The Case for "Weird Social" in VR/XR

A Vision of Social Superpowers Beyond Meatspace

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ABSTRACT

COVID underscores the potential of VR meeting tools to compensate for lack of embodied communication in applications like Zoom. But both research and commercial VR meeting environments typically seek to approximate physical meetings, instead of exploring new capacities of communication and coordination. We argue the most transformative features of VR (and XR more broadly) may look and feel very different from familiar social rituals of physical meetings. Embracing "weird" forms of sociality and embodiment, we incorporate inspiration from a range of sources including: (1) emerging rituals in commercial social VR, (2) existing research on social augmentation systems for meetings, (3) novel examples of embodied VR communication, and (4) a fictionalized vignette envisioning a future with aspects of "Weird Social XR" folded into everyday life. We call upon the research community to approach these speculative forms of alien sociality as opportunities to explore new kinds of social superpowers.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Interaction paradigms; Virtual reality; Human computer interaction (HCI); Interaction paradigms; Collaborative interaction; Human computer interaction (HCI); HCI theory, concepts and models; Human computer interaction (HCI); Interaction paradigms; Mixed / augmented reality.

KEYWORDS

social VR, social augmentation, meetings, weird social

ACM Reference Format:
Joshua Mcveigh-Schultz and Katherine Isbister. 2021. The Case for "Weird Social" in VR/XR: A Vision of Social Superpowers Beyond Meatspace. In *CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '21 Extended Abstracts), May 08–13, 2021, Yokohama, Japan.* ACM, New York, NY, USA, 10 pages. https://doi.org/10.1145/3411763.3450377

1 INTRODUCTION

In the wake of COVID-19, social forms of Virtual Reality (VR) are poised to play a pivotal role in supporting telepresence interactions in the workplace and beyond. As humanity turns to the crisis of climate change, we need new forms of being together and doing together that have a lighter carbon footprint than frequent travel, and that move beyond limitations of the video conferencing tools we have heavily relied upon during the COVID pandemic. We argue our collective vision of social VR meeting tools—what they offer and how they enable us to interact—needs to be rethought. Social VR (and social XR more broadly) have an opportunity to unlock new social capacities *only* available through technological mediation. Revisiting Hollan and Stornetta [26], we argue that social VR meeting experiences could enable more radical departures from familiar social encounters, and should instead be thought of as an opportunity to expand the repertoires of everyday social life.

In many of the examples of contemporary social VR meeting applications and research agendas, we identify a familiar—and seemingly knee jerk—assumption that meetings in VR should simply replicate the experience of physical co-presence. Arguing against this tendency nearly three decades ago, Hollan and Stornetta made the case that communication technologies are transformative *not* because they recreate face-to-face encounters, but rather, because they offer new opportunities that go "beyond being there" [26]. The assumption that VR meetings should be modeled on "real life" is reinforced by the near ubiquity of features like virtual whiteboards, virtual sticky notes, and meeting rooms that resemble familiar workplace environments, etc. While such familiar features may be necessary to ease people into a new opportunity through skeuomorphic scaffolding, the relentless push to approximate the experiential tropes of meetings in physical spaces (to make VR meetings " more realistic"), suggest to us a blind spot about just how weird and alien social interaction in XR could become—and may need to become—as we learn to adapt to and take full advantage of the affordances of the medium.

This kind of blind spot is, in some ways, understandable. The social transformations that have accompanied technological change in the 21st century sometimes outpace the imaginations of even our most imaginative storytellers. In an interview by Mother Jones, William Gibson reflected upon how despite his status as a science fiction author, nothing could have prepared him for the kind of live intimacy-at-a-distance and participatory culture that is now folded into everyday life through social media practices. In 2014, reflecting on the significance of the birth of the internet, Gibson acknowledged that "[s]omething really changed between then and now in the geography of existence, in the way in which we can have these startlingly intimate and nonhierarchical, unfiltered experiences of things at a distance. [In 1994] following disturbances like Ferguson on Twitter would have been fantastically weird" [49]. Referring to the then incipient Black Lives Matter movement, Gibson marvels at Twitter activists' ability to mediate and participate remotely in

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CHI '21 Extended Abstracts, May 08–13, 2021, Yokohama, Japan

ACM ISBN 978-1-4503-8095-9/21/05.
https://doi.org/10.1145/3411763.3450377

the unrest in Ferguson, Missouri (following the killing of Michael Brown by police officer Darren Wilson).

What would have seemed "fantastically weird"—even to an esteemed cyberpunk novelist—is now part of a media landscape that many take for granted. But why do we experience such blind spots in our ability to imagine this kind of strangeness "just around the corner"? In subsequent years, why were so many surprised at the disruptive power of social-media driven political conspiracies, state-sponsored social media misinformation campaigns intended to sway elections, the rise of an international white nationalism movement enabled by social media, not to mention a president who governs by tweet. What other kinds of strangeness-within-reach may we be blind to? The discursive power that is activated through speculations about technology and sociotechnical change—what Anne Balsamo calls the 'technological imagination' —is not merely prospective in nature. Such discourse plays a very real role in shaping aspects of research, investment, and material culture. This influence can be problematic, for example in the ways that culturally narrow visions of the future tend to emanate from the elite research centers like Silicon Valley, recapitulating a colonial framework of cultural export to the periphery [20]. As Balsamo reminds us, however, there are also opportunities to shape the technological imagination through more reflexive and critical modes of practice. So how do we more productively play the role of agentive actors, shaping the technological imagination? In this paper, we turn our attention to virtual reality meetings, and ask ourselves, what new strangeness may be within reach? And how can we think critically and make more thoughtful design decisions now, in ways that help us to anticipate and respond thoughtfully to new "fantastically weird" collective capacities in VR and XR that could be activated in the near future?

In the wake of COVID-19, our capacity to imagine social change may now be more pliant than ever, as broad swathes of society have adapted to new ways of life, including new practices and platforms associated with remote work. Amidst shelter-in-place orders, Zoom quickly became the de facto tool of remote work and education. "Zoom fatigue" became the topic of editorials and academic research [15, 47, 59], with authors identifying this exhaustion as not only posture-related but also stemming from draining demands of attention management and confusing social cues. Some have suggested that an antidote to Zoom fatigue could arrive in the form of VR meeting alternatives [59], which promise more richly embodied ways of connecting while conveying a sense of shared presence with others [55]. The rise of XR[1] has brought with it a new set of interactional parameters to explore in shaping social experience [5]. Research has demonstrated that social VR, unlike traditional screen-based remote meetings, not only supports aspects of embodied awareness (e.g. a heightened experience of social presence [54]), but also enables new forms of social augmentation that exceed what is possible in face-to-face contexts (for example [2, 4]). Hypothetically, VR and XR telepresence tools could supplant a range of social interactions currently supported by video conferencing apps like Zoom, Google Meet, Skype, and Facetime, and in so doing, facilitate broader societal changes by limiting the need for frequent travel and commuting. Indeed, as we have mentioned, companies are racing to get there. A recent spate of current enterprise serving applications that support in-headset VR meetings include GlueVR, MeetInVR, Vive XR Suite, and Spatial (which also supports AR headsets like Hololens 2 and Magic Leap One). In addition, there are more generally consumer-facing commercial social VR applications that support remote meetings include Mozilla Hubs, AltspaceVR, and VRChat as well. We'll dive into example interactions from some of these applications later in the paper, as 'signals' from possible XR futures. For the most part, the examples we discuss here are situated in VR, but we expect that insights from our research may have implications for XR more broadly. While there is currently an AR/VR divide in terms of commercially available hardware, many acknowledge this distinction as a continuum [45] and expect the distinction to become less salient at the device level in the future.

As we explore possible XR futures, we attempt to update Hollan and Stornetta's embrace of technological mediations that transcend face-to-face interaction. We support the ambition of "Beyond Being There," as the path forward to widespread and creative adoption and use of technologies to supplement transporting our meat selves around the planet. Picture this scenario: Two work colleagues who share an office are in a face-to-face meeting when one of them says "let's migrate this into social VR." The two colleagues don headsets and continue their conversation. Why take this step when they're already sharing physical space? What added value can social VR provide? This question drives our research. As humans, we shape social practice with a range of props and routinized structures—from white boards to Roberts Rules—in order to scaffold social interaction and make particular kinds of social coordination possible. Consider the now familiar meeting scenario where participants collaborate on a shared Google doc while sitting together in person (or on a Zoom call where they could use a single shared screen). In such cases, the ability to accommodate active, real time collaboration on a shared writing goal with ambient awareness of what the other participants are working on drives individual screen-time while face to face. Much like how meeting participants migrate to a room with a whiteboard or projector, the move into social VR is one that could unlock new kinds of social affordances and capacities. We'll cover some of these ideas in the envisioning scenario later in the paper.

1.1 Related Work

It's important to acknowledge groundwork from other HCI and related researchers—here we briefly outline work with complementary trajectories to our own. Existing research on social interaction in VR, in particular Bailenson [2, 4], has demonstrated how interventions in VR environments can shape social interaction. This approach "transforms (i.e., filters and modifies) nonverbal behaviors during social interaction" [2], for example, using VR as experimental arena to study the effects of altered proxemics in interpersonal interaction [3]. Bailenson et al.'s concept of transformed social interaction (TSI) [2, 4] decouples visual feedback from the actual physical behavior of participants social VR contexts. TSI as category covers a range of phenomena including the so called "Proteus effect," achieved by altering one's avatar form to influence social behavior [60]. Other areas of TSI include: social mimicry [1], manipulation of interpersonal distance and gaze [3] and augmentations of gaze behavior, whereby a single VR user appears to be looking

[1]XR: an umbrella term encompassing VR, augmented reality, and mixed reality

directly at more than one individual [2]. More recent research by Roth and others explores social augmentations that manipulate or augment non-verbal social cues in VR [51–53]. This work includes augmentations of hybrid social gaze [53], and modulation of shared attention and proximity [52]. These sorts of studies demonstrate how altering the perceptual experience of an individual in VR can profoundly influence social behavior. The powerful effects of these sorts of interventions bolsters Hollan and Stornetta's stance that electronic media are best positioned to support new kinds of communicative affordances rather than "imitation of the mechanisms of face-to-face [interaction]"[26]. That said, existing work in the area of TSI and social augmentation in social VR has, thus far, focused largely on design interventions at the level of **individual** perception (i.e. individuals perceive differently which, in turn, impacts social behavior).

By contrast, our approach emphasizes the transformative potential of social affordances [16, 17, 27, 28, 43], perceived simultaneously by multiple participants. Thus, despite the important contributions of the work above, we argue that these sorts of studies miss opportunities for more radical departures from familiar models of embodied communication. Our research on this topic [27, 28, 43] illustrates how novel social affordances can unleash new collective capacities. Gibson's concept of affordance models human perception in relation to the action capacities of an embodied subject in the physical world for an embodied subject [25]. Likewise, social affordances represent an ecological approach to social interaction whereby the interactive features of bodies, artifacts, and environments all become potential resources for social mediation. In the physical world, for example, we can conceive of the social affordances of whiteboards, projectors, microphones, name tags, sticky notes, and other props that can be passed from hand to hand. These sorts of mediating artifacts operate as 'suprahuman' technologies [27] that transform the ways that humans can interact with one another and enable new kinds of social coordination to emerge. Accordingly, our approach to social augmentations for meetings in VR treats shared social experience itself as the site of design intervention (as opposed to intervening at the level of the individual perception). Our approach to designing for meetings in VR, then, is to expose multiple participants to new embodied capacities, new social artifacts, and new environmental features in order to augment social signalling and unlock new social affordances—or what we have come to think of as "social superpowers"—in VR.

Along these lines, we point to areas where all parties have access to a similar set of shared social affordances. These include: (1) social data visualization as a living feature of the environment, (2) alternative social geometries that expand our sense of embodied relationships in space, (3) new forms of embodied communication that support alien social rituals which would be otherwise impossible in traditional face-to-face encounters.

2 SIGNALS FROM POSSIBLE XR FUTURES

In this section, we gather seeds of an alternative vision for social VR (and XR), one that goes beyond the social patterns and familiar tropes of meetings in the physical world. To paint this picture, we synthesize material from a variety of sources including: (1) experiential vignettes from commercial social VR applications, (2) HCI research on social feedback systems for meetings, and (3) exploratory prototypes that visualize embodied social interaction in novel ways. While the perspective we take here is largely utopian in spirit, we recognize that this vision of the future could provoke more critical perspectives, and we welcome that discussion. There is likely another entire paper that could be written delving into the potential risks and ethical concerns associated with this technology or addressing contemporary issues of harassment—often gendered or homophobic—in social VR [11].

2.1 "Weird social" in Social VR:

For those of us who spend time in social VR applications, the phenomenology of social interactions carries certain unique markers that distinguish it from embodied interactions in the physical world. In commercial social VR applications, the social interaction templates we inherit from the "known world" can be jostled by a range of factors, including: differences in the physics of embodiment and locomotion, alternative geometries of attention, and novel semiotics of phatic [38] or affiliative signaling. These phenomena alter the social physics of embodied interaction in a variety of ways. For example, for users in conversation with one another, teleportation—a standard mode of locomotion in VR—tends to disrupt the orientational geometry (F-formations [14]) of bodies, with listeners "flickering" around the speaker as they make micro-adjustments in personal space and orientation. Flying mechanics (when available) further complicate F-formations by introducing verticality as an additional dimension. The semiotics of the body can also be complicated by users swapping their avatars frequently in the midst of a social interaction or by selecting and copying the avatars of interlocutors in the middle of an interaction. In VRChat, these avatar changes can happen so seamlessly that they can function almost like a form of embodied "punctuation" that peppers conversation.

2.1.1 New Social Rituals in VRChat. In the aggregate, these adjustments to social physics foreclose certain kinds of interactions and open up others. For example, since tactile feedback is not available, hugging can be less rewarding in VR, so some users in VRChat utilize the auditory feedback of kissing sounds as a greeting ritual to say hello and goodbye to friends.[2] While the mechanics of social VR can introduce new constraints (such as not being able to feel a hug from a friend), they also open up new affordances. Such shifts serve as fodder for the creative ingenuity of those who use social VR as they invent novel interaction rituals and redefine social norms. VRChat, in particular, is a social VR environment that has fostered a great deal of user innovation in the area of social rituals, for example, rituals of feeding, in which one user will offer virtual food to another [Figure 1]. The user doing the eating can participate through auditory feedback (loud eating sounds).

Some of these rituals are supported by particular mechanics of the platform, and others are entirely reliant on user performance. The latter category includes social sleeping which occurs in "chill rooms" designed to foster public co-sleeping [39]. Other forms of ritualized affection rely on specific mechanics such as "mirror

[2]In some cases, we have witnessed kissing sounds performed as an exaggerated "make out" noise to heighten visceral auditory feedback. Similarly rituals of erotic (or erotic-adjacent) auditory play are also prominent in VRChat; for example, users sometimes perform ritualized toe sucking on one another with audible sucking sounds seeming to serve as a key part of the performance.

Figure 1: VRChat user feeding a tomato. Image source: VRChat Moments https://www.youtube.com/watch?v=MNXSXE5OM_M&t=239s Creative Commons Attribution license (reuse allowed).

Figure 2: Rec Room's Q&A auditorium space.

cuddling," which involves cuddling with another avatar in front of a mirror. Without the sensory feedback of touch, visual, and auditory cues of physical contact then take on added significance.

2.1.2 New Geometries of Attention. Our research on social VR includes a study based on interviews of the creators of social VR applications including: Mozilla Hubs, High Fidelity, AltspaceVR, Rec Room, and AnyLand [30, 41]. Our goal was to better understand how the creators of commercial social VR think about shaping social interaction in this quickly evolving sector. What design lessons have they incorporated, and what sorts of values and approaches underlie their designs? Many of the creators we talked to were deliberate about utilizing scaffolding of familiar places and experiences from the known world to help shape social behavior, however, in other ways they pushed beyond mere replication of experiences from the physical world. For instance, this sort of departure from the known was particularly salient in contexts where creators had to design environments and feature-sets for large public gatherings where many participants needed to coordinate communication among each other. For example, the creators of both AltspaceVR and Rec Room participate in regular Q&A events or "town hall" gatherings as a way of communicating with and getting feedback from their users [Figure 2]. The application creators and community coordinators developed innovative approaches to environmental design and communication affordances.

The creators of Rec Room found that it was difficult for participants in their Q&A to spot who in the audience was currently speaking into the mic (since signals of spatialized audio and body language are not as clear as they might be in physical space). To address this problem, the creators came up with a rather ingenious solution. They designed a giant cat non-player-character (NPC) to sit on the stage to the side of the speakers and look at wherever the mic is at any given time [Figure 3]. With giant pupils visible to those in the audience, this NPC stares in the direction of the microphone wielding participant, so other attendees can track who is speaking at a given time. The introduction of this element into an otherwise familiar context opened up new capacities of social coordination and new geometries of attention (as participants monitor the cat's gaze). This example is illustrative of a common pattern we see playing out in the social VR sector: creators begin with familiar scaffolding—in this case the auditorium as experiential template—but then introduce new social affordances that begin to augment and stretch our expectations about space, communication, and social interaction. We hypothesize similar processes of discovery could uncover new social affordances in workplace VR meetings that expand our understanding of communication beyond what is possible in physical space.

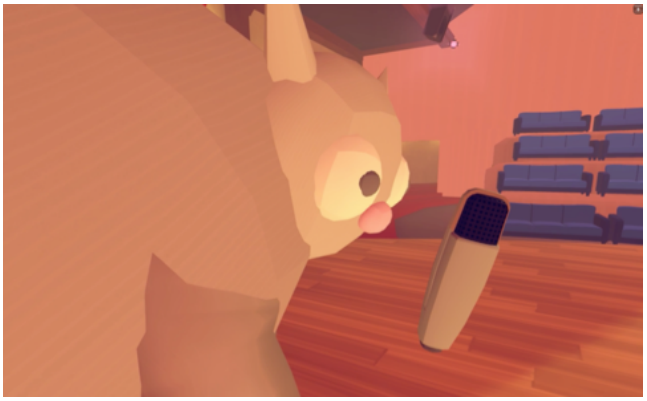

Figure 3: In Rec Room's Q&A space, a giant cat (NPC) sits on the stage and looks at whomever holds the microphone, so that audience members can track who is speaking at a given time.

2.1.3 Embodied Phatic and Affiliative Expressions. Emojis in VR offer an alternative channel for users to communicate emotional affect or phatic meaning, especially in group situations when attention may be split between a speaker or performer and an emoting audience. Figure 4 depicts emoji signalling in AltspaceVR, one of the software applications we examined in this work.

These signals emanate from a user's body and float upwards. During a highly touted first live concert by Reggie Watts in AltspaceVR, audiences utilized this emoji system as a way of communicating collective ambient feedback en masse (for example, as a form of visual applause). In Rec Room, Figure 5, the 'Expresso' emoting system represents a different emoji mechanic that enables users to quickly gesture to select a facial expression, which then appears as a bubble above their avatar's head. In addition, in Rec Room users not only signal emotions, but also team affinity, as a way of managing how groups navigate. The colored watch bands in Figure 6. let team members know that they can travel to a new world together as a unit, and they also signal a shared identity within a team.

Figure 4: VR users emitting virtual emojis at a live VR concert by Reggie Watts in Altspace VR. Image source: Jonathan Doyle, "Direhawk's Den" https://www.youtube.com/watch?v=qaAnAt8rAng Creative Commons Attribution license (reuse allowed).

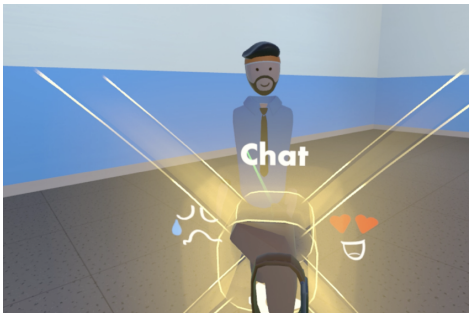

Figure 5: 'Expresso' emoting system in Rec Room.

Figure 6: 'Expresso' emoting system and team bands in Rec Room.

Despite the introduction of emotion and affinity signals in a variety of VR platforms, not enough is known about how these designs impact interpersonal communication, and significant design questions remain regarding how affective and affiliative signaling can best support communication goals of meetings. For example, should shared affinity signals be enduring cues that determine fundamental affordances like navigation, or could they also serve as ephemeral signals of affinity towards others that ebb and flow with context (for example, in the way that mechanics of avatar copying operate in VRChat)? Likewise, are traditional emoticons indeed the most effective way for collections of users to communicate affect? Alternative mechanics of affective communication, include those that channel group feedback through a collective representation. For example, the AudienceBot Microphone is a research-through-design exploration that enables audiences to convey real-time feedback to performers through a kinetic microphone that modulates its "mood" based on audience input [41].

2.2 Social Data Visualization as Environmental and Embodied Feature

Existing work on technologically mediated social augmentation (using any technology) has explored a range of data visualization feedback mechanisms including a wide range of research that uses visualization of sociometric data to improve social dynamics (for example, reducing interruptions and supporting verbal parity) [8, 10, 18, 19, 31, 33, 36, 37, 48, 57]. Related work also includes anonymous voting feedback [9], agent-based meeting moderation systems [5, 21, 22, 29, 34, 57], AI-driven social inference systems [6, 30, 56], robotic agents to assist with balance and turntaking [57], and augmented or "smart" meeting environments [24, 35, 50]. These sorts of interventions tend to support groups in developing reflexive awareness about the dynamics of their communication. HCI researchers have also developed systems that enable users to vote anonymously on parameters of social context including "dominance, turn taking, mimicry, and other aspects to allow people a third person evaluation of their own participation" [9]. Other HCI research has looked at designs which promote reflexive awareness of non-verbal cues such as proximity [33].

To our knowledge, thus far, little has been done to explore these sorts of social data visualizations and feedback mechanisms through virtual reality or other XR media. We see a promising opportunity to design social augmentations that take advantage of the unique affordances of VR by turning environmental and embodied features into visualizations of social data. Our own research on pro-social interaction in social VR has suggested that richer social signalling can be achieved by embedding social signals into the environment and the body [32, 43]. Figure 7 presents a preliminary idea for a VR interface that provides feedback to meeting participants about conversational imbalances (part of an immersive design fiction exploration set in VR [44]). In this example, colored balls emanate from speakers' mouths when they talk.

This concept was developed further and used in a recent lab-based study testing two different mechanics to support conversational balance in VR [see Figure 8] [23].

These range from creating visualizations such as balls accumulating in the room indicating how much each person has spoken (Figure 8) to a 'monster' (Figure 9) that orients to a person who has been speaking too often.

2.3 Visualizing Nonverbal Behavior

In addition to visualizing verbal behavior, a number of opportunities exist to visualize nonverbal behavior in ways that are not possible in the physical world. Figure 10 and Figure 11 show two explorations visualizing nonverbal communication created for an immersive design fiction that explored mixed reality work environments [44]). In Figure 10, multiple participants can join an environment and see

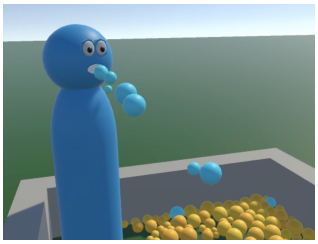

Figure 7: A VR prototype of a speech visualization mechanic to help groups become aware of conversational imbalances. Created as an exploration for an immersive design fiction [44]. Developed by Max Kreminski under guidance of Joshua McVeigh-Schultz & Scott Fisher in USC's Mobile & Environmental Media Lab.

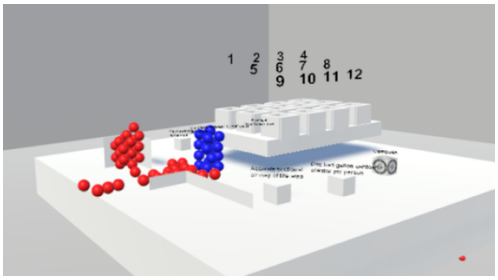

Figure 8: Evolution of the social data visualization concept used in a recent UCSC master's thesis [23]. As participants talk, balls corresponding to their avatar colors fill up columns, giving participants a sense of how much each person is talking relative to others.

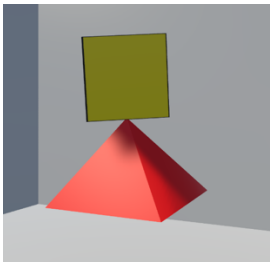

Figure 9: Evolution of the social data visualization concept used in a recent UCSC master's thesis [23]. A 'monster' orients to whomever is currently talking. When a participant is dominating the conversation, the monster's color changes to match the participant's avatar color.

enhanced representations of one another's gazes (depicted as green rays emanating from avatars' eyes). In addition, the objects in the environment gradually turn red to reflect the amount of attention received (leaving a trace in the environment that shows where attention has been focused).

Likewise, while existing gesture tracking systems in VR tend to focus on supporting gesture recognition to trigger actions, alternative opportunities exist to utilize gesture as a shared social resource

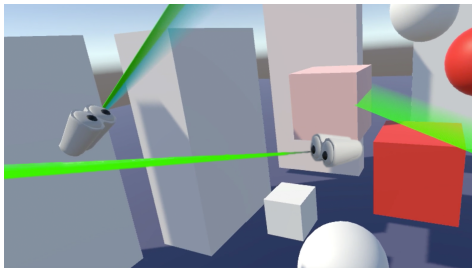

Figure 10: A VR prototype that enables users to see one another's gaze (shown as green rays emanating from the eyes). Developed by Max Kreminski under guidance of Joshua McVeigh-Schultz & Scott Fisher in USC's Mobile & Environmental Media Lab [44].

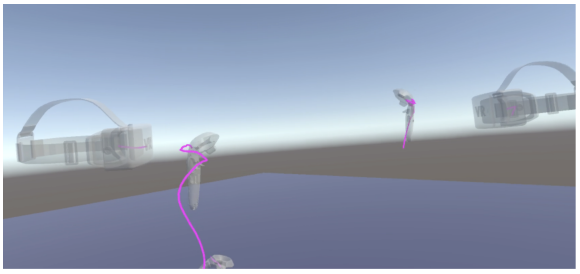

Figure 11: A prototype of a multi-user system that enables users to visualize their gestures by leaving looping animations in the environment as traces. Developed by Max Kreminski under guidance of Joshua McVeigh-Schultz & Scott Fisher in USC's Mobile & Environmental Media Lab [44].

for making meaning. Research has identified gestural communication as a key aspect of creative collaboration [46]. Conversation partners will even unconsciously mimic other's gestures or point to the space where another had previously gestured as a way of referring back to antecedent ideas or points made in the flow of the conversation [40]. By translating gestural communication into VR, these gestural antecedents become concretized as virtual assets in a shared environment, Figure 11 shows a prototype of a multi-user system that enables users to visualize their gestures by leaving looping animations in the environment as traces.

3 ENVISIONING THE FUTURE AS THOUGHT EXPERIMENT

Three decades ago, Mark Weiser laid out his vision for 21st century ubiquitous computing as part of an everyday lived reality [58]. While missing certain details, many aspects of Weiser's vision are now more or less a reality that we inhabit. To help manifest this vision, Weiser crafted a—now well known—narrative depicting a day-in-the-life of "Sal," a native of the ubiquitous computing future that Weiser envisioned. Prefacing this tale, Weiser acknowledges that: "To extrapolate from today's rudimentary fragments of embodied virtuality resembles an attempt to predict the publication of

Finnegan's Wake after just having invented writing on clay tablets. Nevertheless the effort is probably worthwhile" [58].

We attempt a similar envisioning exercise here, acknowledging the futility of any attempt at "prediction." Drawing from the sensibilities of design fiction [12] that now inform techno-social envisioning of experiential futures [13, 42], we use the frame and logic of a storyworld to "try on," "test out," and explore the inferential specificities of a lived world in an imagined near future. While the concept of 'Weird XR' emphasizes the strangeness of this new world, like Weiser (and others who have pointed to the power of defamiliarization as a research tool [7]), we are interested in the uncanny normalization of strangeness that fictional frames can offer. Below, we present a brief vignette depicting a day in the life in a possible near future, in which XR-enabled modes of socialized embodiment offer new ways to communicate, coordinate, create, and think together. These new modalities are "normal" to the inhabitants of our fictional world but—we anticipate—may come off as productively strange to our readers.

Stella awakens early to the murmurs of hushed voices. She opens her eyes to see the familiar cabin with beach-front vista, waves lapping softly in the distance and the sun beginning to peak above the ocean. Stella scans the room to see her virtual friends---part of a ''sleeping den'' that she joins each night---in various stages of waking-up. They lie on assortment of pillows and stylish lounge furniture. It is a cozy room and densely packed with slumbering bodies---although a few are now waking up. She has developed intimate and close-knit of friendships with the den members over the years, a fact that at one time had sparked jealousy in her wife, who still sleeps ''naked eyed'' (without a headset).

She switches out of VR-mode on her headset and gets out of bed. Later, making coffee in the kitchen of her small apartment, Stella chooses to share her morning coffee with her AR-telepresent family members (including her brother in Austin). Stella's four-year old daughter, Pinar, is awake now and wanders into the kitchen. Pinar is not allowed her own headset yet, but she says ''good morning'' to her uncle through a screen on the table. Her mother orients instead to a virtual avatar of the uncle (invisible to Pinar). Having grown up with these telepresence rituals, Pinar takes for granted that different geometries of eyelines can exist simultaneously. Stella has likewise grown accustomed to navigating confusing telepresence-redundancies in work meetings, since colleagues typically join through both in-world screens and VR avatars simultaneously, and quick decisions have to be made about how to orient when talking to dually present participants. Virtual gaze-visualizers (soft rays emanating from either in-world screen or avatar) help in these negotiations, and ambient feedback visualizes gaze-matching data to help teams make sense of how reciprocally attuned they are as a group.

In her ''home-office'' (a modest standing desk in her bedroom), Stella switches back into VR-mode on her headset and joins a meeting space to prep the facilitation environment for her clients --- a planning committee for an international summit focused on addressing mass migration associated with the climate crisis. For the past year, Stella has been freelancing as a social augmentation consultant for enterprise clients, government contracts, and NGOs. She specializes in supporting cross-cultural communication among international teams, which really means that she helps them select and configure custom augmentation features to better coordinate in telepresence contexts. The planning committee's eleven members hail from a handful of countries, and Stella knows from experience that this group will have fairly divergent communication styles, not to mention the challenges of coordinating time zones. When her clients join the meeting, fatigue monitors and local time icons will be visible above each avatars head. The environment will gradually darken as it gets late in the evening for the participants in East Asia. Since this will be a first meeting, she selects an exterior for the encounter --- a swooping cantilevered veranda with benches overlooking the mountains. She also selects a moderator agent --- an iridescent cat --- who will gracefully assist with speaker-turn-taking and interruption mitigation for the meeting. She adds a conversation tracker module that will enable participants to annotate key moments of the meeting along with a parity visualization to help the more loquacious participants to avoid dominating the conversation. While at one time, these features demanded considerable cognitive attention and tended to result in slower, more deliberate, conversations, people have since adapted to processing this kind of metadata less consciously. Many now turn on social feedback features in AR so that they can rely on these augmentations even when engaged in face-to-face conversation.

The goals for the meeting include general introductions, reviewing of virtual venues for the upcoming summit, and making some initial decisions about calendar logistics. When the guests arrive, they greet one another by sending so-called ''love-bomb'' animations to one another in place of handshakes or bows. One sends sparkling rainbows that emanate from the greeter's chest and briefly envelope others' heads with shimmering water droplets. Another sends a cherry tree from above their head that drops its blossoms on others in a shower of petals. Once seen as playful and frivolous, these animations are now so much a part of ritualized greetings that they read as appropriately professional for the context.

The first order of business is to decide on virtual venues for the upcoming conference. They examine miniature models of auditoriums, breakout rooms, outer space zero-gravity lounges, and ski-lift style moving vista experiences. For a closer look, some teleport into the environments (shrinking to scale) and then reemerge.

They signal interest in a particular conference space by wearing the miniature model as an accessory. Some pile their favorites on their heads, while others wear them like bracelets. While each pitches their favorite venues to the group, the other participants utilize anonymous signaling to indicate their vote. As the pitches wrap up, the cat circles around the more popular examples from the group.

Turning finally to a fairly meta-topic, the group samples a range of turn-management tools to see what would work best for a particularly fraught workshop event that they know from experience can get heated. They select a turn management agent --- this time a school of fish that congregate based on who has waited the longest to speak. They also select a conversational parity visualizer that makes your avatar shrink the longer you talk (unless your listeners decide to grant you additional time).

Wrapping up the meeting, she shows them the modules she had selected for today, and the group reflects on the impact of these interventions, which leads to a rather thoughtful conversation about cultural differences in communication style. They make suggestions about how to tweak the thresholds for what counts as an interruption as well as some minor modifications in the interaction mechanics to prevent teleporting into another's personal space.

4 REFLECTIONS AND NEW DIRECTIONS

As can be seen from the signals from a possible future that have been emerging in everyday interaction in commercial and artistic VR spaces, as well as through our own physical prototyping and future telling, there is great promise in 'Weird XR' for new forms of social connection. As we already have begun to blend our social selves and identities into digital forms that interleave with everyday life through laptop and mobile screens, we can imagine a future of social VR interleaved with nuanced social connection and communication such that social actors treat the decision to speak "nakedly" face-to-face as merely one metapragmatic choice among a variety of new social repertoires (enabled by a range of social XR augmentations). The repertoires can be shuffled, swapped, and remixed as we augment our social interactions in different ways in pursuit of different communicative goals. Difficult household discussions might go better if we don playful avatars seated in a soothing virtual environment; a work team might bolster diverse input by hopping into VR and tuning social settings to scaffold smoother turntaking without burdening a human moderator.

We see these speculative capacities of communication and coordination as a social superpowers that enable new forms of embodied communication: new affective or affiliative signals, new geometries of attention, new ways of balancing participation and managing turn-taking, and new nonverbal cues to support reflexive awareness of embodied dynamics and social processes.

We can see Weird Social XR not just as a form of playfulness of expression, but as a migration toward tools that enable us to be together better—to augment the space between us to enhance our collective capabilities, creating 'social super powers' to the benefit of us all. We have embarked on a systematic Research-through-Design process and continued landscape analysis of current social VR environments to build toward this future. We invite interested readers to join us in this set of explorations, by trying out our research prototypes and/or sharing inspirational examples from emergent VR spaces and places that we may not yet have experienced ourselves.

ACKNOWLEDGMENTS

This material is based upon work supported by the National Science Foundation under Grant No. 2007627 and No. 2007755. We also thank Mozilla for seed funding that went towards early research and exploration in this area. An early prototype created at USC was part of a research project funded by Steelcase Workspace Futures.

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COMMENTARY

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This paper introduces meaningful background regarding remote social interactions, making the point that a good goal is to achieve functionality/interactions which would not be possible with face-to-face meetings. The descriptions of current trends in VR communication tools such as VRchat are fascinating and to some extent do feel like something from a science fiction novel. The author's thought experiment did an excellent job of summarizing the ideas in the paper in a very concrete fashion that is both easy to understand and is comfortably reminiscent of Weiser's seminal paper.

The brief mentions of social interaction with Zoom in the abstract caught my attention initially. VR social interactions will certainly develop and play an increasing role in future remote communication. However, I am not convinced that users will always choose the technology that offers the most realistic "richness of interaction" referred to by Hollan and Stornetta (referencing Daft and Lengel). For example, since a face-to-face meeting has long been considered

the gold standard in "richness of interaction", one might reason that a video call is preferable to a phone call is preferable to an email. However, since many people choose to make audio calls when easy to use ad-hoc video call technology is commonly available demonstrates that there are other factors. (There are likely many "costs" involved in the choice of interaction method.) For example, I prefer audio-only calls for business meetings since I can focus on the meeting content and do not loose focus worrying about how I or other people look in the call. It has been said that this need for extra attention to video is the cause of "Zoom Fatigue."

Although the topics of XR and VR are interesting, surely there is significant room for research and innovation with the standard Zoom or Webex video call. Not only is it exciting to observe business video call software companies compete with new function on a monthly if not more frequent basis, but more importantly these features are rapidly approaching a "beyond being there" point. Long before we turned to video calls for everything during the pandemic, it was common for my coworkers to incorporate the use of video call software in our regular meetings since there were almost always remote participants. Unlike today where we are typically working in an isolated environment, before the pandemic the majority of participants would usually gather in one or two conference rooms equipped with projectors to share screen content. Although strictly unnecessary, nearly always the in-person participants would also join the video call even though they are in the same room, perhaps to see the slides better? Perhaps to better access online content such as chat? Perhaps to better interact with remote participants? These days, with polling, breakout rooms, interactive whiteboard and brainstorming tools, real time closed captioning, and even real time machine translation, there are more reasons than ever to continue this practice of using video call software along with in-person meetings. Additionally, with virtual backgrounds, dynamic video filters, eye-contact-correction filters, etc. perhaps it can be said that standard video calls are in fact getting closer to XR?

It is exciting to create brand new ideas and functionality, however, ease-of-use should not be ignored. This could be another reason why users purposefully choose communication technology that offers lower "richness of interaction" when other options are available. I for one look forward to the increasing availability of easy-to-use but non-intrusive communication technologies.