



















social connectivity by balancing, accessibility, and customization, 2) continued communication both in and out social VR, and 3) increasing realism and naturalness. We now use our findings to discuss the implications of this work for extending our current understandings of new social practices and phenomena surrounding social VR as well as for informing potential directions for designing more socially supportive and satisfying VR platforms in the future.

### 5.1 Why Meaningful? Understanding Actual User Behavior in Social VR

As we described at the beginning of this paper, few empirical studies on social VR have explored what users are actually doing on these platforms and why they found such activities meaningful to them. Therefore, our findings provide valuable empirical evidence to better understand actual user behavior in social VR.

*5.1.1 The Nuance of Social VR Mediated Activities Compared to Traditional Virtual Worlds.* In this paper, we extend existing work on social dynamics and sociality in traditional 2D/3D virtual worlds by exploring the nuance of social activities that are mediated, facilitated, and supported by the emerging social VR platforms. In particular, our findings illustrate a number of similarities and differences between digital activities in traditional virtual worlds and in social VR.

One similarity is the broad range of educational, entertainment, and self-improvement activities across both traditional virtual worlds and social VR. For example, our findings are consistent with Bruckman's work [8] on educational activities in traditional virtual worlds. According to Bruckman, virtual worlds promote learning in four ways: 1) motivating users for learning; 2) providing emotional support; 3) offering technical support; 4) hosting appreciative audience to encourage learning [8]. In our work, we also found that social VR platforms motivated users to learn new languages and cultures in an immersive way. In addition, they encouraged users to learn new methods of self-improvement such as collaborative mediation. These new and immersive ways of learning then created deeper emotional support and led to a more meaningful learning experience where an appreciative audience were present. Another similarity is the wide range of technical attributes that both traditional virtual worlds and social VR employ to afford activities that were significant and valuable to users. Social VR is real time, unobtrusive, and can be multiuser or exclusive, which all are the attributes that Evard credited in facilitating meaningful interactions in traditional virtual worlds [17].

However, social VR also extends the capability of traditional virtual worlds as it affords the communication and interpretation of rich social cues through posture, gesture, and voice intonation. This facilitates more in-depth and immersive real time social experience. For example, our participants reported that social VR enabled them to engage in diverse immersive events including collaborative efforts for mental health, seeking feedback from the community, and professional development. They also noted that the richness of multi-modal communication in social VR helped users who may lack mobility better engage in these digital activities.

In addition, social VR affords a number of digital activities that are common in traditional virtual worlds such as paintball, yoga, dancing, meditation, experiencing aspects of a different culture,

or just casual socialization [24, 44]. However, social VR facilitates these activities in a more personal and immersive manner through its unique full body mirroring feature, which also attracts diverse sets of users. For example, dancing in social VR is much different from dancing in traditional virtual worlds. In traditional virtual worlds, dancing is usually induced through some forms of avatar body dancing through a non immersive interface [7, 9, 16]. In social VR, dancing is more immersive, embodied, and real time, which creates a more natural and engaging experience.

Our findings also demonstrate that full body mirroring in social VR allowed for mundane everyday activities that were rarely seen before in virtual worlds, such as sleeping. This finding is significantly different from prior literature on how players in traditional virtual worlds would forget to sleep, become addicted to the virtual world, or accidentally fall asleep while playing [23, 31, 54]. In our study, participants chose to intentionally fall sleep in social VR. For them, social VR seemed to create natural feelings of offline presence and let them feel comfortable and safe. This made falling sleep in social VR a meaningful and valuable activity that further blurred the boundaries between online and offline.

In summary, though traditional digital activities are also taking place in social VR, social VR both affords new and novel activities and offers more nuance ways to conduct and experience traditional digital activities.

*5.1.2 A Balance between Enhanced Social Connectivity and Self-Reflection.* Our findings show that social VR users seemed to be able to find a balance between social connectivity and self-reflection, which made their social VR mediated activities meaningful and valuable to them.

For example, our findings are consistent with Zamanifard and Freeman's work [55]: long distance couples did use social VR as a modality to stay connected. However, our findings also extend this work and highlight that intimate mundane behaviors such as falling asleep together in social VR was a novel way through which couples felt their time spent together in social VR more meaningful. Additionally, social VR is not only advantageous for those who are in long distance relationships but for those who are looking to develop new friendships, foster sense of belongingness, and engage in community building. These point to social VR's potential to afford a wide range of social connectivity and forms of interpersonal relationships beyond intimate romantic relationships.

In particular, an interesting finding is that though social VR is generally designed for social interactions and connectivity, one of the most important activities in social VR actually centers around experiencing, exploring, and improving one's self. This focus may result from the combination of *presence, immersion, and embodiment* in social VR. In VR, presence is known to influence the illusion of the virtual environment, and even the plausibility of the experience [48, 50]. Correspondingly, high presence often leads to stronger perceptions of immersion [47, 49] and connections within the environment. While senses of presence and immersion in social VR are both heightened due to full body tracking, *embodiment* is also further enhanced as users' bodies have become the sole interface for interacting with others. In this context, the mirroring of their physical body and virtual body not only communicates spatial behaviors [22] but also displays expression, social interaction, and

proximity [27, 32, 33, 53]. Such an interplay of enhanced *presence*, *immersion*, and *embodiment* may encourage users to pay more attention to their selves and reflect how they connect to their selves, the others, and the world.

## 5.2 Exploring Future Design Directions

Our findings also reveal three user-generated design implications for better supporting novel and meaningful activities in social VR. Our goal is to contribute to the current researcher and designer generated design frameworks for social VR (e.g., [29, 36, 45]) and inform future design directions to create more socially supportive and satisfying social VR spaces by introducing end users' voices and insights.

One interesting user-generated design recommendation is the ability to leave messages for other users through the headset or computer (e.g., a built-in in game voicemail system) rather than using any standalone external communication applications such as Discord. Asynchronous communication methods have been used in online games for a long time [43]. Yet, adding such features to social VR could allow voice mail messages in the form of textual, audible, or video messages, which would help social VR users balance their engagement in social VR and regular lives in the offline world. This suggestion aligns with one of McVeigh-Schultz et al's design considerations of "*consider[ing] the ways that your experience will bridge between VR and the outside world*" [36]. Yet our participants expected to *bridge* their experience, activities, and interactions with other users on the platform in addition to family and friends who are not associated with social VR. In this sense, asynchronous communication systems that mainly focus on building and maintaining connections between online strangers may need to be taken into account when designing future social VR platforms.

In addition, our participants' expectations of traditional aspects of realism holds true in social VR as they expect similar graphical fidelity compared to the physical world, but they also expect naturalness in interactions and experiences that resemble face-to-face interactions in the offline world. This is consistent with McVeigh-Schultz et al's another design consideration, which focuses on "*leveraging the familiar social context through the aesthetics of place and architecture*" [36]. Specifically, we found that to what degree realism and naturalness should be achieved is not an one-fit-all design principle. Currently, different social VR platforms such as RecRoom, VRchat, and AltspaceVR afford varying levels of realism. The expectations of the specific platform also seems to dictate the level of realism expected by the users. For example, RecRoom focuses on games and play, which may yield lower expectations of realism. In contrast, AltspaceVR, a platform to attend live shows, experience meetups, and take part in classes with other people, may yield higher expectations of realism because of the similarities to the offline activities. A better understanding of specific platforms' goals and main activities that they focus on seems to be necessary to determine the degree of realism and naturalness that users expect from a given platform. It should also be noted that our participants highlighted that social VR design should be more accessible for people with disabilities. Previous scholarship have demonstrated that traditional virtual worlds such as Second Life was beneficial for people with physical disabilities to experience self-discovery,

relaxation, and in-world equality [28]. However, how to make social VR more accessible to people with physical disabilities, hearing impairments, visual impairments, or mental impairments seems to be an understudied topic in current designer/researcher generated design frameworks.

After considering design frameworks and methodologies proposed in prior research [12, 36, 41], along with user-generated design recommendations emerging in our findings, we suggest the following potential practices for designing social VR for *accessibility* and *inclusion*:

*Participatory Design*: proactively involving people with various disabilities and marginalized communities in the process of designing social VR experiences and digital activities.

*Virtual Places for Social Support*: designing virtual places in social VR where marginalized and/or disabled users can share experiences, support one another, and combat harassment or negative social interactions collaboratively.

*Crafting An Onboarding Process to Explore Accessibility of the Platform*: in this process, users can experiment with the environment, features, and settings to identify and practice what interactions, if any, are accessible on the platform, without others being present.

## 5.3 Limitations

Our study has a few limitations. First, all participants were recruited from online forums, social media, and on social VR platforms. This sample mainly focuses on social VR users who actively use social media accounts. Another limitation is the lack of even distribution between participants and the platforms they use. Future investigation should aim at recruiting a broader participant pool with more diverse social VR platforms to capture a more comprehensive picture of social VR experiences and activities. In addition, we did not particularly discuss avatar creation as an activity in this paper because we focused on such activities in one of our prior work [20]. We also want to mention that we intentionally did not define what should be considered "meaningful" to give our participants flexibility to openly answer the interview questions and reflect on their subjective experiences. Future work can also be conducted to further investigate and differentiate how different types of social VR activities indicate various meanings, values, and significance to users.

## 6 CONCLUSIONS

Commercial social VR applications have emerged to be increasingly popular online digital spaces that afford real time multimodal interactions and a broad range of activities via full body tracking (play, meetings, social gatherings). Yet what makes activities on these novel platforms meaningful to users? Our investigation has identified five forms of activities that users find meaningful and valuable and three end user generated design recommendations for designing future social VR platforms to better support such activities. We believe that our focus on *meaningful* activities in social VR contributes towards addressing two main limitations in prior literature, namely, the lack of scholarship on actual activities in social VR and first hand accounts of end user generated design recommendations. We hope that our findings inform future directions

for designing more supportive, enjoyable, and satisfying social VR platforms.

## ACKNOWLEDGMENTS

We thank our participants and the anonymous reviewers. We also thank Samaneh Zamanifard and Alex Adkins for data collection.

## REFERENCES

- [1] Jeremy N Bailenson, Andrew C Beall, Jack Loomis, Jim Blascovich, and Matthew Turk. 2004. Transformed social interaction: Decoupling representation from behavior and form in collaborative virtual environments. *Presence: Teleoperators & Virtual Environments* 13, 4 (2004), 428–441.
- [2] Jeremy N Bailenson, Jim Blascovich, Andrew C Beall, and Jack M Loomis. 2003. Interpersonal distance in immersive virtual environments. *Personality and social psychology bulletin* 29, 7 (2003), 819–833.
- [3] Jeremy N Bailenson and Nick Yee. 2005. Digital chameleons: Automatic assimilation of nonverbal gestures in immersive virtual environments. *Psychological science* 16, 10 (2005), 814–819.
- [4] Richard A Bartle. 2004. *Designing virtual worlds*. New Riders.
- [5] Steve Benford, John Bowers, Lennart E Fahlén, Chris Greenhalgh, and Dave Snowden. 1995. User embodiment in collaborative virtual environments. In *Chi*, Vol. 95. Citeseer, 242–249.
- [6] Lindsay Blackwell, Nicole Ellison, Natasha Elliott-Deflo, and Raz Schwartz. 2019. Harassment in Social VR: Implications for Design. In *IEEE Virtual Reality*.
- [7] Tom Boellstorff. 2015. *Coming of age in Second Life: An anthropologist explores the virtually human*. Princeton University Press.
- [8] Amy Bruckman. 1994. Programming for Fun: MUDs as a Context for Collaborative Learning. (1994).
- [9] Jacky CP Chan, Howard Leung, Jeff KT Tang, and Taku Komura. 2010. A virtual reality dance training system using motion capture technology. *IEEE Transactions on Learning Technologies* 4, 2 (2010), 187–195.
- [10] Elizabeth F Churchill and Sara Bly. 1999. Virtual Environments at Work: ongoing use of MUDs in the Workplace. In *ACM SIGSOFT Software Engineering Notes*, Vol. 24. ACM, 99–108.
- [11] Elizabeth F Churchill, David N Snowden, and Alan J Munro. 2012. *Collaborative virtual environments: digital places and spaces for interaction*. Springer Science & Business Media.
- [12] Roy C Davies. 2004. Adapting virtual reality for the participatory design of work environments. *Computer Supported Cooperative Work (CSCW)* 13, 1 (2004), 1–33.
- [13] Nicolas Ducheneaut, Ming-Hui Wen, Nicholas Yee, and Greg Wadley. 2009. Body and mind: a study of avatar personalization in three virtual worlds. In *Proceedings of the SIGCHI conference on human factors in computing systems*. ACM, 1151–1160.
- [14] Nicolas Ducheneaut, Nicholas Yee, Eric Nickell, and Robert J Moore. 2006. Alone together?: exploring the social dynamics of massively multiplayer online games. In *Proceedings of the SIGCHI conference on Human Factors in computing systems*. ACM, 407–416.
- [15] Nicolas Ducheneaut, Nicholas Yee, Eric Nickell, and Robert J Moore. 2007. 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*. ACM, 839–848.
- [16] Daniel L Eaves, Gavin Breslin, Paul Van Schaik, Emma Robinson, and Iain R Spears. 2011. The short-term effects of real-time virtual reality feedback on motor learning in dance. *Presence: Teleoperators and Virtual Environments* 20, 1 (2011), 62–77.
- [17] Remy Evard. 1993. Collaborative Networked Communication: MUDs as Systems Tools.. In *LISA*.
- [18] Guo Freeman, Jeffrey Bardzell, and Shaowen Bardzell. 2016. 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*. ACM, 4325–4336.
- [19] Guo Freeman, Jeffrey Bardzell, Shaowen Bardzell, and Susan C Herring. 2015. 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*. ACM, 1191–1200.
- [20] Guo Freeman, Samaneh Zamanifard, Divine Maloney, and Alexandra Adkins. 2020. 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*. 1–8.
- [21] Guo Zhang Freeman, Jeffrey Bardzell, and Shaowen Bardzell. 2016. Intimate experiences in virtual worlds: The interplay among hyperpersonal communication, avatar-based systems, and experiential drives. *ICConference 2016 Proceedings* (2016).
- [22] Edward Twitchell Hall. 1966. *The hidden dimension*. Vol. 609. Garden City, NY: Doubleday.
- [23] Harris Weems Henderson. 2008. Through the looking glass: Copyright protection in the virtual reality of Second Life. *J. Intell. Prop.* 16 (2008), 165.
- [24] Kyung Hoon, JY Park, KD Yul, HL Moon, and HC Chun. 2002. E-lifestyle and motives to use online games. *Iris Marketing Review* 15, 2 (2002), 71–72.
- [25] Searle Huh and Dmitri Williams. 2010. Dude looks like a lady: Gender swapping in an online game. In *Online worlds: Convergence of the real and the virtual*. Springer, 161–174.
- [26] Marcel Jonas, Steven Said, Daniel Yu, Chris Aiello, Nicholas Furlo, and Douglas Zytko. 2019. Towards a Taxonomy of Social VR Application Design. In *Extended Abstracts of the Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts*. ACM, 437–444.
- [27] Iason Kastanis and Mel Slater. 2012. Reinforcement learning utilizes proxemics: An avatar learns to manipulate the position of people in immersive virtual reality. *ACM Transactions on Applied Perception (TAP)* 9, 1 (2012), 1–15.
- [28] Camilla Kleban and Linda K Kaye. 2015. Psychosocial impacts of engaging in Second Life for individuals with physical disabilities. *Computers in Human Behavior* 45 (2015), 59–68.
- [29] Anya Kolesnichenko, Joshua McVeigh-Schultz, and Katherine Isbister. 2019. Understanding Emerging Design Practices for Avatar Systems in the Commercial Social VR Ecology. In *Proceedings of the 2019 on Designing Interactive Systems Conference*. 241–252.
- [30] Elly A Konijn, Sonja Utz, Martin Tanis, and Susan B Barnes. 2008. *Mediated interpersonal communication*. Routledge.
- [31] Lawrence T Lam. 2014. Internet gaming addiction, problematic use of the internet, and sleep problems: a systematic review. *Current psychiatry reports* 16, 4 (2014), 444.
- [32] Hao Li, Laura Trutoiu, Kyle Olszewski, Lingyu Wei, Tristan Trutna, Pei-Lun Hsieh, Aaron Nicholls, and Chongyang Ma. 2015. Facial performance sensing head-mounted display. *ACM Transactions on Graphics (ToG)* 34, 4 (2015), 1–9.
- [33] Joan Llobera, Bernhard Spanlang, Giulio Ruffini, and Mel Slater. 2010. Proxemics with multiple dynamic characters in an immersive virtual environment. *ACM Transactions on Applied Perception (TAP)* 8, 1 (2010), 1–12.
- [34] Nora McDonald, Sarita Schoenebeck, and Andrea Forte. 2019. Reliability and Inter-rater Reliability in Qualitative Research: Norms and Guidelines for CSCW and HCI Practice. *Proceedings of the ACM on Human-Computer Interaction* 3, CSCW (2019), 1–23.
- [35] Gregor McEwan, Carl Gutwin, Regan L Mandryk, and Lennart Nacke. 2012. 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*. ACM, 549–558.
- [36] Joshua McVeigh-Schultz, Anya Kolesnichenko, and Katherine Isbister. 2019. Shaping Pro-Social Interaction in VR: An Emerging Design Framework. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, 564.
- [37] Joshua McVeigh-Schultz, Elena Márquez Segura, Nick Merrill, and Katherine Isbister. 2018. 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*. ACM, 289–294.
- [38] Fares Moustafa and Anthony Steed. 2018. A longitudinal study of small group interaction in social virtual reality. In *Proceedings of the 24th ACM Symposium on Virtual Reality Software and Technology*. ACM, 22.
- [39] Bonnie Nardi and Justin Harris. 2006. Strangers and friends: Collaborative play in World of Warcraft. In *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*. ACM, 149–158.
- [40] Tyler Pace, Shaowen Bardzell, and Jeffrey Bardzell. 2010. The rogue in the lovely black dress: intimacy in world of warcraft. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 233–242.
- [41] Gabriela T Richard. 2013. Designing games that foster equity and inclusion: Encouraging equitable social experiences across gender and ethnicity in online games. In *Proceedings of the CHI'2013 Workshop: Designing and Evaluating Sociability in Online Video Games (Paris, France)*. 83–88.
- [42] Bonnie Ruberg and Adrienne Shaw. 2017. *Queer game studies*. U of Minnesota Press.
- [43] Christopher Ruggles, Greg Wadley, and Martin R Gibbs. 2005. Online community building techniques used by video game developers. In *International Conference on Entertainment Computing*. Springer, 114–125.
- [44] Joe Sanchez. 2009. A social history of virtual worlds. *Library Technology Reports* 45, 2 (2009), 9–13.
- [45] Anthony Scavarelli, Ali Arya, and Robert J Teather. 2019. Circles: exploring multi-platform accessible, socially scalable VR in the classroom. In *2019 IEEE Games, Entertainment, Media Conference (GEM)*. IEEE, 1–4.
- [46] Ralph Schroeder. 2012. *The social life of avatars: Presence and interaction in shared virtual environments*. Springer Science & Business Media.
- [47] Richard Skarbez, Solene Neyret, Frederick P Brooks, Mel Slater, and Mary C Whitton. 2017. A psychophysical experiment regarding components of the plausibility illusion. *IEEE transactions on visualization and computer graphics* 23, 4 (2017), 1369–1378.
- [48] Mel Slater. 2009. Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. *Philosophical Transactions of the Royal Society*

- B: Biological Sciences* 364, 1535 (2009), 3549–3557.
- [49] Mel Slater, Bernhard Spanlang, and David Corominas. 2010. Simulating virtual environments within virtual environments as the basis for a psychophysics of presence. *ACM Transactions on Graphics (TOG)* 29, 4 (2010), 1–9.
- [50] Mel Slater, Bernhard Spanlang, Maria V Sanchez-Vives, and Olaf Blanke. 2010. First person experience of body transfer in virtual reality. *PloS one* 5, 5 (2010).
- [51] Misha Sra, Aske Mottelson, and Pattie Maes. 2018. Your place and mine: Designing a shared VR experience for remotely located users. In *Proceedings of the 2018 Designing Interactive Systems Conference*. ACM, 85–97.
- [52] Anselm L. Strauss. 1987. *Qualitative analysis for social scientists*. Cambridge university press.
- [53] Laura C Trutoiu, Elizabeth J Carter, Iain Matthews, and Jessica K Hodgins. 2011. Modeling and animating eye blinks. *ACM Transactions on Applied Perception (TAP)* 8, 3 (2011), 1–17.
- [54] Nick Yee. 2002. Understanding MMORPG addiction. Retrieved February 15 (2002), 2008.
- [55] Samaneh Zamanifard and Guo Freeman. 2019. "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*. ACM, 438–442.