

Social Virtual Reality: Ethical Considerations and Future Directions for An Emerging Research Space

Divine Maloney*
Clemson University

Guo Freeman†
Clemson University

Andrew Robb‡
Clemson University

ABSTRACT

The boom of commercial social virtual reality (VR) platforms in recent years has signaled the growth and wide-spread adoption of consumer VR. Social VR platforms draw aspects from traditional 2D virtual worlds where users engage in various immersive experiences, interactive activities, and choices in avatar-based representation. However, social VR also demonstrates specific nuances that extend traditional 2D virtual worlds and other online social spaces, such as full/partial body tracked avatars, experiencing mundane everyday activities in a new way (e.g., sleeping), and an immersive means to explore new and complex identities. The growing popularity has signaled interest and investment from top technology companies who each have their own social VR platforms. Thus far, social VR has become an emerging research space, mainly focusing on design strategies, communication and interaction modalities, nuanced activities, self-presentation, harassment, privacy, and self-disclosure. These recent works suggest that many questions still remain in social VR scholarship regarding how to ethically conduct research on these sites and which research areas require additional attention. Therefore, in this paper, we provide an overview of modern Social VR, critically review current scholarship in the area, raise ethical considerations for conducting research on these sites, and highlight unexplored areas.

Keywords: social virtual reality, commercial VR

Index Terms: Human-centered computing—Virtual Reality—

1 INTRODUCTION

Social Virtual Reality (VR) provides novel digital spaces where users can interact, socialize, and game with one another through head-mounted displays (HMDs) [49, 50]. In these open-ended 3D virtual spaces, users engage in cultivating online social relationships [67], exploring diverse virtual activities [40], experimenting with self-representation [26, 27], and enjoying immersive gaming [41, 42]. These spaces are similar to traditional virtual worlds such as Second Life, Runescape, and Club Penguin. However, social VR provides a much more immersive experience due to the use of HMDs and open up new opportunities for embodied interaction. The popularity and immense potential for social VR has signaled significant interest and investment from top technology companies such as Microsoft, HTC, and Facebook, who each own a social VR platform. Recent worldly events (e.g., the COVID-19 global pandemic) have further demonstrated the increasing potential of using social VR for interaction and virtual relationships. As these platforms continue to grow in popularity, many questions still remain about the ramifications of social VR as it grows as an emerging research space.

*e-mail: divinem@clemson.edu

†e-mail: guof@clemson.edu

‡e-mail: arobb@clemson.edu

Therefore, in this paper we provide an overview of modern Social VR, critically review current scholarship in the area, point researchers towards unexplored areas, and raise ethical considerations for how to ethically conduct research on these sites and which research areas require additional attention.

2 Social VIRTUAL REALITY

2.1 Defining and Characterizing Commercial Social VR

For the purpose of this paper, we adopt and expand McVeigh et al.'s [49, 50] work to define social VR as any *commercial* 3D virtual environment where multiple users can interact with one another through VR HMDs. We focus on commercial applications of Social VR for two reasons. First, VR's relevance and societal impact will likely have a more significant impact on commercial VR uses than non-commercial uses. Second, non-commercial platforms impose significant barriers to entry, including programming expertise and VR knowledge that is not available to the average consumer. The majority of prior scholarship involving VR will also be more applicable to commercial social VR platforms (i.e., for entertainment purposes) as opposed to other forms of VR (e.g., for training and simulation purposes). For example, commercial social VR is used in ways that researchers would not normally expect, such as users *sleeping* in VR [40]. This demonstrates that certain facets of social VR may be challenging to replicate in a laboratory.

Modern commercial social VR platforms afford four main characteristics, making them attractive and popular digital social spaces. One of the characteristics is embodied virtual avatars. These avatars support full/partial body representation along with real-time movements and gestures. In these environments, users can create and customize their embodied avatars to explore different virtual spaces and interact with other users. The avatar body in social VR is the primary interface for the user. Second, social VR supports vivid spatial and temporal experiences through high-fidelity 360-degree content and six degrees of freedom. These experiences include a plethora of activities and engagement experiences that may or may not resemble activities in the offline world. Third, there are multiple means of communicating and interpreting communication in social VR via verbal or non-verbal communication. The ability to communicate with another person via non-verbal means such as gestures and body movements has the potential to eliminate language barriers and allow for accessible communication to those who are impaired [43]. Finally, modern social VR platforms are free to play and are widely accessible to anyone who has a VR device; some social VR platforms are also accessible to non-VR users, allowing interaction between desktop-based users and VR users. To the best of our knowledge, most if not all, major social VR platforms are free to use. These include: AltspaceVR, RecRoom, VRchat, Facebook Spaces (discontinued), Facebook Horizon, Mozilla Hubs, Big Screen, High Fidelity, Sansar, Neos, Anyland, and Pokerstars.

2.2 Popular Social VR Platforms

The majority of social VR platforms afford various types of events/activities and the creation of diverse places and spaces. Each platform has different levels of customizable avatars and offers different levels of avatar fidelity. We introduce several of the most popular social VR platforms below.

AltspaceVR. Owned by Microsoft, AltspaceVR is described as “the premier place to discover the next frontier of entertainment and community.” In AltspaceVR, users can attend live events and meetups such as open mic night, improv comedy, meditation, yoga, LGBTQ meetups, or VR church. Users can also host their own events. Events on AltspaceVR can also be accessible via a PC.

RecRoom. RecRoom is considered most popular among minors, while adults tend to prefer AltspaceVR [41]. The main activities in RecRoom are centered around games (e.g., paintball and basketball). Users can create their own private rooms. They can also venture into a central hub called the Rec Center and go into different rooms for gaming.

VRchat. Among all the social VR platforms, VRchat (owned by HTC) affords minimal activities but features uniquely designed rooms (e.g., spaceship, Japan Shrine) that attract various types of users. It also offers the most sophisticated avatar customization compared to RecRoom and AltspaceVR. VRchat is ranked as one of the most popular applications on the Steam game marketplace.

Facebook Horizon. Currently, Facebook Horizon’s is the newest of all the social VR platforms. Horizon is Facebook’s second social VR platform, building on the now discontinued Facebook Spaces. According to Facebook, Horizon is a sandbox universe where users can create and craft their environments and games; they can also socialize with current Facebook friends or other users on the platform.

2.3 Comparing Social VR with Traditional Virtual Worlds

Grounded in the definitions and characteristics of emerging social VR platforms, we therefore, summarize and highlight the similarities and uniqueness of social VR compared to traditional virtual worlds.

The current designs and experiences of social VR platforms mimic behaviors and designs that were first observed in collaborative virtual environments (CVEs) [12]. In fact, social VR can be compared to CVE in three ways: multiple methods of communication, various interactive and collaborative experiences, and experiences mediated by the agency of digital self (i.e., avatar).

Communication. In early CVEs, interactivity was mediated via rich text-based interaction [10, 15], involving role-playing, adventure, questing, and reenacting pop culture [31, 60]. Collaboration was also facilitated in these spaces as they were seen as a more efficient means of communication in the workplace [17]. Similar to social VR, this facet was attractive to users because even though communication was mediated via text, it was *real-time, unobtrusive, multi-user, and exclusive* [23]. However, two key differences should be noted between early text-based CVEs and social VR. First, current interactions in social VR platforms are not yet *archivable* as these in early CVEs were [23]. Second, text-based CVE systems limit the ability to convey and interpret rich social cues via verbal (e.g., voice intonation) or nonverbal behavior (e.g., gestures, facial expressions), while social VR significantly promotes this ability.

Interaction and Collaboration. The nature of *sociality* in social VR very closely mimics early CVEs where users can be connected, play, and work with one another while being physically apart [18]. As time progressed, CVEs evolved to include multiple means of communication specifically highlighting in-depth interpersonal communication [3–5, 36]. These early examples demonstrate the nuances of CVEs when compared to face-to-face interaction and modern commercial social VR, yet the majority of prior scholarship was conducted in a controlled lab setting versus an open collaborative environment like social VR.

As CVEs evolved to have a multi-player focus, different social groups began to emerge. For example, groups in MMORPGs vary in size but often have a common goal, enabling different types of social interactivity between group members [47, 54]. Some groups (often known as guilds) are highly organized, which promotes more dynamic and intimate relationships between guild members [21, 22, 54]. Similar to social VR, the intimate relationships formed in

these virtual groups can lead to social activities unrelated to actual in-game objectives, such as building substantial emotional bonds of friendship, intimacy, affection, and romance [25, 28, 56].

Avatar-Mediated Experiences. Currently, facets like appearance and identity in most CVEs, MMORPGs, and virtual worlds are mediated via their embedded systems. As avatars become more advanced and embodied, they may lead to more nuanced connections with the users who control them. For example, customizing one’s avatar is commonly considered an activity in virtual worlds [32, 61]. This activity is also seen in social VR [26, 27]. In particular, social VR creates a more natural avatar-body connection, where the users’ body acts as the interface rather than a mouse or keyboard. This connection may lead to more naturalistic experimentation with different bodies as compared to experimenting in virtual worlds [20, 24, 25].

In summary, social VR demonstrates both similarities and uniqueness compared to traditional CVEs. This leads to an emerging research space on social VR about how these novel digital systems are shaping our online social lives.

3 CURRENT SOCIAL VR RESEARCH LANDSCAPE

There is a growing research agenda to explore social VR as an emerging technology. Current studies have focused on design strategies [33, 49, 65], communication and interaction modality [7, 40, 43, 50, 53, 66], long-distance couples’ and children’s experiences [41, 42, 67], exploration of self-representation [26, 27], harassment [13], and privacy [45].

3.1 Design Strategies

Early scholarship surrounding design strategies for social VR was conducted by McVeigh et al. [49, 50]. In their works, McVeigh et al. coined the term *social VR* and introduced the design strategies surrounding this pro-social interaction in social VR. In particular, McVeigh et al. highlighted three types of recommendations: (1) leveraging offline modalities and interactivity, (2) self-governed social environments and safe onboarding, and (3) creating meaningful connections with friends, inside and outside of the environment. However, as these recommendations were not exhaustive, they did not point towards future design directions for accessibility, mitigating unwanted interactions, and designing for different demographics (e.g., age).

Similarly, design strategies by Jones et al. [33] only focused on the taxonomy of social VR design, which did not include solely commercial social VR applications but rather a broader definition of social VR as “a growing set of multi-user applications that enable interactivity between head-mounted displays.” In this work, Jones et al. shed light on three core features of social VR: avatars, interaction with others, and the environment. However, these facets did not fully explain why the immersiveness of social VR made these facets any different from prior work done in traditional virtual worlds or comment on how they may influence interactivity in social VR.

3.2 Communication and Interaction Modalities

One of the nuances of social VR is the interpretation of interpersonal communication cues, which have been demonstrated to mimic behavioral cues of the offline world [43, 50, 53, 66]. McVeigh and colleagues’ early work highlighted that the affordances of locomotion, spatial embodiment, and social mechanics were key modalities for expressing *sociality* on social VR platforms [50]. Similar work by Moustafa and Steed demonstrated that users perceived interactions in social VR as identical to those in the offline world, specifically relating to gestures and embodiment [53]. These studies demonstrated the distinct similarities of interpersonal communication between social VR and the offline world. Still, they did not fully explain how or why users were using communication modalities in social VR. In addition, Maloney et al. demonstrated that social VR users used non-verbal communication modalities to communicate in a safer and

more comfortable fashion [43]. This work also highlighted some key interaction outcomes of using non-verbal communication in social VR. Although this work sheds light on how a particular subset of social VR users (e.g., marginalized users) may take advantage of non-verbal communication, it did not classify in-depth all the different types of non-verbal communication modalities such as facial control mentioned by Tanenbaum and colleagues [66].

3.3 Nuanced Activities & Engagement

Social VR inherently affords a broad range of social activities and engaging experiences. Many are traditional activities that can be found in virtual worlds and MMORPGs, such as game playing, entertainment, and learning [40,42]. However, one uniqueness of engaging in social VR is re-experience offline actions, events, and interactivity. For example, Zamanifard and Freeman highlighted that long distance couples used social VR as a means to be connected and replicate their offline activities so as to feel virtually *together* [67]. Maloney et al. also highlighted that mundane offline activities such as *dancing* and *sleeping* were re-experienced in social VR but in a new way [40]. Similar to Zamanifard and Freeman's work, the affordance of the body as the sole interface made behaviors such as dancing more engaging in social VR and even as a means to invite interactivity. Additionally, behaviors such as sleeping demonstrate the distinct affordances of social VR over traditional virtual worlds and online experiences. In the same study, Maloney et al. found that users' enjoyed a variety of activities including social and mental improvement, immersive cultural appreciation, and engaging in immersive events. More scholarship is needed to confirm these findings and extrapolate different immersive activities.

Another set of activities in social VR are geared towards younger users. For example, Maloney et al. described social VR as a new experience for relationship building between different generations [41] and a new modality of building intimacy and stronger emotional connections [42]. These works also highlighted the inter-cultural exchange between younger users and adult users as an everyday activity. Therefore, activities in social VR have emerged beyond gameplay and entertainment and expand to education, relationship building, and immersive specific behaviors (e.g., dancing and sleeping).

3.4 Self-Presentation & Avatar

Another focus in social VR scholarship revolves around how users choose to present themselves in social VR. Like traditional MMORPGs and virtual worlds, social VR users opt for a variety of choices in avatar self-representation. Yet recent works by Freeman et al. [26, 27] highlight that users choose to represent themselves similarly to their physical selves or craft a self-presentation based on the affordances and social atmosphere of the specific platform. Therefore, these works explore a different aspect of selective self-presentation that emphasizes consistency and involves an interplay of body, avatar, audience, and conscious personal choice. They have also highlighted how such nuanced self-presentation in social VR affects users' understandings of self. For example, social VR avatars allow for a more in-depth exploration of identities, particularly by trans users. For them, this was an embodied approach of exploring their non-traditional gender identity.

3.5 Harassment, Privacy, and Self-Disclosure

Similar to traditional virtual worlds, negative experiences such as harassment and unwanted interactivity occur in social VR. For example, a survey by Shriram and Schwartz highlighted that two out of seven women and 21 out of 99 men reported that they had experienced harassment in social VR [62]. Work by Blackwell et al. pointed out that feelings of presence, body movement, embodiment, and voice chat could aggravate harassment [13]. However, it should be noted that this study only explored harassment in Facebook Spaces. More

research on other social VR spaces is needed to verify such findings. Additionally, Maloney et al. demonstrated that marginalized users (e.g., younger users, non-English speakers, LGBTQ, and women) are often subject to more harassment based on their gender, sexuality, race, and age, with one instance of virtual sexual assault towards a minor [41–43].

Thus far, the area of privacy and self-disclosure in social VR has also revealed how different users perceive and approach privacy and self-disclosure in various ways [45]. In particular, Maloney et al. described three patterns regarding self-disclosure in social VR: (1) sharing information based on familiarity with friends or close acquaintances; (2) preferring to remain anonymous when sharing information; and (3) open to sharing information regardless of their familiarity and anonymity. These findings demonstrate particular trade-offs and conflicting points of view regarding privacy and self-disclosure in social VR. Future directions for privacy consent and privacy transparency are needed as the use of social VR continues to grow.

4 ETHICAL CONSIDERATIONS FROM PRIOR VR AND VIRTUAL WORLDS RESEARCH

Existing social VR literature has highlighted future areas of exploration in this emerging research space. However, we express cautions and urge researchers to draw ethical considerations from both prior VR work [11, 37, 63, 64] and work in traditional virtual worlds as they conduct future social VR research [14, 29, 48]. These considerations are two-folded; one focuses on VR and virtual worlds as a research context and the other focuses on the safety of VR and virtual worlds for consumer use.

4.1 Challenges for Conducting VR Research

As VR technology has become widely available and accessible, challenges for conducting VR research are of growing concern. Slater introduced two grand challenges for VR technology [63], which focus on consumer well-being. The first challenge recognizes that VR will become a mass consumer product. Therefore, these devices must be cheap, safe, and deliver compelling experiences so that researchers should investigate their longitudinal impacts on consumers. Second, barriers and challenges determined by the offline-world physics may impact user experiences.

Regarding the safety and experimentation of users, Behr and colleagues insisted that *motion sickness* must be mitigated and that researchers must assist their research participants to reorient to the offline world [11]. To address the posed risks of motion sickness, Behr et al. suggested that exposure time should be limited until adaptation to VR has occurred; tasks prone to sickness should be avoided, and considerations for VR use should be on an individual basis. Yet, these suggestions did not fully elaborate on other ethical concerns or other risks posed by VR. Madary and Metzinger built upon Behr et al.'s work and highlighted six potential issues of VR research: (1) limits of experimental environments, (2) informed consent with regard to the lasting psychological effects, (3) risks associated with clinical applications of VR, (4) the possible use of VR research for malicious purposes, (5) online research using VR, and (6) inherent limitations of a code of conduct for VR research [37]. Madary and Metzinger also highlighted that ethical VR experimentation must follow the principles of *beneficence* and *non-maleficence* in VR. To address the concerns of VR and concerns regarding VR research, Madary and Metzinger proposed the following recommendations. First, all research must follow procedures of informed consent and preserve participants' autonomy and trust. Second, be honest and clear with the scientific progress of VR for medical treatment.

4.2 Concerns & Risks Towards Consumers in VR Research

Prior VR scholarship has highlighted several risks and concerns towards consumers [1, 37, 44, 64], which we summarize below.

One risk is the *cognitive, emotional, and behavioral changes via virtual embodiment*. For example, embodied virtual avatars are capable of altering a person's racial biases [8, 9, 38, 39, 57, 58]. Another risk is the *over-use of VR content*, especially regarding the frequency and duration of using the device. Additionally, *negative psychological effects* may emerge when users leave VR (e.g., fantasy-based content). Users may feel less enthusiastic about venturing back into the offline world and suffer depression or withdrawals. As negative experiences may occur in VR, concerns surrounding the *legal and ethical responsibilities* of VR also begin to emerge as this is largely a grey area.

The area of *privacy* is also of growing concern of VR use, specifically regarding the sharing of personal data with third parties. Similar to other online technologies (e.g., social media), users will have access to negative content and/or mature content that is readily available. This is of concern as immature audiences such as children and teens may have access to this content. Slater et al. even highlighted that some if not all of these concerns may become more apparent as VR moves towards higher levels of realism [64].

To address the above-mentioned risks, Slater and colleagues proposed five principles for action, including: (1) Minimizing potential harm of immoderate use, (2) minimizing content-induced risk, (3) selecting levels of deception, (4) educating implementers and participants, and (5) protecting personal information.

4.3 Challenges for Conducting Virtual Worlds Research

The research potential of virtual worlds have been a long-standing interest of scientific communities [5, 6, 10, 16, 19, 21, 22, 29–31, 34, 35, 46, 48, 52, 54, 60]. Bainbridge explains that virtual worlds have emerged as an interdisciplinary space [6]. He also highlighted emerging challenges for conducting research in these spaces. One challenge lies in the psychological concerns about the attachment with a users' virtual avatar/character. Another challenge focuses on ethics regarding human subjects research in virtual worlds.

Another set of considerations by Minocha et al. highlighted their experiences and suggestions for conducting empirical research in Second Life [52]. One of the research considerations mentioned is communicating details of the experiment with said ethics committee and focusing on how to achieve the *privacy and dignity of observations* in public and private spaces in virtual worlds. Another consideration emphasized the recruitment of participants, where they scouted potential participants within Second Life and sent them a short, direct message informing them of the potential research opportunity. Minocha et al. also suggested that researchers should be part of the online community for an extended period of time before any formal data could be collected. The goal is to familiarize themselves with the community before conducting any research. Researchers were also recommended to develop their identity in the virtual worlds in order to maintain participants' trust and confidence in the project. Finally, Minocha et al. stated that researchers should adhere to the platform-specific community standards of practice.

Grimes et al. also highlighted a few considerations when thinking of approaching research in virtual worlds [29]. One consideration is that research on virtual worlds cannot be conducted exactly as research in offline space. Another consideration is that respecting individuals' privacy and their avatars are essential to build and keep participants' trust. Finally, striving for transparency and respecting the (social) norms of the virtual community should be essential to any virtual world research.

In addition, several ethical and legal considerations regarding concerns and risks towards consumers in virtual worlds research have also been observed [30]. One example is the intellectual property

rights of user-generated content, such as objects created by users. Additional concerns emerged regarding how offline laws apply to virtual worlds. For example, regarding privacy and safety, at what point does misrepresentation (via avatar) become unethical or criminal? What are the ramifications of the incorporation of copyrighted music/video that occur in virtual worlds?

5 PROPOSED GUIDELINES FOR CONDUCTING RESEARCH IN SOCIAL VR

Grounded in prior scholarship on challenges, concerns, and risks toward VR and virtual world research and taking the nuances of social VR technology into account, we propose the following guidelines for conducting social VR research in an ethical way.

- **The welfare and consent of the research participant(s) should be prioritized in all social VR research.**

Specifically, social VR research should adhere to *beneficence* and *respect for persons* [2, 55]. This requires maximizing potential benefits and minimizing possible harms and making sure participants have autonomy and rights to make their own decisions. Informed consent of risk must be given and only should be waived if complying with platforms' policies.

- **Knowledge of said Social VR platform**

Before embarking on a specific social VR to conduct research, researchers should aim to spend ample time on the platform to fully understand the nuances, novelty, and uniqueness of the platform. As each platform has different norms, user-bases, and affordances, such knowledge is necessary to ensure that the researcher understand the underlying culture and social atmosphere of the specific platform.

- **Ensuring Privacy and Care of Participants**

Participants' anonymity and privacy must be kept safe as not to reveal their identity unless given consent by participants. This includes data such as gait, motion-tracked data, avatar appearance, username, and voice. For example, as scholarship demonstrates, motion-tracked data can be identifiable up to 95% accuracy when other personally identifiable information is redacted [51]. This demonstrates that researchers should take measures to ensure the privacy of unique motion signatures (e.g., biometric data, eye-tracking, brain-computer interface) of participants. An additional level of care should be noted when conducting research with users and particularly younger users on these platforms, as users are not always entirely aware of said risks posed. For example, when conducting research with adolescents seeking informed consent of the younger user and their parent/guardian and only waiving consent when minimal to no harm is possible.

- **Compliance with Platforms' Terms of Service.**

Researchers must aim to comply with the specific social VR platform's terms of service when conducting research as this may affect their research methodology. For example, if a researcher aims to conceal or present a different identity in a specific community, it may not comply with certain platforms' community rules. For example, AltspaceVR's terms of service restricts creating "a false identity or impersonating another person or entity in any way." Similarly, RecRoom also restricts "impersonate or misrepresent your affiliation with any person or entity." These platforms' terms of service also include procedures for conducting research. For example, public spaces on some platform are fair ground for conducting research, whereas private rooms are not.

- **Respect for Community Norms**

Most social VR platforms foster specific sub-communities (e.g., users of a certain identity and/or interest). Some sub-communities are formally recognized by said platforms whereas others are created and managed by their respective group members. Sub-communities may have their own rules, social norms, and regulations. Researchers should respect these communities and adhere to their community norms while conducting research. Some sub-communities may also be cautious when researchers conduct research covertly within their communities.

- **Recruit diverse participants**

Social VR attracts a broad range of users, each with different demographics relating to race, gender, sexual orientation, ability, and age. Researchers should seek to diversify participants as to best ensure that diverse viewpoints and perspectives are taken into account. The current lack of representation was demonstrated by Peck et al. who showed that female participants are significantly underrepresented in VR research [59].

We acknowledge that these guidelines are neither complete nor exhaustive but aim to lead to open conversations and reflections. We also note that the uniqueness of social VR may continue to lead to new concerns and emerging guidelines that are currently not included in this paper. For example, as advances in VR technology further enable photo-realistic telepresence, what considerations should be made for participants as social experiences in VR become indistinguishable from the offline world? These concerns, therefore, point to unexplored areas and emerging questions for social VR research, which we discuss in the next section.

6 CALL TO ACTION FOR SOCIAL VR RESEARCHERS

Our guidelines for conducting social VR research in an ethical way also highlights the need to further investigate unexplored or understudied areas in social VR research. In this section, we point researchers towards such areas. These emerging questions are grounded in research considerations in prior social VR scholarship surrounding social VR design, self-presentation, safety, well-being, immersive experiences, and privacy,

- What design considerations should be made to help platforms maintain intimate communication and still grow their user base?
- What does the design of social VR platforms lend itself to? Should social VR mimic the offline world or be a balance of both the offline and online world?
- What are the considerations for designing a social environment inclusively for marginalized groups of all kinds?
- How can bias (e.g., gender/racial), body dysmorphia, and other concerns of self-identity be mitigated in social VR?
- How do we help protect personal space and other considerations of psychological and physical vulnerability in social VR?
- How can you validate the identity of another person in social VR without violating their privacy?
- Given the immense sociality of social VR, what are the long-term psychological and behavioral effects of social VR immersion?
- What are the legal considerations and ramifications regarding content, interactivity, misbehavior, and privacy in social VR?

- What information is considered biometric data in social VR, and what types of information is not biometric but can still be identifiable?

7 CONCLUSIONS

In this paper, we call attention to commercial *social VR*, a popular online digital space where users socialize via HMDs in immersive virtual worlds. These spaces resemble traditional 2D virtual worlds where users engage in interactive activities and are represented via avatars. Yet, social VR affords facets that traditional 3D virtual experiences do not offer, such as full/partial body tracked avatars and 360-degree immersive content. Despite the increasing popularity of social VR, research in this area is still emerging. Therefore, in this paper, we provide a summary of social VR scholarship relating to design strategies, communication and interaction modalities, nuanced activities and self-presentation, harassment, privacy, and self-disclosure. Additionally, we provide ethical guidelines on how to conduct research in this space and point the VR community towards unexplored areas of social VR. We hope that our summary, guidelines, and research directions motivate and inform future directions for designing more safer, transparent, and fulfilling social VR experiences.

REFERENCES

- [1] D. Adams, A. Bah, C. Barwulor, N. Musaby, K. Pitkin, and E. M. Redmiles. Ethics emerging: the story of privacy and security perceptions in virtual reality. In *Fourteenth Symposium on Usable Privacy and Security* ({SOUPS} 2018), pp. 427–442, 2018.
- [2] W. M. Association et al. World medical association declaration of helsinki. ethical principles for medical research involving human subjects. *Bulletin of the World Health Organization*, 79(4):373, 2001.
- [3] J. N. Bailenson, A. C. Beall, J. Loomis, J. Blascovich, and M. Turk. Transformed social interaction: Decoupling representation from behavior and form in collaborative virtual environments. *Presence: Teleoperators & Virtual Environments*, 13(4):428–441, 2004.
- [4] J. N. Bailenson, J. Blascovich, A. C. Beall, and J. M. Loomis. Interpersonal distance in immersive virtual environments. *Personality and social psychology bulletin*, 29(7):819–833, 2003.
- [5] J. N. Bailenson and N. Yee. Digital chameleons: Automatic assimilation of nonverbal gestures in immersive virtual environments. *Psychological science*, 16(10):814–819, 2005.
- [6] W. S. Bainbridge. The scientific research potential of virtual worlds. *science*, 317(5837):472–476, 2007.
- [7] S. Baker, R. M. Kelly, J. Waycott, R. Carrasco, T. Hoang, F. Batchelor, E. Ozanne, B. Dow, J. Warburton, and F. Vetere. Interrogating social virtual reality as a communication medium for older adults. *Proceedings of the ACM on Human-Computer Interaction*, 3(CSCW):1–24, 2019.
- [8] D. Banakou, R. Groten, and M. Slater. Illusory ownership of a virtual child body causes overestimation of object sizes and implicit attitude changes. *Proceedings of the National Academy of Sciences of the United States of America*, 110(31):12846–51, 2013. doi: 10.1073/pnas.1306779110
- [9] D. Banakou, P. D. Hanumanthu, and M. Slater. Virtual embodiment of white people in a black virtual body leads to a sustained reduction in their implicit racial bias. *Frontiers in human neuroscience*, 10:601, 2016.
- [10] R. A. Bartle. *Designing virtual worlds*. New Riders, 2004.
- [11] K.-M. Behr, A. Nosper, C. Klimmt, and T. Hartmann. Some practical considerations of ethical issues in vr research. *Presence*, 14(6):668–676, 2005.
- [12] S. Benford, J. Bowers, L. E. Fahlén, C. Greenhalgh, and D. Snowdon. User embodiment in collaborative virtual environments. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pp. 242–249, 1995.
- [13] L. Blackwell, N. Ellison, N. Elliott-Deflo, and R. Schwartz. Harassment in social virtual reality: Challenges for platform governance. *Proceedings of the ACM on Human-Computer Interaction*, 3(CSCW):1–25, 2019.

- [14] T. Boellstorff, B. Nardi, C. Pearce, and T. L. Taylor. *Ethnography and virtual worlds: A handbook of method*. Princeton University Press, 2012.
- [15] A. Bruckman. Programming for fun: Muds as a context for collaborative learning. 1994.
- [16] A. S. Bruckman. *MOOSE crossing: Construction, community and learning in a networked virtual world for kids*. PhD thesis, Massachusetts Institute of Technology, 1997.
- [17] E. F. Churchill and S. Bly. Virtual environments at work: ongoing use of muds in the workplace. In *ACM SIGSOFT Software Engineering Notes*, vol. 24, pp. 99–108. ACM, 1999.
- [18] E. F. Churchill, D. N. Snowdon, and A. J. Munro. *Collaborative virtual environments: digital places and spaces for interaction*. Springer Science & Business Media, 2012.
- [19] N. Di Blas and C. Poggi. Can ict support inclusion? evidence from multi-user edutainment experiences based on 3d worlds. In *Proceedings of the 7th international conference on Interaction design and children*, pp. 97–100, 2008.
- [20] N. Ducheneaut, M.-H. Wen, N. Yee, and G. Wadley. Body and mind: a study of avatar personalization in three virtual worlds. In *Proceedings of the SIGCHI conference on human factors in computing systems*, pp. 1151–1160. ACM, 2009.
- [21] N. Ducheneaut, N. Yee, E. Nickell, and R. J. Moore. Alone together?: exploring the social dynamics of massively multiplayer online games. In *Proceedings of the SIGCHI conference on Human Factors in computing systems*, pp. 407–416. ACM, 2006.
- [22] N. Ducheneaut, N. Yee, E. Nickell, and R. J. Moore. The life and death of online gaming communities: a look at guilds in world of warcraft. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pp. 839–848. ACM, 2007.
- [23] R. Evard. Collaborative networked communication: Muds as systems tools. In *LISA*, 1993.
- [24] G. Freeman, J. Bardzell, and S. Bardzell. Revisiting computer-mediated intimacy: In-game marriage and dyadic gameplay in audition. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, pp. 4325–4336. ACM, 2016.
- [25] G. Freeman, J. Bardzell, S. Bardzell, and S. C. Herring. Simulating marriage: Gender roles and emerging intimacy in an online game. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*, pp. 1191–1200. ACM, 2015.
- [26] G. Freeman and D. Maloney. Body, avatar, and me: The presentation and perception of self in social virtual reality. *Proc. ACM Hum.-Comput. Interact. (CSCW)*, 2020.
- [27] G. Freeman, S. Zamanifard, D. Maloney, and A. Adkins. My body, my avatar: How people perceive their avatars in social virtual reality. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, pp. 1–8, 2020.
- [28] G. Z. Freeman, J. Bardzell, and S. Bardzell. Intimate experiences in virtual worlds: The interplay among hyperpersonal communication, avatar-based systems, and experiential drives. *ICConference 2016 Proceedings*, 2016.
- [29] J. M. Grimes, K. R. Fleischman, and P. T. Jaeger. Virtual guinea pigs: Ethical implications of human subjects research in virtual worlds. *International Journal of Internet Research Ethics*, 2(1):38–56, 2009.
- [30] A. Hendaoui, M. Limayem, and C. W. Thompson. 3d social virtual worlds: research issues and challenges. *IEEE internet computing*, 12(1):88–92, 2008.
- [31] K. Hoon, J. Park, K. Yul, H. Moon, and H. Chun. E-lifestyle and motives to use online games. *Iris Marketing Review*, 15(2):71–72, 2002.
- [32] S. Huh and D. Williams. Dude looks like a lady: Gender swapping in an online game. In *Online worlds: Convergence of the real and the virtual*, pp. 161–174. Springer, 2010.
- [33] M. Jonas, S. Said, D. Yu, C. Aiello, N. Furlo, and D. Zytco. Towards a taxonomy of social vr application design. In *Extended Abstracts of the Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts*, pp. 437–444. ACM, 2019.
- [34] Y. Kafai, D. A. Fields, M. T. Giang, N. Fefferman, J. Sun, D. Kunka, and J. Wong. Designing for massive engagement in a tween community: Participation, prevention, and philanthropy in a virtual epidemic. In *Proceedings of the 2017 Conference on Interaction Design and Children*, pp. 365–370, 2017.
- [35] J. L. Kolodner, T. Said, K. Wright, and A. Pallant. Drawn into science through authentic virtual practice. In *Proceedings of the 2017 Conference on Interaction Design and Children*, pp. 385–391, 2017.
- [36] E. A. Konijn, S. Utz, M. Tanis, and S. B. Barnes. *Mediated interpersonal communication*. Routledge, 2008.
- [37] M. Madary and T. K. Metzinger. Real virtuality: a code of ethical conduct. recommendations for good scientific practice and the consumers of vr-technology. *Frontiers in Robotics and AI*, 3:3, 2016.
- [38] L. Maister, N. Sebanz, G. Knoblich, and M. Tsakiris. Experiencing ownership over a dark-skinned body reduces implicit racial bias. *Cognition*, 128(2):170–178, 2013.
- [39] L. Maister, M. Slater, M. V. Sanchez-Vives, and M. Tsakiris. Changing bodies changes minds: owning another body affects social cognition. *Trends in cognitive sciences*, 19(1):6–12, 2015.
- [40] D. Maloney and G. Freeman. Falling asleep together: What makes activities in social virtual reality meaningful to users. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play*, 2020.
- [41] D. Maloney, G. Freeman, and A. Robb. It is complicated: Interacting with children in social virtual reality. In *2020 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)*, pp. 343–347. IEEE, 2020.
- [42] D. Maloney, G. Freeman, and A. Robb. A virtual space for all: Exploring children’s experience in social virtual reality. In *Proceedings of the Annual Symposium on Computer-Human Interaction in Play*, 2020.
- [43] D. Maloney, G. Freeman, and D. Y. Wohn. “talking without a voice”: Understanding non-verbal communication in social virtual reality. *Proceedings of the ACM on Human-Computer Interaction*, CSCW, 2020.
- [44] D. Maloney, S. Rajasabeson, A. Moore, J. Caldwell, J. Archer, and A. Robb. Ethical concerns of the use of virtual avatars in consumer entertainment. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)*, pp. 1489–1492. IEEE, 2019.
- [45] D. Maloney, Z. Samaneh, and G. Freeman. Anonymity vs familiarity: Self-disclosure and privacy in social virtual reality. In *26th ACM Symposium on Virtual Reality Software and Technology (VRST)*, 2020e.
- [46] J. Marsh. Young children’s play in online virtual worlds. *Journal of early childhood research*, 8(1):23–39, 2010.
- [47] G. McEwan, C. Gutwin, R. L. Mandryk, and L. Nacke. I’m just here to play games: social dynamics and sociality in an online game site. In *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*, pp. 549–558. ACM, 2012.
- [48] H. A. McKee and J. E. Porter. Playing a good game: Ethical issues in researching mmogs and virtual worlds. *International Journal of Internet Research Ethics*, 2(1), pp. 5–37, 2009.
- [49] J. McVeigh-Schultz, A. Kolesnichenko, and K. Isbister. Shaping prosocial interaction in vr: An emerging design framework. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, pp. 1–12, 2019.
- [50] J. McVeigh-Schultz, E. Márquez Segura, N. Merrill, and K. Isbister. What’s it mean to” be social” in vr? mapping the social vr design ecology. In *Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*, pp. 289–294, 2018.
- [51] M. R. Miller, F. Herrera, H. Jun, J. A. Landay, and J. N. Bailenson. Personal identifiability of user tracking data during observation of 360-degree vr video. *Scientific Reports*, 10(1):1–10, 2020.
- [52] S. Minocha, M. Tran, and A. Reeves. Conducting empirical research in virtual worlds: experiences from two projects in second life. *Journal of virtual worlds research*, 3(1):3–21, 2010.
- [53] F. Moustafa and A. Steed. A longitudinal study of small group interaction in social virtual reality. In *Proceedings of the 24th ACM Symposium on Virtual Reality Software and Technology*, p. 22. ACM, 2018.
- [54] B. Nardi and J. Harris. Strangers and friends: Collaborative play in world of warcraft. In *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*, pp. 149–158, 2006.
- [55] M. National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, Bethesda. *The Belmont report*:

Ethical principles and guidelines for the protection of human subjects of research. Superintendent of Documents, 1978.

- [56] T. Pace, S. Bardzell, and J. Bardzell. The rogue in the lovely black dress: intimacy in world of warcraft. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 233–242, 2010.
- [57] T. C. Peck, M. Doan, K. A. Bourne, and J. J. Good. The effect of gender body-swap illusions on working memory and stereotype threat. *IEEE transactions on visualization and computer graphics*, 24(4):1604–1612, 2018.
- [58] T. C. Peck, S. Seinfeld, S. M. Aglioti, and M. Slater. Putting yourself in the skin of a black avatar reduces implicit racial bias. *Consciousness and cognition*, 22(3):779–787, 2013.
- [59] T. C. Peck, L. E. Sockol, and S. M. Hancock. Mind the gap: The underrepresentation of female participants and authors in virtual reality research. *IEEE Transactions on Visualization and Computer Graphics*, 26(5):1945–1954, 2020.
- [60] J. Sanchez. A social history of virtual worlds. *Library Technology Reports*, 45(2):9–13, 2009.
- [61] R. Schroeder. *The social life of avatars: Presence and interaction in shared virtual environments*. Springer Science & Business Media, 2012.
- [62] K. Shriram and R. Schwartz. All are welcome: Using vr ethnography to explore harassment behavior in immersive social virtual reality. In *2017 IEEE Virtual Reality (VR)*, pp. 225–226. IEEE, 2017.
- [63] M. Slater. Grand challenges in virtual environments. *Frontiers in Robotics and AI*, 1:3, 2014.
- [64] M. Slater, C. Gonzalez-Liencrees, P. Haggard, C. Vinkers, R. Gregory-Clarke, S. Jelley, Z. Watson, G. Breen, R. Schwarz, W. Steptoe, et al. The ethics of realism in virtual and augmented reality. *Frontiers in Virtual Reality*, 1:1, 2020.
- [65] M. Sra, A. Mottelson, and P. Maes. Your place and mine: Designing a shared vr experience for remotely located users. In *Proceedings of the 2018 Designing Interactive Systems Conference*, pp. 85–97. ACM, 2018.
- [66] T. J. Tanenbaum, N. Hartoonian, and J. Bryan. ” how do i make this thing smile?” an inventory of expressive nonverbal communication in commercial social virtual reality platforms. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, pp. 1–13, 2020.
- [67] S. Zamanifard and G. Freeman. ” the togetherness that we crave” experiencing social vr in long distance relationships. In *Conference Companion Publication of the 2019 on Computer Supported Cooperative Work and Social Computing*, pp. 438–442, 2019.