Immersive gathering: insights into virtual workplace meetings

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In the aftermath of the COVID-19 pandemic, the prevalence of remote business meetings through videoconferencing platforms such as Zoom and Microsoft Teams has substantially increased. While remote meetings provide benefits such as increased efficiency, flexibility, and environmental sustainability, they may also reduce meeting engagement, hamper conversational flow, or cause fatigue. This study investigates whether social Extended Reality technology can serve as a viable alternative for videoconferencing for remote business meetings. Employees from three distinct organizations in the Netherlands convened through Meta Horizon Workrooms, a collaborative virtual platform. Afterwards, participants were inquired about their perspectives on Extended Reality during semi-structured interviews that focused on the meeting's engagement, conversational flow and the system's usability. The study's findings highlight the benefits of Extended Reality for remote business meetings, as participants reported improved interaction, more togetherness, and a better conversational flow. Embodied virtual reality was identified as useful in supporting nonverbal communication by allowing for more natural interaction and turn-taking, similar to face-to-face interactions. Nonetheless, challenges associated with avatar realism and the developing technological state of Extended Reality present barriers, rendering current widespread adoption a difficult task.

1 Introduction

In recent years, the use of remote meetings at work has become more common. Particularly during the COVID-19 pandemic, the number of videoconferencing business meetings increased dramatically (Agostino et al., 2020; Waizenegger et al., 2020; Bennett et al., 2021). In response to government measures to combat the virus, a broad range of workers were forced to work remotely. After the global pandemic ended and the measures loosened, many of these workers retained their right to work away from the office (Gould et al., 2023). In the context of business meetings, this resulted in a large increase in the use of 2D videoconferencing platforms such as Zoom and Microsoft Teams (Standaert et al., 2022).

Remote business meetings offer several advantages. Firstly, remote meetings allow for greater flexibility in terms of scheduling and accommodating different time zones (Mohamedbhai et al., 2021; Standaert et al., 2022), given that participants can join from anywhere with an internet connection. Remote meetings can also optimise efficiency by

reducing time spent on extraneous activities such as commuting to a workplace. Consequently, this also lowers the environmental impact associated with in-person meetings, concurrently resulting in cost savings related to travel. Lastly, remote working may also facilitate work-life balance through easing the management and performance of tasks relating to the care of children and household work (Sullivan, 2012).

Presently, videoconference (VC) meetings have emerged as the predominant mediated communication method for remote business meetings (Karl et al., 2021; Standaert et al., 2021). Despite its widespread adoption, there are certain drawbacks warranting consideration. While VC may be adequate for short, routine business meetings aimed at information clarification, its efficacy diminishes in the context of longer meetings, particularly when robust interpersonal communication is critical for achieving meeting objectives (Standaert et al., 2022). This limitation is attributed to the VC meetings' deficiency in facilitating an exchange of opinions and emotions, or building interpersonal relationships (Standaert et al., 2021; Standaert et al., 2022). More specifically, this can be attributed to interlocutors in VC meetings lacking a sense of social presence – the feeling of being physically present with and socially connected to others (Biocca et al., 2003).

Furthermore, VC technology insufficiently supports business meetings as it only offers limited support for nonverbal cues. As a result, these meetings provide fewer opportunities for informal and social interactions than traditional face-to-face business meetings (Standaert et al., 2022). One theory that has been posited related to this limited support for nonverbal communication focuses on the concept of "nonverbal overload." In this theory, Bailenson (2021) contends that individuals must continuously interpret and enact nonverbal communicational cues; a challenge aggravated by VC providing fewer social cues (Sharan et al., 2022) than face-to-face (F2F) meetings, making it more difficult to discern subtle nonverbal cues such as facial expressions and gestures (Nesher Shoshan and Wehrt, 2021). Additionally, Fauville et al. (2023) indicated that nonverbal overload in VC meetings was exacerbated by individuals constantly observing themselves (i.e., "mirror anxiety" (Kuhn, 2022)), and hyper-gaze – the having to engage in reciprocal eye contact with multiple interlocutors simultaneously. As a result of this nonverbal overload, videoconferencing can hinder the ability to properly evaluate the reactions of others (Kuzminykh and Rintel, 2020a; Bailenson, 2021; Fauville et al., 2023). As VC meetings become more common and frequent, this may expose workers to a risk of diminished wellbeing (Standaert et al., 2022; Fauville et al., 2023; Queiroz et al., 2023). That is, the fatigue caused by videoconferencing – which has been popularly coined as "Zoom fatigue" (Bennett et al., 2021; Fosslien and Duffy, 2022) – can put individuals at risk of exhaustion or even burn-out in the long-term (Döring et al., 2022). The frustration arising from the aforenoted aspects of VC meetings may even trigger participants to purposedly lower their engagement in VC meetings (Kuzminykh and Rintel, 2020b).

Aside from its effect on participants' engagement, it has been suggested that videoconferences have a detrimental effect on a meeting's conversational flow (Bailenson, 2021; Skowronek et al., 2022). Whereas in F2F meetings the conversation naturally flows

from one subject to another, this dynamic becomes more intricate in VC meetings. Interlocutors have to make more effort to receive and send nonverbal cues, making active participation a more challenging endeavour (Bailenson, 2021). Furthermore, VC meetings are limited in their ability to support smooth turn-taking, meaning that it is more difficult for meeting participants to predict who will speak next at the end of the previous speaker's utterance (Skowronek et al., 2022). In F2F meetings, eye gaze plays a regulating role in this process, specifically by facilitating turn yielding (Degutyte and Astell, 2021). When gaze cues are not mutually shared, smooth turn-taking among interlocutors is inherently more challenging (Ishii et al., 2013). VCs typically have participants distributed in small and suboptimal positions on a screen, incommoding a consistent visual gaze with other participants (Horstmann and Linke, 2022). This obstacle in establishing and sustaining a visual gaze with other participants may encumber turn-taking during VC business meetings and subsequently impede a smooth conversational flow.

In instances where VC has limitations regarding the engagement and conversational flow of business meetings, eXtended Reality (XR) technologies (i.e., virtual, augmented or mixed reality) have the potential to be a viable solution (Campbell et al., 2019; Abdullah et al., 2021; Sadeghi et al., 2021; Döring et al., 2022; Standaert et al., 2022). Social XR, in particular, is an emerging social interaction paradigm mediated by XR technologies, where individuals experience social and spatial presence and engage in real-time interpersonal conversation and shared activities. Social XR is of particular importance to enable social interactions in the Metaverse (Hennig-Thurau et al., 2023), i.e., a network of virtual computer-mediated environments. Many social XR applications have been developed and deployed to better support remote interaction and collaboration during the COVID-19 pandemic (Osborne et al., 2023). Such applications and their immersive environments may allow users to interact in a similar manner to face-to-face communication, as it enhances users' social presence (Campbell et al., 2019; Abramczuk et al., 2023) and spatial presence (Hartmann et al., 2015). This, in turn, can promote more togetherness – the sense of being together with others in a virtual environment (Durlach and Slater, 2000; Barreda-Ángeles and Hartmann, 2022).

Moreover, social XR can enhance users' comprehension of the nonverbal cues exhibited by fellow participants, enabling users to discern others' intentions and gauge to what extent they are engaged to the meeting (Abramczuk et al., 2023), which is – as indicated before – proven to be challenging in VC meetings (Bailenson, 2021). Given that a better detection of nonverbal cues leads to improved turn-taking (Degutyte and Astell, 2021), this may also positively affect the conversational flow. A recent study by Mills and Boscher (2023) indeed suggests that social XR allows conversation partners to flexibly take turns through visual gaze, which further cements social XR's potential to overcome the disadvantages of VC for remote business meetings. Taken together, social XR not only enables a more natural and immersive experience (Skowronek et al., 2022), but also facilitates the convergence of individuals who are geographically separated within the same virtual environment. The sense of being in the same location allows them to communicate as if they were interacting in F2F (Perry, 2016; Standaert et al., 2022). In this exploratory study, we investigated whether social XR is able to sustain the advantages of meeting remotely, while concurrently mitigating the drawbacks

associated with remote videoconferencing. For this purpose, we facilitated XR meetings in various organizations' workplaces, allowing employees to review the XR system during an actual work meeting. The meetings were conducted in Meta Workrooms, a collaborative virtual office and conferencing platform that allows users to participate from diverse locations through the use of a head-mounted display (HMD). It provides a range of customizable office environments, adaptable to the specific requirements and preferences (e.g., giving a presentation, number of participants, etc.). Moreover, Workrooms employs embodied VR, which tracks participants movements and facial expressions and thus allows users to control the avatar's nonverbal communication in the virtual environment. Embodied VR has demonstrated efficacy in engendering a sense of social presence (Smith and Neff, 2018), and thus can be beneficial for remote meetings. As this interpersonal connection is critical for a group to collectively develop innovative ideas in brainstorm meeting (Paulus and Kenworthy, 2019), this type of meeting was selected to explore if social XR can offer a viable alternative to VC in regard to remote business meetings. This decision was reinforced by Abramczuk et al. (2023)'s study, which suggested that social XR can present an optimal platform for remote business meetings that require strong engagement from all participants. We expected that in these XR brainstorming sessions, participants would be more engaged and experience a more natural conversational flow compared to VC meetings.

2 Materials and methods

2.1 Participants

The current study recruited 42 adult participants (20 females, 22 males), with a mean age of 42.9 (SD = 11.6). The participants were employees recruited from three organizations in the Netherlands; which were i. an applied research organization, ii. an occupational health organization, and iii. a nationwide newspaper. Descriptives of the participants are shown in Table 1. Note that participants from the applied research organization were somewhat younger and mainly female, whereas participants recruited from the nationwide newspaper were mostly male.

2.2 Materials

2.2.1 Apparatus

Meta Quest Pro VR headsets were used to allow the participants to meet in virtual reality. The Quest Pro is a standalone device, no additional hardware is required. The participants were encouraged to utilize the motion control

TABLE 1 Participant characteristics, broken down by organization.

Organization	Mean age (SD)	Sex
Applied Research	36.0 (13.0)	12 females, 3 males
Occupational Health	48.9 (7.4)	7 females, 7 males
Newspaper	44.5 (9.3)	1 female, 12 males

TABLE 2 Technical specifications of the Meta Quest Pro headset.

Resolution	1800 × 1920 pixels per eye
Visual Field of View	106° horizontal x 96° diagonal
Refresh Rate	90 Hz
Peak Pixels Density	22 ppd
Eye, face and hand-tracking	YES
Spatial Audio	YES
Weight	722 g

feature instead of the controllers, allowing them to control the system with their own hands. The technical specifications of the VR headset are provided in Table 2.

2.2.2 Software

The business meetings were held in Meta Horizon Workrooms, a virtual collaboration platform developed by Meta. Users are represented by avatars (Freeman and Maloney, 2021), as is depicted in Figure 1. The avatars can be edited and customized to resemble participants in appearance. Horizon Workrooms aims to provide a more immersive meeting experience by incorporating spatial audio, as well as eye and face-tracking, which allows for more natural facial expressions. Each workroom can accommodate up to sixteen participants in VR and includes a variety of presentation and collaboration tools such as a digital whiteboard, file and screen sharing.

2.3 Procedure

A total of thirteen interactive brainstorm sessions – each consisting of 2–4 participants – were constructed to evaluate the experience of meeting in a virtual environment. All sessions for an organization took place on a single workday – for a total of three testing days – and within the corresponding organization's office. Most participants were already familiar with each other prior to testing. Before obtaining informed consent, participants were given information about the study aims and characteristics. Participants
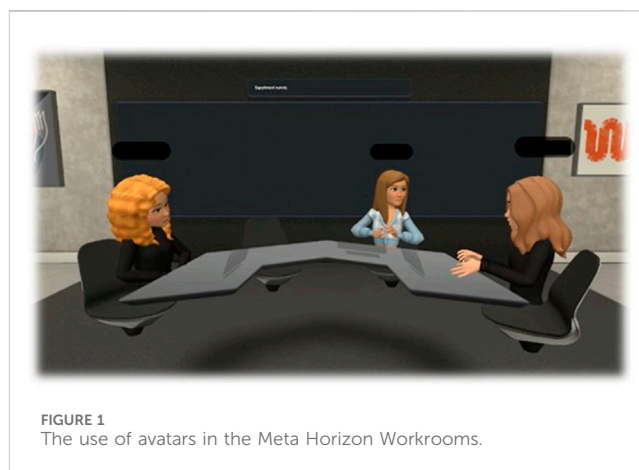

FIGURE 1
The use of avatars in the Meta Horizon Workrooms.

were explicitly instructed to engage in an interactive meeting session, discussing or brainstorming about a topic related to their work activities. Participants who had already organized their own meetings were asked to convene these scheduled sessions, whilst participants with no scheduled settings were given a script. Each participant was seated in a separate room, where he or she was handed a Quest Pro headset: simply putting on the headset made them enter the virtual room as an avatar. Participants were assigned either a male or female avatar, depending on their gender. The meeting sessions lasted between 20 and 30 min, and no data was collected through the virtual system during the meeting.

At the end of the meeting, each participant was interviewed individually. The interview questions were constructed after reading and familiarizing with literature on the topic of virtual business meetings, thereby identifying important components for successful meetings. The interview questions focused on engagement, meeting flow, and usability of the virtual application – see the Supplementary Material for the semi-structured interview guide. Participants were asked about cyber sickness – i.e., the bodily discomfort associated with exposure to XR (Weech et al., 2019), given that they could potentially experience cyber sickness symptoms during the meetings. Furthermore, participants were asked about their previous experience with gaming – as it may bring users more intuitiveness with the XR technology (Weech et al., 2020) – and Meta Horizon Workrooms on a three-point rating scale ranging from "none" to "considerable".

2.4 Analysis

After the meetings, participants were interviewed using a semi-structured format, focusing on the following topics: 1. engagement, 2. meeting flow, and 3. technical aspects of the virtual meeting. The interviews were transcribed ad verbum by two of the researchers. Thematic analysis was used to analyze the semi-structured interviews, which allows researchers to explore people's beliefs, perspectives, and experiences (e.g., Braun and Clark, 2019). The six-step approach outlined in Figure 2 was followed by the researchers. After completion of the semi-structured interviews, similarities between the interviews were coded into common themes by two independent researchers, with any inconsistencies resolved by consensus.

2.5 Ethical approval

Informed consent was obtained from all participants, and the Ethical Committee of TNO Healthy Living and Work approved the study.

3 Results

The current study explored whether social XR has the potential to become a superior option over VC meeting methods for
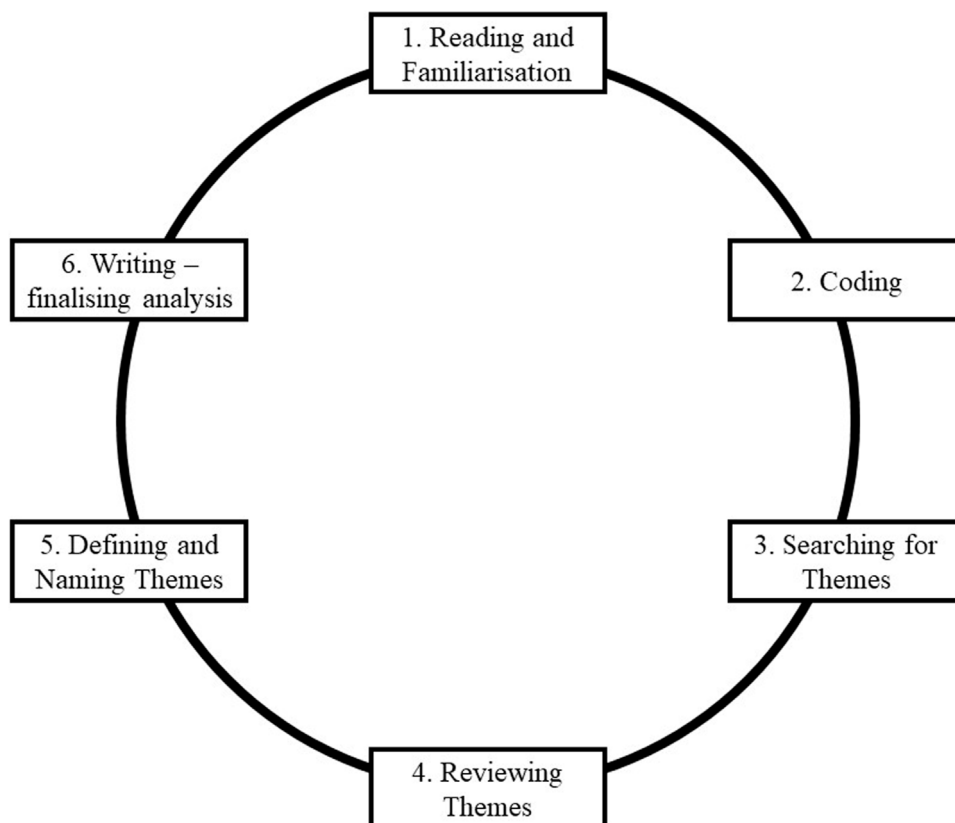

FIGURE 2
The iterative steps in the thematic analysis conducted in this study, as described by Braun and Clarke (2019).

TABLE 3 Topic-related themes identified from the semi-structured interviews.

Main theme	Sub-themes	Description
Engagement	Interaction	How participants evaluate the interaction with the other interlocutors
	Meeting participation	How participants evaluate their own participation
	Togetherness	The feeling of having a real personal connection to the other interlocutors
	Avatars	How participants experience the use of avatars
Flow	Turn-taking	The ease in which a turn is yielded from one speaker to the next speaker
	Interrupting	How natural or disruptive the interruptions during the conversation feel
Usability		The quality of the user experience when interacting the system

workplace business meetings. The vast majority of the participants had no previous experience with Meta Horizon Workrooms – i.e. 98%. Moreover, 47% of the sample reported no prior experience with gaming, compared to 24% with considerable gaming experience. The various topic-related themes and subthemes identified from the qualitative interviews are displayed in Table 3.

3.1 Engagement

Four subthemes were associated with engagement: interaction, meeting participation, togetherness, and avatars.

3.1.1 Interaction

A sizeable proportion of participants stated that the nonverbal communication – like facial expressions and body language – was easily discernible, improving the interaction. One participant noted that "facial expressions perhaps even appear to be magnified." This heightened visibility of their colleagues' expressions assisted a participant to "discern whether other participants were actively engaged in the meeting or distracted by the virtual surroundings." Participants were not unanimous about this however, as some felt that facial expressions and mimicry were "limited" and "imperfect," mainly due to the latency in the avatar's display of the nonverbal cues. Overall, participants appeared to prefer the interaction they had in social XR over videoconference meetings, but not over face-to-face meetings.

The auditory features of the XR technology greatly enhanced the interaction. Firstly, participants were able to recognize their colleagues through voice. Moreover, the spatial audio assisted participants in identifying the speaker and their location in the virtual environment: "When you are oriented towards an individual, the audio emanates from the corresponding direction." This helped the participants to turn to someone and establish eye-contact, or as a participant put it: "In VC meetings, the absence of direct eye gaze is notable; in contrast, the current meeting environment allows for direct visual engagement." This granted participants a significant advantage in their interaction over VC meeting methods.

3.1.2 Meeting participation

The majority of participants were very positive about how social XR enabled them to actively participate in the meeting. They indicated that they felt immersed in the virtual environment, without being bothered by distractions such as email notifications or text messages. Wearing an XR headset creates a barrier between the user and the outside world, consequently improving concentration and focus. Some participants were initially distracted by the novelty of their virtual surroundings, but this quickly abated.

3.1.3 Togetherness

Most participants felt as if they were sitting next to their colleagues at the same table within the virtual environment. This improved the sense of togetherness that is often lacking in VC meetings. Conversely, many participants indicated that the use of avatars caused a diminished sense of togetherness: "The absence of a tangible person beside me elicited the impression of an inauthentic and unnatural connection." Notably, they primarily felt a personal connection through the recognition of their colleague's voice instead of through visual input.

3.1.4 Avatars

The majority of participants found the avatars unrealistic and unsuitable for a work environment. Some participants claimed that the avatars were "doll-like" or even "Barbie-like." However, some participants considered the use of avatars as a way to make work more enjoyable, but only for meetings with colleagues they are familiar with and for informal practices. Some participants preferred the use of avatars at work as they have the potential to mask gender, age, ethnicity, and other characteristics, thereby promoting workplace equality. This was put into words by one participant, who said: "I experienced a greater sense of freedom in verbal expression, as I felt detached from my actual self." Notably, an age difference appeared in the perception of avatars, that is, dislike of avatars increased with age – see Figure 3. Also, participants' previous gaming experience seemed to positively influence the assessment of avatars. That is, participants with no gaming experience were less positive about avatars than those with some or extensive gaming experience.

3.2 Flow

Participants almost unanimously agreed that the meeting flow was superior in social XR compared to VC meeting methods. Two sub-themes were distinguished: turn-taking and interrupting.

3.2.1 Turn-taking

Participants reported that they experienced more natural turn-taking in social XR in comparison to VC meetings. This was primarily attributed to the avatars facilitating nonverbal communication in a more discernible manner than VC, such as facial expressions and
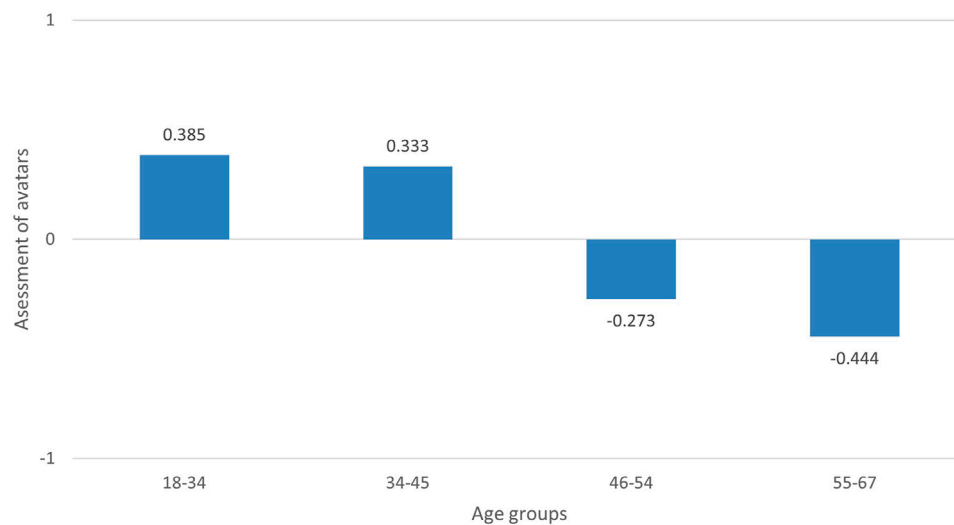
FIGURE 3
The effect of age on participants assessment of avatars based on quantified aggregated scores of the participants qualitative responses, whereby −1 = negative, 0 = neutral, and 1 = positive.

hand gestures. Furthermore, participants indicated that in social XR, the nonverbal communication allowed them to more directly grasp the intentions and desires of others, making it more efficient than existing VC meetings. Nonetheless, the present study only consisted of up to four participants per meeting. Whether these turn-taking dynamics remain intact with larger virtual group meetings still needs to be investigated.

3.2.2 Interrupting

Interrupting generally felt more natural in social XR than in VC meetings as social cues were easier to read. Furthermore, the participants reported feeling less bothered by a dominant speaker, as is more common in VC meetings. In social XR, the threshold to break into a discussion appeared to be more comparable to face-to-face meetings.

3.3 Usability

Almost all of the participants were positive about the ease of use of XR technology, and the functionalities were easily accessible and used. However, participants were instructed to refrain from using most functionalities and focus on the conversation. Whereas a few participants reported dizziness from moving around the virtual environment, the vast majority of participants showed no signs of cyber sickness whatsoever. The headset was generally well tolerated, but some participant found it uncomfortable near the end of the meeting. Note that in the current study the headset was worn for a maximum of 30 min.

4 Discussion

The objective of this study was to explore the efficacy of social XR in contrast to VC meeting methods within the context of

business meetings, with an emphasis on meeting engagement and conversational flow. Participants consistently expressed a preference for the interaction experienced in social XR over the conventional VC meetings. Furthermore, they were positive about the ease of taking and relinquishing a turn. These modalities were commonly attributed to the enhanced discernability of nonverbal communication in comparison to VC, such as hand gestures and body language. As a consequence, meetings in social XR were more closely aligned with F2F encounters. This finding is in line with previous research, which suggested that embodied XR can resemble F2F meetings not only in verbal, but also nonverbal communicative behavior (Smith and Neff, 2018; Maloney et al., 2020).

Participants expressed that they experienced less hindrance from dominant speakers in the XR meetings, in comparison to VC meetings. Previous research suggested that interlocutors utilize a more formal speaking style in VC meetings, whereas social XR meetings seem to emulate the less formal style of F2F meetings (Abdullah et al., 2021). This less formal style may contribute to participants being less hampered by dominant speakers. The incorporation of spatial audio further enhanced the meeting interaction by facilitating the identification of the speaker's location. The capacity to discern from which direction an interlocutor is speaking in the social XR environment allows individuals to turn toward others and engage in eye gazing, which contributes people in their interpersonal interaction. This creates a conversational environment similar to F2F meetings (Campbell et al., 2019).

However, participants maintained a preference for F2F meetings over the interaction in social XR. This inclination toward F2F meetings can be attributed to two underlying factors. The first factor is related to the technology itself, as the current imperfections in XR contribute to this preference. Participants indicated that the avatars often fail to accurately convey facial expressions, impeding the interpretation of nonverbal cues by

their interlocutors. Second, it is important to consider that for the majority of participants, this was their first meeting in a virtual environment. In previous research by Abramczuk et al. (2023), individuals were given the opportunity to use social XR for meetings over a duration of 7 weeks. Their findings suggested that their participants exhibited a gradual increase in receptivity of the XR system, suggesting the presence of a habituation phase. Interestingly, recent findings show that the intention to use XR technology is positively influenced by cognitive age (Charness and Boot, 2009; Yang and Shih, 2020). Here, individuals belonging to older age cohorts definitely held a less favorable disposition towards the utilization of avatars compared to their younger counterparts.

In line with previous research (Campbell et al., 2019), participants felt an improved sense of togetherness. However, the sense of proximity to other participants in the virtual environment originated more through the recognition of other participants' voices than the visual representation of their avatars. This underscores the importance of avatar realism (Bailenson et al., 2006). Consonant with previous research (Phadnis et al., 2023), the avatars were perceived as fun, but lacking in professionalism and consequently deemed as unfit for use for external business meetings. Moreover, participants indicated that the lack of appropriate facial expressions can cause conversations to feel artificial, a sentiment previously emphasized in research of XR featuring avatars (Abramczuk et al., 2023).

5 Limitations and future work

A major limitation of this study is the notable divergence in resemblance between the avatars and the participants. Unfortunately conducting the study on-site during the participants' workdays, imposed time constraints that prevented modifications of the avatars prior to each meeting. Considering the *Proteus* effect (Yee and Bailenson, 2007), which states that an individual's behavior in the virtual environment is altered by the characteristics of their avatars, this divergence may have influenced the behavior participants exhibited during the meeting. In social immersive environments, realistic avatars are rated significantly more human-like when used as avatars for other participants and evoke a stronger acceptance in terms of virtual body ownership (Latoschik et al., 2017).

A second limitation is rooted in technology, namely, the reality head-mounted display (HMD) that users wear in order to enter the virtual world. Various participants argued that they experienced wearing the HMD to be cumbersome after a while. This would make it difficult for participants to engage in longer or multiple subsequent meetings in a day, which reduces the efficacy of the usage of XR for business meetings. Nonetheless, as XR technology develops, newer HMDs tend to weigh less and impose less stress on a user's head. In line with previous research on XR meetings (Abramczuk et al., 2023), no issues related to cyber sickness were found. This is promising for the future use of XR as a platform for meeting purposes, as its acceptance is negatively affected by cyber sickness (Sagnier et al., 2020). One additional limitation arose from the Wi-Fi connectivity. In some sessions, technical difficulties relating to the Wi-Fi connectivity were encountered, resulting in restricted meeting capabilities during those meetings.

Given that the meeting groups in this study were limited to a maximum of four participants, the dynamics of taking and yielding conversational turns in multiparty XR meetings remain uncertain. As was discussed earlier, participants were very positive about the ease of turn-taking in these relatively small groups. However, multiparty VC meetings can comprise of groups with a significantly larger number of participants than four. In these meeting scenarios "false start" issues may appear, meaning that multiple listeners attempt to initiate a new turn, resulting in those speakers interrupting each other and necessitating multiple iterations to ascertain who can proceed the next turn (Skowronek et al., 2022). Considering that the gaze patterns are crucial for interaction and turn-taking appear to differ in varying group sizes (Maran et al., 2020), investigating how these manifest in XR could be an interesting avenue for future research endeavors.

In addition to the restricted group sizes, a limitation of this study was that it only contained a single session. Participants articulated the necessity to acclimate to the virtual environment. Hence the outcomes of this study may have differed if the participants had accrued a more extensive familiarity with the system. Consequently, exploring the responses of participants subsequent to prolonged usage could yield further valuable insights into the use of XR technology for meetings. Additionally, some participants indicated the importance of knowing the other participants beforehand – or indicated they felt togetherness due to the recognition of their interlocutors. Hence, the findings of this study may have been influenced by whether a participants knew the others or not.

Additionally, in this single testing session, participants received attention and support. Firstly, the meetings were relatively short, which was a deliberate choice as most participants were first time users, most participants were familiar with the other participants, and only used a single software application, which was readied for them by the researchers. This session was then compared to all previous experiences with VC and F2F meetings. In other words, this study compares a standardized version of XR meetings to unstandardized VC and F2F meetings. Consequently, participants contrasted one well-organized XR meeting to a wide array of non-XR meetings, potentially leading to an exaggeratedly more favorable experience for the XR meetings. Issues around factors such as connectivity issues were not taken into account, which could potentially lead to problems for XR meetings in places with less stable internet connection in comparison to the Netherlands. Besides this, almost none of the participants in this study had previous experience with XR meetings. Future studies could further investigate how various of these scenario's that may occur during the "real-life" usage of XR applications could affect people's perspective on XR meetings.

The use of avatars has limited many participants in their interaction with other interlocutors. This has, however, also had its advantages, particularly in their capacity to serve as facilitators of workplace equality. For example, the utility of avatars has the ability to support individuals experiencing discomfort with public speaking by offering a sense of concealment behind their virtual representation (Abramczuk et al., 2023). This positively

contributes to the impact XR meetings can have on reducing the perception of being observed and the lowering of self-consciousness in comparison to VC meetings (Lenning et al., 2023). Given that lowering these negative effects decreases the nonverbal load (Bailenson, 2021; Fauville et al., 2023), the usage of avatars has the potential to increase the overall wellbeing (Fauville et al., 2023). However, previous research also suggested that individuals using an avatar of a person with a different skin color or cultural identity may reinforce negative stereotypes (Nakamura, 2002). Investigating how avatars affect workplace discrimination and equality may serve as an interesting trajectory for future studies.

Lastly, the importance of avatar realism implies the potential viability of photorealistic social XR for remote business meetings, in which individuals are scanned by a camera, and their representations are displayed in the virtual environment via the utilization of point cloud technology (Prins et al., 2018; Gunkel et al., 2021). The efficacy of certain platforms for business meetings could be a promising trajectory for future research.

6 Conclusion

In conclusion, this study has investigated whether social XR technology holds promise as a viable alternative to VC methods for conducting business meetings. The study has shown that the use of social XR comes with benefits for conducting remote business meetings and presents interesting possibilities for mitigating the challenges associated with remote VC. Participants of the study reported improved interaction, more togetherness, and a better conversational flow when using social XR. Embodied virtual reality was identified as useful in supporting nonverbal communication by allowing for more natural interaction and turn-taking, similar to face-to-face interactions. However, it must be taken into account that the current study was exploratory and compared one meeting in XR to a wide range of previous VC and F2F meetings. Furthermore, certain obstacles must be addressed before endorsing the widespread adoption of XR for remote business meetings. These obstacles pertain to avatar realism and the developing technological state of social XR, which renders current widespread adoption a difficult task. Subsequent research should address these issues.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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Ethics statement

Author contributions

NH: Data curation, Methodology, Writing–original draft. MS: Conceptualization, Data curation, Methodology, Writing–review and editing. SG: Writing–review and editing. NW: Conceptualization, Writing–review and editing. GL: Writing–review and editing. ON: Writing–review and editing.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frvir.2024.1391662/full#supplementary-material

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