P18, a cis White man, expresses similar sentiments. For him, running around and screaming is a sign of being "*obnoxious to everyone*," which is clearly a form of harassment to him. He also views such behavior as quite severe because it targets everyone "*all at once*".

Five participants add that intentionally blocking one's viewpoint in social VR is harassing to some degree, citing the same argument that such behaviors ruin others' experiences on purpose and make people feel unsafe. P30 (cis man, White, 43) reveals his experience in BigScreen:

"I was watching a movie with someone in BigScreen. But a young lady tried to stand in front of us and draw all over our faces so that we couldn't see the screen. I was not sure why she was doing that but I did feel somewhat harassed. [...] I feel I become a target for something."

As a cis white man, P30 felt that he was harassed by a woman in social VR. Though this user did not directly verbally or physically attack him *per se*, P30 did feel becoming a target of certain unwanted activities and his ongoing action (e.g., watching a movie with friends) was interrupted intentionally by others. This thus made him feel unsafe and harassed.

These physical behaviors can even have more destructive impacts on certain users, such as newcomers or people with anxiety. For newcomers, first experiences are important to feel comfortable and welcomed on a social VR platform. Yet, six participants describe their first experience on some social VR platforms as hostile and provocative because strangers chase and shout at them. P1 (cis man, White, 19) explains that he does not want to enter Rec Room for a long time because a huge group of strangers surrounded him and shouted swear words and slurs when he first entered the space, making him feel quite threatened and unsafe. P3 (trans woman, White, 30) also shares that one of her friends had a panic attack due to anxiety caused by loud shouting and noise in VRChat:

"Last week one of my friends who has bad anxiety issues started having a panic attack in the room because someone continued to shout and play very loud and bad music. We had to take him somewhere quiet and block all avatars except for his friends to calm him down and get him back to a baseline state. This is a terrible experience for my friend."

In summary, participants tend to interpret physical behaviors to disturb others as threats to all users. For them, such behaviors not only destroy the overall social atmosphere in social VR but also may evoke disturbing and negative experiences of anxiety, panic, and unsafety.

4.1.2 Forced Attention as Harassment Due to the Predominant Use of Voice Chat. The predominant way for most users to communicate with one another in social VR is to use its synchronous voice chat. However, at least 12 participants express concerns that the predominance of voice chat in social VR may lead to harassment. For example, everyone nearby is forced to pay attention to the content in the voice chat regardless of their willingness. Participants mention that sometimes, they are forced to listen to others' inappropriate or crude jokes, which makes them feel oppressed and thus harassed. In the offline world, telling jokes that are not funny may be considered as "boring" or "annoying" but not a form of harassment. Yet, these participants feel that this behavior can become a way to harass people in some situations. As P11 (cis man, White, 21) points out, he feels that any forced, involuntary, and unpleasant experiences in social VR can be a form of harassment.

P27 (cis man, White, 45) further explains that he was forced to listen to others' racist slurs toward a group of social VR users:

"I was just standing next to this group of people who were talking about a religion, like just someone was talking about his religion and stuff. I did not know this group but I was listening because I didn't know much about the religion and I was curious. Then someone just came and started verbally attacking this group, like really racist stuff, because that person did not like that religion. It was so bad that even though I was not part of the group, I felt I was harassed as well.

In this example, the harasser's racist attack aiming at a group of social VR users could be heard by all the other users nearby, including P27. While P27 was not part of the direct target, he still felt harassed because these attacks created an intimidating and hostile environment for all social VR users and he was forced to hear the racist comments. Though social VR users can mute others whom they do not want to listen to, they understand the muting feature provided by social VR platforms as more of a reactive rather than a proactive function, which may not work well in the context of forced attention. First, they have already heard the comments and then decide to mute the harasser. In this case, damage has already been made and muting will not make them "unhear" the voice chat that involves verbal attack or trolling. Second, even if they mute a certain user, others surrounding them can still hear that user and then behave accordingly (e.g., joining the harassment). We will discuss these platform tools for mitigating harassment in Section 4.3.

However, some participants are also hesitant to describe forced attention through voice chat as "harassment" despite the similar unpleasant and uncomfortable feelings. For example, P14 (cis man, Hispanic, 32) recalls that people made fun of him when he lost a game in Rec Room. At that moment, he was annoyed and unwilling to interact with those users. Yet, he is also unclear what behaviors or social norms should be considered as inappropriate in social VR. Therefore, he is uncertain whether he should describe such behaviors as a form of harassment or not.

4.1.3 Invading Personal Space as Harassment Due to Embodied Interactions. When designing digital play experiences, proxemics is an important concept that describes the interpersonal distance between players to understand and mediate their interactions with other people [65]. In general, in online gaming or traditional 3D virtual worlds, players may not feel uncomfortable or anxious about close interpersonal distance between their avatars on the screen [94]. However, social VR's unique focus on embodied interactions not only provides more natural and immersive interactive experiences but also makes some users more sensitive to their spatial experience [89]. If one tries to be physically close to another user in social VR without asking for permission, the majority of our participants (N=28) would consider it a potential form of harassment – because it disrupts the social norm of appropriate physical distancing.

For example, P5 (cis man, White, 29) feels threatened if someone suddenly comes physically close to him in Rec Room. In his opinion, this inappropriate distancing indicates an invasion of his intimate personal space. This may lead to "*unsafe*," "*jarring and uncomfortable*" experiences even for a cis white man. P24 (cis woman, White, 27) adds,

"The first negative interaction I had was before I turned on my personal space bubble in AltspaceVR. This guy came up to me really slowly and his face was like right in my face. It felt like that he was trying to kiss me. I don't know if that was harassment but I did feel super uncomfortable and didn't know how to deal with that."

P24 felt harassed when someone tried to get close to her without consent in AltspaceVR. For her, this closeness often signals intimate physical behavior such as kissing, which she obviously does not agree on. In the offline world, a stranger who attempts to perform similar uninvited intimate behaviors on another stranger without consent is often considered as a harasser. In social VR, people seem to hold the same understanding – P24 perceives it as a form of harassment because

her personal space is "*invaded*." Therefore, P8 (cis woman, White, 27) suggests that the excessive closeness between people who are not close friends should be viewed as a form of harassment in social VR. In her opinion, the appropriate code of conduct in social VR should be maintaining a reasonable physical distance between each other. This should be a norm of courtesy instead of cuddling or snuggling strangers without even asking.

4.1.4 Children Can Harass Adults Due to the Interaction Dynamics between Different Age Groups. Social VR platforms are generally open to anyone who ages 13 and older. The diverse and rich activities that these platforms offer have attracted users of different age groups, and particularly a large amount of children. For example, the presence of minors across different social VR platforms has been noted due to either their relatively shorter avatars [12] and/or their higher pitched voices [51]. As a result, unique interaction dynamics between different age groups (e.g., children and adults) seem to emerge in social VR, which normally do not exist in online gaming or other traditional virtual worlds [50, 51].

In our study, participants notice this coexistence of children and adults and express their concerns about potential harassment towards children and the risk of exposing children to inappropriate content in social VR, as our prior work have reported [51, 52]. However, around half of the participants also share concerns about how this may lead to children harassing adults as a new form of harassment in social VR. They cite the increasing popularity of social VR technologies within the younger population and the absence of appropriate guidance as potential reasons for such harassment. For example, P1 (cis man, White, 19) and P17 (trans woman, White, 26) highlight:

"Someone has been really rude to me and others and they seem to be really young. I think this is mostly a problem in rec room as kids don't use the junior accounts. I'm very uncomfortable in these situations." (P1)

"Yeah I have been harassed in VRChat, usually by kids. They're just out of control. They have access to this technology and think they can do everything, including harassing people with no consequences. And few people can tell them what they should do and shouldn't." (P17)

In P1's experience, often times rude behaviors in Rec Room are done by children. He considers such behaviors a form of harassment that makes him "*very uncomfortable*." In his opinion, as social VR grows into popularity and attracts a wide range of audience, it would be more appropriate for younger users to use junior accounts, or having separate social spaces designed for younger and adult users respectively to better cater to different age groups' interests and behaviors. However, the design of most existing social VR platform does not adequately separate children and adults. P17 further points out the dilemma between children's increasing access to novel technology and the urgent need to teach them how to use such technology appropriately. This dilemma seems to make children harassing adults a concern to people like P17, as she feels that children do not understand "*what they should do and shouldn't*" in social VR.

Others also describe the mismatch between children's and adults' understandings of *play* as another potential reason for children harassing adults. According to P6 (cis man, White, 29), children in social VR seem to have rambunctious and playful attitudes. For them, behaviors such as running around, following adults, and screaming may not appear to be troubling but a form of *play*. However, for P6 and other adult users, these behaviors can significantly disturb their experiences and make them feel harassed.

While these participants perceive children's certain behaviors as harassing, they still consider them "*not a big deal, just irritating*" (P23, trans woman, White, 21) compared to some other forms of harassment. However, some participants acknowledge that these behaviors can have quite negative

impacts on adults in some situations. P14 (cis man, Hispanic, 32) mentions that he was even forced to leave the VR environment:

"Harassment happens quite a lot and most when there are kids. These kids would try to break the game and get super tall or super short or screaming and doing silly stuff. That's not the thing and I'm here for. So I will even go away from the room and go to another room."

A unique characteristic of social VR is that users can experience first person point of view from different heights and experiment such view with different body orientations. These features tend to be extremely appealing to children, making them more prone to experimenting and exploring their surrounding environment. To adults such as P14, this can be perceived as disrupting and harassing, which undermines their social VR experiences and sometimes even make them leave the environment. This further demonstrates the emerging tension in the adult-children interaction dynamic in social VR we mentioned above: while children may regard certain behaviors as exploratory, fun, and enjoyable, adults can interpret them as harassment.

In summary, all social VR users are likely to face these new characteristics of potential harassment, such as physical behaviors to disturb others, using voice for forced attention, using the nuance of embodiment to invade one's personal space, and the aggravation between different age groups. In the next section, we turn our attention to how users who are often considered marginalized in social VR (e.g., women, LGBTQ, and ethnic minorities) may experience additional challenges of online harassment.

4.2 Marginalized Social VR Users' Experiences of Harassment

In tech spaces such as gaming in the U.S., harassment that specifically targets users based on their gender and ethnicity happens often, making women, LGBTQ individuals, and ethnic minorities marginalized in these contexts. Social VR is no exception. Our participants who self identify as women, LGBTQ, and ethnic minorities also highlight that they experience harassment in a more disruptive way in social VR. First, these users' gender and ethnicity become more identifiable because of the combination of avatar design and voice. Second, women may feel more vulnerable due to the increased unreasonable expectations for traditional gender roles. Third, there seems to be a higher risk of stalking even out of social VR as a form of harassment due to the personal cues revealed in embodied interactions.

4.2.1 Marginalized Users Become More Identifiable Due to the Combination of Avatar Design and Voice. In other online social spaces such as social media, online gaming, and traditional virtual worlds, the general online *anonymity* often shields users from potential harassment – e.g., users can easily hide their gender identity and ethnicity if they want. In contrast, social VR users seem to create their avatars in a way similar to their physical self regarding gender, ethnicity, skin tone, and facial feature, as our prior work has shown [36, 37]. This similarity between their avatar and physical self makes their offline gender and ethnicity more identifiable in social VR. The combination of full body tracked avatar and voice chat also adds to such identifiability. As a result, people who are already considered as marginalized in traditional tech and gaming spaces may face harassment in an even more disruptive way.

First, these users become easy targets for explicit racist attacks. P10 (cis man, Asian, 20) explains how he encountered racism in AltspaceVR because he used an Asian avatar to represent his Asian origin:

"I had two experiences of pretty bad racism against Chinese Americans in AltSpaceVR. 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 this case, P10's avatar choice made him an easy target for racism despite he did not do anything wrong to trigger such prejudice. Potential harasser easily identified him, a Chinese American, simply based on his avatar design (i.e., an Asian avatar). Even if a user chooses not to disclose their ethnicity by using a generic or non-human avatar, their voice may still reveal cues about ethnicity or country of origin, leading to potential racist attacks. P16 (cis man, Hispanic, 65) points out the drawback of voice:

"People can figure out lots of things from your voice, like your race or where you are from. [...] Just a few days ago, I was on AltSpaceVR. 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 directly present their ethnicity or present a different ethnicity by crafting their avatar appearance in social VR, others are still able to identify their race through voice or accent. This can lead to racism towards non-native English speaker or non-white users based on their country of origin.

Second, women and LGBTQ users can be identified as the targets of misogyny and homophobia. Even cis man users such as P2 (Cis Man, 23, race unknown) note that people who use feminine avatars are often identified and harassed. In particular, voice has been frequently used 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. Therefore, it can also be used to identify women as potential targets for harassment. P8 (cis woman, 27, White) explains that she was harassed based on her voice in VRChat:

"I asked them why they were harassing me and they said it's because of how I talk. They don't seem to have a reason. They'll put me down because I'm a woman. They usually try to hone in on my voice. Women get harassed more. Even in the LGBT groups, they make fun of my voice."

P8's voice, more than any other identifiable feature, leads to harassment towards her gender. Even other marginalized communities (e.g., LGBTQ groups) who faced similar risks of harassment took part in harassing her because of her voice.

Trans woman users face additional risks. P23 (trans woman, White, 21) understands gender as a complex phenomenon that is perceived and understood differently depending on the culture and society. She explains her experience in Rec Room as a trans user:

"Gender is a weird thing. It's like there's different cultures and different expectations. For example, when I've worn a character with a dress in Rec Room, I get 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?" It's very uncomfortable".

Based on P23's account, she is harassed because people identify her as a transgender user based on her voice. Despite her efforts to present herself as a woman (e.g., wearing a dress), her voice still seems to trigger judgements and potential harassment.

4.2.2 Women Feel More Vulnerable Due to the Increased Unreasonable Expectations for Traditional Gender Roles. As an emerging high tech, social VR is often perceived as male-dominated [12]. This masculine culture seems to make women feel vulnerable and create two main barriers for women to engage in social VR.

Our participants highlight the traditional male-dominated gaming culture as one of the main barriers. For example, P5 (cis man, White, 29) thinks that women may face additional challenges

and potential harassment if they enter certain areas of social VR, such as gaming. Since Rec Room is a gaming-centric social VR platform, it is also influenced by the notorious gaming culture in other platforms (e.g., MMOs) where women are not always welcomed and respected. In this sense, women may experience even worse harassment in social VR compared to traditional online gaming due to "*the presence and immersion*" (P5).

Even in social VR platforms that are not gaming-focused, women may be easily harassed due to the unreasonable expectations for traditional gender roles in tech spaces. This becomes another main barrier for women to enjoy social VR. P8 (cis woman, White, 27) shares her experience of being harassed in VRChat simply because she is both a social VR user and a mother with a child:

'I'm harassed because I'm older and I'm a woman and I'm a mother. Those people think it's strange that I'm not with my kid. They'll ask why I'm not with my child. And then they started to judge me and harass me because they automatically assume I'm leaving some sort of obligation by being in VR. This is so strange.'

P8 experiences harassment based on how others perceive her traditional gender role and responsibilities. Without knowing her actual life, other users automatically comes to the conclusion that she is irresponsible simply because she is a mother who also engage in social VR. For her, this is clearly a form of bias and discrimination because of her gender.

These unreasonable expectations for traditional gender roles also make trans woman users targets of potential harassment. In P23's (trans woman, White, 21) example we mentioned in the previous section, her presentation in social VR (e.g., wearing a dress) is consistent with her offline gender identity. Yet, for some other users, this is inconsistent with their expectations for traditional binary genders (e.g., only women can wear dresses and a woman should not have a man's voice), leading to harassment targeting P23.

4.2.3 Higher Risks of Harassment out of Social VR. Social VR platforms offer nuanced and multimodal means to identify and verify cues about gender and ethnicity from one's self-presentation – e.g., as a combination of voice, appearance, and behavioral patterns. Yet, these cues may also reveal personal information that would have not been easily disclosed in other anonymous online platforms (e.g., facial features and location). As a result, some marginalized social VR users experience higher risks of stalking out of social VR, which they perceive as a severe form of harassment. P25 (cis woman, Asian, 20) describes such a risk:

'One case of harassment was that a guy had found almost all my social media user names. Once he knew I'm a woman, he had found all of that. He wanted to follow me on everything even though I hadn't given any consent to him. He wanted to follow me on Instagram, add my Snapchat, and so forth. [...] This was truly unacceptable and made me feel unsafe. What if he found out where I was living?'

To P25, a person she met in VRChat and stalked her on all her social media out of social VR is clearly a harasser. For her, such behavior can be transformative and escalated: instead of stalking her online, her harasser could have started stalking her offline ("*what if he found out where I was living?*"). She also adds that her friend's similar experience:

'He would join her in every server she was in. He would constantly ask for her social media. He would claim to other people that they were dating and that he knew her in real life and all that. he would even join when he was drunk sometimes and he would harass her. I would definitely count this as harassment. My friend felt so uncomfortable and sometimes scared but there was nothing she really could do other than blocking him because again, there is not much regulation in VRChat.'



(a) Personal Space and Bubble quick controls

(b) User add, block, and mute controls

Fig. 3. AltspaceVR's safety features

These cases show that it seems to be easy to disclose or identify cues about one's offline identity in social VR. Even after P25 and her friend exit the social VR application, these cues can still help the harasser continue the harassment on other online platforms and ruin other aspects of their lives out of VR. For them, such portability makes harassment in social VR quite disruptive and damaging. P25 and her friend's experiences also show the challenges to regulate harassment in social VR (*"there is not much regulation in VRChat"*), which we will discuss in the next section.

4.3 Strategies and Recommendations for Mitigating Harassment in Social VR

In this section, we focus on strategies and recommendations that our participants suggest to prevent emerging harassment in social VR.

4.3.1 The Use of Personal Techniques & Platform Tools. In general, participants depend on two types of strategies to mitigate potential harassment in social VR: employing unique personal techniques, and using platform specific tools.

Personal Techniques. Ten participants mention *avoiding sharing personal information* as an effective and commonly used personal technique to mitigate harassment in social VR. For instance, P25 (cis woman, Asian, 20) explains that she prefers to stay anonymous because this strategy prevents people from learning anything about her. She believes that this strategy can significantly limit the type and frequency of harassment that could ever happen to her. P20 (cis man, White, 20) employs a similar strategy to carefully avoid disclosing information about the country or area where he lives. For him, not disclosing such information can prevent harassment or discrimination towards him based on his location.

Some participants even go so far as to not share any personal information at all. For example, P30 (cis man, White, 43) believes that even user names should only be shared with people whom he knows. This may protect him from potential harassment since people will not be able to find him on other online platforms (e.g., social media) by searching his username.

More than half of the participants mention that they would just *leave a world, room, or situation where they might encounter harassment*. This becomes another popular personal technique to protect them from harassment. According to P20 (cis man, White, 20), simply running away may not be a feasible strategy in the offline world to deal with potential harassment. Yet, "*vanishing*" in social VR is in fact effective to help people avoid potential harassment. In addition, social VR provides features such as teleportation and portal hopping to transfer one's avatar into another virtual location within seconds. This feature can help users like P20 "escape" even more efficiently and limit the damage that any potential harassment may lead to.

Platform Tools. Participants also rely on several tools provided by social VR platforms that are specifically designed to prevent harassment. Such tools include *muting*, *blocking*, and *a personal space bubble* as shown in Figure 3. By muting, a user will no longer hear a potential harasser's voice. This prevents verbal attacks or hate speech. By blocking, a potential harasser will be completely removed from a user's surroundings and will no longer be seen by this user. By using a personal space bubble, one can prevent others from getting too close physically.

All participants note that they have used or seen others using these platform tools before. They also emphasize that people tend to use different tools to protect themselves from harassment based on specific situations and contexts. For instance, P22 (cis man, White, 32) mention that he uses blocking and muting under various circumstances:

"Most of the time I just block them. Like if someone's harassing me or harassing others with horrible language. Sometimes if it's not severe enough, I'll just mute them."

How P22 chooses a harassment prevention tool depends on the degree of perceived severity of the potential harassment. For him, different tools are designed to manage various levels of harassment. For example, a complete blocking would be needed for the highest level of harassment while muting is sufficient "*if it's not severe enough*." However, he also acknowledges that there is no definite and objective criteria to judge the severity of harassment in social VR - it all depends on the involved user's personal decision.

In fact, eight participants comment that blocking may be the most effective method to deal with harassment in social VR. This feature not only mutes a potential harasser but also makes them disappear from the victim's view. In this way, the harasser can no longer verbally or physically attack the targeted victim.

Ten participants also highly praise the use of personal space bubbles in Rec Room and VRChat. P4 (cis man, White, 32) explains that maintaining an appropriate personal distance is important to mitigate potential harassment. Without getting too close to the victim, the harasser can not perform physical attacks and/or deliver hate speeches or discriminatory comments. In this sense, using a personal space bubble seems to be a more proactive method to mitigate harassment. It avoids harassment *before* it could even happen rather than responding to ongoing harassment using blocking or muting.

However, some participants express their hesitation to use these platform tools because they do not want to be seen as "*confrontational*" (P26, cis man, White, 30). As P26 suggests, many of his friends do not want to block people because they feel uncomfortable when directly confronting someone (e.g., taking actions to block a person).

4.3.2 User Recommendations for Mitigating Harassment in Social VR. Our participants strategically use several personal techniques and platform tools to deal with potential harassment in social VR. Yet, they still consider that the current design of social VR platforms should be improved to better mitigate and prevent harassment. They propose two major recommendations for the future design of social VR systems: 1) refining the reporting mechanism by allowing for adding contextualized information, enforcing consequences, and making reporting more accessible; and 2) providing a more nuanced moderation mechanism with privacy and scaling considerations.

Refining the Reporting Mechanism. Reporting has been considered effective for mitigating harassment in online platforms such as social media, online forums, and online gaming [2, 11, 26, 86, 88]. However, many existing social VR platforms provide little to no reporting features. For example, there is no reporting mechanism in Rec Room. Instead, a user can only initiate a "vote-kick" against a target user. This means that if the majority of the users in the same room vote to kick out the target user, they can eliminate and possibly ban this individual from that room.

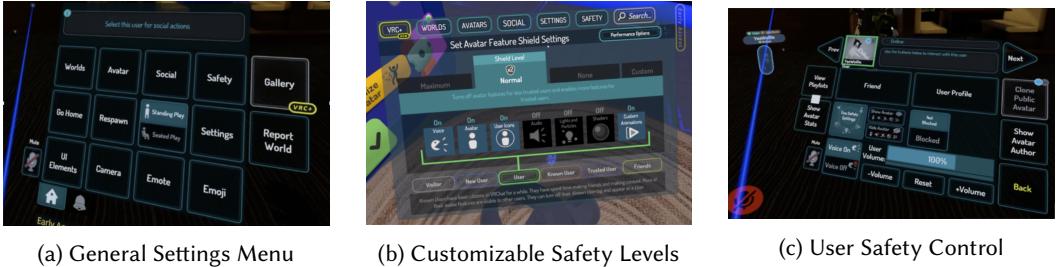


Fig. 4. VRChat's safety features

AltspaceVR only provides an external ticketing system for technical issues, which can also be used to report inappropriate behaviors after users exit VR. VRChat provides a reporting mechanism but it has very limited options for what can be reported, which caters more towards reporting problems of the platform in general rather than an individual, as shown in Figure 4.

According to our participants, one challenge to implement an effective reporting system in social VR is that social VR supports real time synchronous interactions. This means that instances of harassment can be ephemeral, making timely and appropriate documentation difficult. About half (N=12) of our participants complain that they are unable to report the specific reason and context why they block or mute a user in the moment.

For instance, after blocking or muting a specific user, the person who initiates the blocking or muting no longer sees or hears the potential harasser. However, other users still can see or hear and thus be in danger of being harassed by the same user. Therefore, our participants suggest that it may be helpful to refine the reporting mechanism by allowing the reporter to insert the reason why they choose to block or mute a person. It may also be helpful if the victim can document or record the instance of harassment and submit the report in the moment. Adding these features may not only help warn other users about the potential harasser but also allow the harasser to better understand and reflect on their behaviors. As we have shown in our findings, some people do not realize that their behavior is perceived as harassment by others. Rather, they interpret it as fun or play. Knowing why other people report them, therefore, can help them better reflect on their behaviors, make necessary adjustments, and discontinue potential harassing behaviors.

P25 (cis woman, Asian, 20) further highlights two main drawbacks of the existing reporting mechanisms in most social VR systems such as VRChat:

'I wish that the social VR systems take the reports more seriously. Because when you report someone, there's only three options (behavior, speech, and harassment) to check off for reporting someone. And I wish there were at least a little box where you can write what happened. I think there's such a big umbrella with behavior harassment and hate speech, that kind of thing. So whoever you report to don't know the extent of why this person is being reported. If there was a feature that you can explain what had happened, it would be easier on both the user's part and the system's part in what they could do to the person being reported.'

In P25's opinion, reports for harassment in social VR seem not to be taken seriously, which significantly damages the reputation of the platform and lowers user trust. In addition, users are only be able to choose from a pre-determined list of some limited and vague categories provided by the platform to report troubling behaviors. For P25, these categories fail to cover the variety and complexity of harassing behaviors in social VR.

Following P25's complaint about how reports for harassment should be taken seriously, another recommendation is to enforce the consequences of being reported. Participants suggest that limiting the reported harasser's access to social VR for a certain period of time can be a potential consequence. For example, P3 (trans woman, White, 30) suggests that a reporting mechanism without any enforced consequences will not be effective at all to prevent harassment in social VR – because it will not substantially change the harasser's action or behavior. Rather, she highlights that other mechanisms such as reducing power and accessibility as well as temporary or permanent banning should be implemented collectively with reporting to better mitigate harassment.

Lastly, participants emphasize the need to make the reporting process easier and more accessible. P5 (cis man, White, 29) noted,

"Making it very easy for a person to report another person is very important. One of the biggest problems that I've realized about social VR is that people do not know how to report people and where to report if they are harassed. I think people really need to know how to handle harassment because these kinds of experience can really affect you more in VR than in a regular video game."

P5 points out that many users are unaware of any reporting mechanism in social VR. This limits how they can actively protect themselves. Therefore, it is critical for future social VR platforms to improve the accessibility of the reporting mechanism and increase user awareness of such mechanisms.

Providing a More Nuanced Moderation Mechanism. Moderation and moderators have been widely used in various online platforms (e.g., online forums, live streaming, and social networking sites) to monitor inappropriate behaviors/comments and mitigate harassment. Surprisingly, at least 11 participants express concerns about using moderators to mitigate harassment in social VR. For them, simply applying existing moderation models and mechanisms on other platforms to social VR may not work well. Instead, they suggest designing a more nuanced moderation mechanism for future social VR systems by taking privacy and scaling considerations into account.

One major concern that participants mention about using moderators to mitigate harassment in social VR is the subjective biases that a human moderator might have:

"Moderators have their own biases. I've had negative experiences interacting with user moderators in the past." (P3, trans woman, White, 30)

"I don't know if moderators would be helpful because they are biased. Their experience is not your experience. So, they might not be acting in your best interest or your most desired interest." (P11, cis man, White, 21)

"I've seen instances where moderators are more biased than just having their own opinions. They might not agree with you. So I think I personally lean towards enjoying a more free community instead of a moderated one." (P17, trans woman, White, 26)

In all three examples, participants seem to have difficulties in building trust with moderators, citing reasons such as prior negative experiences of interacting with moderators and worries about moderators' personal biases. While they do not absolutely reject the idea of moderation, they feel that it is important to consider how, when, and where implementing moderators can suit the social VR environment best.

This lack of trust also leads to participants' privacy concerns about moderators. For example, P5 (cis man, White, 29) and P13 (cis man, Black, 46) do not reject the idea of using moderation to mitigate harassment all together. However, they warn that this approach may introduce potential privacy risks that must be addressed before a moderation mechanism can be implemented. For

P5, these privacy risks involve the scope and nature of personal information that a moderator can access. P13 is also worried about the uncomfortable feeling of someone constantly "*hovering over everything*." For them, a balance between moderation and the quality of people's social experiences in social VR should be achieved.

Even for participants who are supportive of moderators, they express concerns about scaling. P23 (trans Woman, White, 21) and P30 (cis man, White, 43) share,

"I think moderation is doable. For example, AltspaceVR can have moderators but that's because they're small. I don't think VRChat can do it because they are so big and there are hundreds of instances going on all at the same time. I just don't know how moderation is feasible unless there are thousands of people working on it. I don't know if that's realistic." (P23)

"I don't know if active moderation is possible. I think it's all reactive. I know BigScreen do have moderators but they are, again, reactive. So if you report somebody, the moderator will be here. But there is no way they can actively monitor things because of the scale." (P30)

Participants such as P23 and P30 indeed support the implementation of moderation in social VR. However, they are worried that such moderation mechanisms may only be effective for preventing harassment in a small-scale social VR environment. On that scale, the moderators still have the capacity to manage incidents that occur simultaneously. In contrast, it can be challenging to moderate a large-scale VR environment because moderators may be overwhelmed. In addition, how to make moderation more of a proactive mechanism (e.g., preventing potential harassment from occurring) rather than reactive (e.g., reacting to reported harassment) is important to maintain a safe and supportive social VR environment.

5 DISCUSSION

To answer our research questions, our findings have the following highlights. First, new characteristics of online harassment can jeopardize all social VR users' experiences across different VR platforms. According to our participants, these characteristics include physical behaviors mediated by the physicalized nature of social VR, forced attention as a result of the predominant use of voice chat, invading one's intimate personal space due to embodied interactions, and the possibility of children harassing adults (RQ1).

Second, social VR users who are often considered as marginalized in tech spaces, such as women, LGBTQ, and ethnic minorities, tend to experience harassment in a more disruptive way. It is easier to identify and target them as potential victims due to the combination of avatar design and voice in social VR. The increased unreasonable expectations for traditional gender roles make women and LGBTQ users more vulnerable. Personal cues revealed through embodied interactions also make stalking a severe form of harassment out of social VR (RQ2).

Third, social VR users collectively identify employing unique personal techniques and using platform specific tools as strategies to mitigate harassment in social VR. They also recommend refining the reporting mechanism and providing more nuanced moderation mechanisms for designing future social VR systems (RQ3).

In this section, we first situate our findings in studies of online harassment and social VR in HCI and CSCW to discuss new perspectives of social VR mediated harassment. We then provide a critical reflection on social VR users' perceptions and understandings of harassment both to open up future inquiry and to identify what we view as new characteristics of online harassment that are of value to the broader CSCW research community. Based on user recommendations and our

critical reflection, we also explore potential directions for designing future social VR systems to better mitigate harassment.

5.1 New Perspectives of Online Harassment in Novel Online Social Spaces

Our findings highlight several new perspectives of online harassment emerging in social VR users' own accounts. First, harassment in social VR is perceived as an embodied and immersive form of online harassment. Second, while harassment in social VR may simulate harassing behaviors in the physical world, how social norms in the physical world should also be applied to define and mitigate social VR harassment is unclear. Third, harassment in social VR further reflects the unique challenges that marginalized users in tech spaces are constantly facing.

5.1.1 Social VR Harassment as Simulation vs. Harassment in Traditional Online Gaming/Virtual Worlds. One of the main appeals of social VR is that it goes beyond just interacting via a computer screen – it offers three layers of simulated immersive experiences: (1) it simulates the physical world by providing highly realistic and immersive 360 degree visual content (e.g., a bar, a coffee shop, or a theatre); (2) it simulates a variety of everyday mundane activities that people often conduct in the physical world (e.g., dancing, watching a movie, and even sleeping [49]); and (3) it also simulates how people act and conduct such activities in the physical world. Social VR users not only are equipped with an immersive first-person view through their avatar body but also directly use the motion of their physical body to animate their virtual avatar body. This means that one will need to actually conduct physical activities in the offline world (e.g., dancing and hugging) if they want to conduct such activities in social VR.

Therefore, compared to harassment that has been studied in the context of traditional online gaming and virtual worlds [23, 28, 31, 44, 61, 71, 79], harassment in social VR is regarded as an embodied and immersive form of online harassment by our participants. In both social VR and online gaming or virtual worlds, user communication and interaction is mediated by one's avatar, which may increase the possibility of harassment [71]. However, social VR's focus on simulated immersive experiences may both lead to new forms of online harassment and make harassing behaviors feel more realistic thus more severe and negative. For example, while physical closeness between avatars on a computer screen may not often be considered as harassing in traditional games or virtual worlds [94], our participants perceive uninvited spatial proximity as a serious form of harassment due to the direct correspondence between one's physical body and avatar body. Participants also emphasize the importance of consent in social VR: intimate behaviors such as hugging and cuddling between strangers without consent are considered as harassing, whereas they may be perceived more positively in traditional online gaming and virtual worlds (e.g., a sign of friendliness, care, and personal attachment) [35, 72]. Based on these observations, which behaviors are perceived as new forms of harassment and how people react to such behaviors can be quite different in a social VR environment versus in other online social spaces.

5.1.2 The Vague Role of Social Norms in Defining and Regulating Social VR Harassment. Though our participants tend to understand harassment in social VR as a simulation of harassing behaviors in the physical world (e.g., physical closeness or touch without consent), there seems to be no consensus on whether and to what degree social norms in the physical world should also be applied to social VR. These confusions further complicate why harassment in social VR occurs and how to regulate it.

We found that different social VR platforms were designed to support various types of activities and social atmospheres, including gaming, creativity, public events and workshops, and professional development. Yet, it is unclear if any shared understandings of social norms have been established in these emerging digital social spaces. As we have shown, many people may not have a clear

awareness of what types of behaviors should be considered as (in)appropriate on a specific social VR platform – e.g. should Rec Room be treated as a gaming space where playful and informal behaviors are expected? Should AltSpaceVR be treated as a mature and professional environment similar to offline workplace where people should behave formally? These different expectations for social norms may likely lead to a mismatch in understanding, experiencing, and reacting to certain behaviors and interactions among users, especially those from different age groups and/or cultural backgrounds. For example, previous studies have highlighted several barriers, challenges, and misunderstandings emerging in adult-children interaction in social VR, such as social distancing and frustrations of co-existing [51, 52]. Therefore, certain behaviors and comments can be perceived as harassment by adults but as play, fun, or entertaining by children. Likewise, due to the culturally sensitive nature of harassment, people from different cultures may perceive certain behaviors as harassment (e.g., standing too close) while others may interpret it as friendliness.

In summary, these insights point to the importance of investigating *embodied harassment* as an emerging but understudied form of harassment in novel online social spaces. In this context, harassing behaviors are both conducted and experienced through a sense of embodiment about one's virtual body with a higher awareness of body ownership and more physical and transformative interactive experiences [45]. In this sense, social VR users are not merely “viewing” their activities on the screen as in online gaming or traditional virtual worlds. Their bodies are also not merely transported to the VR space. Instead, they engage in the virtual space both with their physical body and bringing in their offline history, background, and sociocultural experiences [67]. How the lens of embodiment can advance the current research discourse of online harassment in CSCW, such as how the design of platforms may invite or discourage embodied harassment, emerging online social norms that influence perceptions of embodied harassment, and how embodied harassment can be understood and experienced in various ways, may require future research.

5.1.3 Social VR Harassment as Marginalized Tech Users' Unique Challenge. 17 out of the 30 participants in our study self identify as marginalized users in tech spaces such as gaming (e.g., women, LGBTQ, and ethnic minorities). Similar to social media and online forums [11, 59, 86, 88], harassment that targets these populations based on their race, gender, and national origin exist in social VR. The risks and severity of such harassment also seem to be further magnified in social VR. For example, it is much easier for harassers to target these populations based on their avatar design, behavioral patterns, and voice. It is also more challenging for these populations to conceal or hide their gender and ethnicity due to the popular use of voice chat and the main trend to create a virtual avatar similar to one's physical self.

Our findings reveal several unrealistic expectations for women's traditional role as well. Still as a male-dominated social space, these expectations, gender stereotypes, and potential penalties for women to immerse themselves in social VR are enhanced by the underlying masculine culture. Male harassers in our study show traits that mirror social dominance, hostile sexism, and cyber-aggression toward women [85]. These unrealistic expectations and beliefs are also enforced on the LGBTQ community and trigger harassment toward them. An additional risk for marginalized users is the *portability* of harassment in social VR. Compared to other anonymous online platforms, participants in our study seem to inevitably reveal more personal cues when engaging in embodied interaction and voice chat in social VR, leading to a higher risk of stalking as a form of harassment out of social VR. All these challenges demonstrate the unique tensions that marginalized tech users must constantly negotiate with when choosing how to represent themselves in novel online social spaces [13, 16, 55].

Therefore, on the one hand, users who are considered marginalized in tech space may become more vulnerable and experience online harassment in a more disruptive way in social VR. For

example, regardless of creating an avatar that is consistent or inconsistent with their racial identity, ethnic minority users may still be identified and harassed based on their voice and accent. On the other hand, though these users are often the focal point of specific instances of harassment, social VR also provides them with powerful platform specific tools such as blocking or muting to better protect themselves. In addition, these users are able to employ personalized and flexible strategies to better prevent harassment in social VR, such as discreetly sharing personal information and either leaving or avoiding areas of potential harassment. These phenomena thus highlight the need to further unpack the complicated role of social VR in marginalized tech users' online social lives and the importance to design future social VR technologies to better support and protect these populations.

5.2 Users' View of Social VR Harassment: A Critique

We have presented social VR users' view of harassment using their own accounts; we have also carefully separated our own views from theirs for further critical inquiry. While acknowledging users' own understandings, interpretations, and experiences of harassment in social VR, we propose three questions that critically reflect on their accounts. In doing so, we hope that our critical view can contribute to CSCW's research agenda on understanding and preventing harassment in novel online social spaces.

What are new forms of harassment, and why? As we explained earlier in this paper, in our interviews, no specific definition of harassment was offered to the participants to allow them to freely reflect on what they may perceive as forms of harassment in social VR. As a result, participants tend to describe any behaviors or interactions that intentionally upset them and cause harm, aggravation, anxiety, and instability as harassment. Examples emerging in our data include telling a crude joke for attention, disturbing the social atmosphere with unwanted rambunctious behaviors such as shouting and screaming, blocking views, invading personal space and touching without consent, making racist or sexist comments, and children's childish behaviors to annoy adults.

While we acknowledge the nuances of these examples and the potential negative impacts of these behaviors on social VR users, we argue that it may be misleading and inappropriate to count all these behaviors as new forms of online harassment. Rather, a more in-depth discussion of *which* specific behaviors or interactions and in *which context* in social VR should be qualified as harassment is much needed. This does not mean that harassment in social VR is always subjective or even undefined. In our findings, all participants indeed express a baseline understanding of harassment in social VR: any discriminatory conducts in social VR based on identity features such as gender and race (e.g., racism, misogyny, and homophobia) and with a specific target or victim are undoubtedly harassment. This perception is consistent with the understanding of forms of harassment in the U.S. culture [21]. Many participants also highlight how social VR's focus on embodiment and immersion might simulate physical harassment that often happen in the offline world, such as touching without consent. To our understanding, it seems appropriate to consider these behaviors as new forms of online harassment because 1) they simulate physical harassment in the offline world, which have not been seen in other online social spaces (e.g., 2D social networking sites); and 2) they can be felt more severe and disruptive because they are conducted in a realistic and immersive manner in social VR.

What are NOT forms of harassment, and why? In contrast, some behaviors may cause unpleasant or irritating experiences. However, the person who conducts the behavior does not intentionally aim at hurting a specific person or group and may not view this behavior as harassing. For example, some participants report playing loud music or telling a crude joke for attention as harassment. We argue that such behaviors normally are not perceived as harassment, unless the

goal of playing music or telling jokes is to intentionally create a hostile and intimidating social atmosphere to make people feel unsafe. We also question the concept of children harassing adults as a form of "reversed harassment." With the known power imbalance between adults and children, it seems inappropriate to consider children's childish and playful behaviors as ways to intentionally harass adults. As we discussed in the previous section, these above mentioned behaviors may likely result from a mismatch between different expectations for social norms in social VR rather than having a clear intention to hurt people. In this sense, they may not be considered as forms of harassment but evidences of the evolving and complicated social interaction dynamics in social VR. These phenomena also lead to interesting questions regarding why such behaviors are perceived as harassing in social VR by some, while they often are not considered as harassment in the offline world or in other online social spaces, which require future research.

Which claims for mitigating harassment in social VR may require further examination?

We also believe that it is important to critically reflect on our participants' proposals for mitigating harassment in social VR, which will inform future research and design directions on social VR. For example, some participants seem to indicate that platform tools such as blocking may not be effective to prevent harassment because people are reluctant to be seen as "confrontational." This opinion draws our attention because why certain users might perceive protecting people from a potential harasser as a negative "confrontation" would need more investigation. However, this sentiment does show that some social VR users may have certain concerns about how to best protect themselves from online harassment, either through a reactive or proactive approach. To us, it seems necessary to further understand people's reluctance to confront and cope with online harassment, which will both help design more effective mitigation technologies and encourage people to actually use these technologies.

A handful of participants also doubt the feasibility to implement moderation in social VR to prevent harassment, mainly citing trust, privacy, and scaling barriers. We acknowledge the current technical limitations related to moderating a large scale VR environment in real time. We also acknowledge that users may inevitably reveal more personal cues and biometric data (e.g., appearance) to fully enjoy the novelty of social VR, leading to potential privacy concerns. However, we argue that a moderation mechanism does not necessarily conflict with social VR users' personal interests of privacy. As moderation has been proved effective and well accepted in other online social platforms such as live streaming [78, 91], rather than completely rejecting the possibility of implementing moderation in social VR, a more important question seems to be: how can we build trust between moderators and users in a more nuanced way in social VR? As moderators and community-led regulations have been proposed as a potential solution for preventing and mitigating harassment in social VR [12], answers to this question will be critical for successfully designing and deploying potential moderation mechanisms in social VR and for helping users better approach and accept such mechanisms.

5.3 Design Implications for Mitigating Harassment in Social VR

Grounded in the critical reflection of our findings and inspired by prior studies on mitigating harassment in non-VR systems, we explicate three potential design implications to protect users from harassment in social VR. We acknowledge that these design implications are neither complete nor exclusive. Our goal is to promote an open conversation on online harassment across various online social spaces.

Platform Embedded Voice Modulators. Voice chat is the main method through which social VR users interact with one another. Yet, it can also be used to immediately identify one's gender identity, ethnicity, and country of origin. Those personal cues revealed through voice make certain users easy targets for potential harassment. Therefore, platform provided voice modulators, which

make users' voices anonymous or generic, may help people not disclose specific personal cues through voice. In this way, social VR users may be able to avoid potential harassment based on their identity while still enjoying the immersive and interactive experiences through voice chat.

More Robust Reporting in-the-moment that Involves Contexts and Documentation.

Reporting has been proven successful for mitigating harassment on traditional online platforms [11, 26]. For example, the Women Action and the Media (WAM) helped Twitter create an efficient system for reporting harassment, which focused on collecting feedback from the user who submitted the claim. This system includes tagging the report, identifying and documenting the harassment, and responding to any questions the user who submitted the report may have [59]. Our participants also suggest that a similar robust reporting system would help mitigate harassment in social VR. They also highlight three required features for such a system to be successful in social VR:

1) In-the-moment: Harassment in social VR often happen within real time synchronous interactions, which can be ephemeral. The harasser may also immediately disappear via teleport before the victim could even react. Therefore, it is important to provide users with the ability to immediately report a potential harasser in-the-moment (e.g., by hitting a hotkey) rather than having to go through extra procedures of filing a complaint (e.g., entering an additional external "reporting" system or menu).

2) Detail-oriented: Compared to harassment in traditional online platforms, new characteristics and behaviors of harassment seem to emerge in social VR. Therefore, it is crucial to provide users with the ability to fully elaborate why a user is reported as harasser and details about the instance (e.g., time, location, and context). This detail-oriented feature will help users and the platform better capture the uniqueness and complexity of harassment in social VR.

3) Necessary documentation: Relating to the first feature, it can be challenging for victims to provide evidence due to the ephemeral nature of harassment in social VR. It can also be challenging for users to dispute a decision when they are incorrectly reported as harasser. In this sense, it would be necessary to provide features that immediately document an ongoing instance of harassment (e.g., hotkeys for taking screenshots or requesting witnesses).

In summary, such a robust reporting system can lead to a few positive effects: (1) effectively informing the harasser of their behavior, as one may not be aware that their behavior is perceived as harassment; (2) warning other users of a specific harasser's behavioral trend (e.g., prone to sexual misconduct); and (3) a repeated number of offenses could lead to ramifications (e.g., account suspension and permanent banning) for the harasser.

Build Trust between Moderators and Users in a Nuanced Way. Our participants express concerns regarding using moderators to mitigate harassment, citing trust, privacy, and scalability issues. Similar findings regarding Facebook also reveal that moderators may sometimes have their own biases and inappropriate perceptions, which can lead to misjudgement [17]. Therefore, though our participants understand that the purpose of having moderators is to protect them from potential harassment, some of them seem to be reluctant to be in a social VR environment that is moderated. This finding somewhat contradicts Blackwell et al.'s [12] work, which shows that social VR users are eager to have moderators and community regulations. As we discussed in the last section, this finding highlights the unique challenges for mitigating harassment in social VR and makes us reflect on how to successfully design and deploy moderation in future social VR systems – e.g., focusing on how to build trust between moderators and users in a more nuanced way. To our understanding, building such a trust would require both improving the transparency of the potential moderation mechanism in a specific social VR context and fostering more organic interpersonal dynamics between moderator and users in that context.

5.4 Limitations and Future Work

This work has a few limitations. We mainly recruited participants who speak English from English-based online forums (e.g., Reddit) and social VR platforms. We also situate our investigation in the perspective of harassment in the U.S. culture. As harassment is a culturally contextualized construct, it is important to recruit participants who speak other languages or are from non-Western cultures in our future study to better understand the sociocultural specifics of harassment in social VR. In addition, we acknowledge that there are not many voices in this study that would be considered most marginalized or most at risk in tech spaces (e.g., 13 out of the 30 participants still self-identify as white cis man). These groups, for example, Black trans users, could potentially face more novel forms of harassment or more intense versions of what we found in this study, which requires future research. In our study, we also observe that participants seem to define harassment differently in some respects. For example, some participants simply treat harassment as any "unpleasant experiences" in social VR whereas some others consider harassment a more severe and destructive behavior. Our future study will further explore how and why such diverse perceptions and understandings emerge in the social VR context.

6 CONCLUSION

The rapid growth of Commercial social VR platforms has presented distinct challenges regarding understanding and mitigating emerging online harassment. In this paper, we have investigated new characteristics of online harassment emerging in different social VR platforms as well as social VR users' strategies and recommendations to prevent these destructive behaviors. We have also especially attended to how people who are already considered as marginalized in the gaming and virtual worlds contexts (e.g., women, LGBTQ, and ethnic minorities) experience such harassment. We hope that our findings shed light on new perspectives of online harassment and marginalized tech users' unique challenges in emerging novel online social spaces. We also hope that these insights lead to a more in-depth and comprehensive understanding of online harassment and inform potential directions for designing safer and more satisfactory social VR platforms where harassment and xenophobia are mitigated.

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