

How Embodiment in Virtual Hybrid Meetings Affects Collaboration Experience: An Explorative Investigation

Short Paper

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Abstract

The metaverse offers promising opportunities to enhance the experiences in virtual meetings. However, its limitations have led to the emergence of virtual hybrid meetings. This meeting format uses virtual conference rooms accessible via head-mounted displays (HMD) and 2D video interfaces. Given the limited research on virtual hybrid meetings, an exploratory approach is needed to determine key perspectives and dimensions. This short paper initiates a discussion on how hybrid meetings impact meeting experiences, focusing on employee collaboration. We also shed light on the role of user embodiment in shaping meeting experiences. Our early insights lay the groundwork for future investigations, which will explore how hybrid meetings can foster a sense of togetherness and boost well-being as well as group performance. Thereby, we support companies to implement metaverse meetings while addressing constraints such as cost and health concerns, ultimately enhancing meeting experience and productivity.

Keywords: Virtual Hybrid Meetings, Virtual Collaboration, Meeting Experiences, Virtual Meeting Formats, Embodiment, Social Presence

Introduction

Virtual collaboration has become a reality for many workplaces in recent years, with remote work and virtual meetings becoming increasingly common. Therefore, many organizations rely on online 2D videoconferencing (VC) platforms such as Zoom, Teams, or Skype to accommodate the needs of a remote workforce (Bailenson, 2021). While such platforms have improved employees' flexibility, their technological affordances cannot compete with face-to-face interactions in a physical office (Kydd & Ferry, 1994). In real-world meetings and communications, individuals can refer to additional behavioral cues that are lacking in 2D VC meetings, which is why employees demonstrate, for instance, excessive nodding to signal their attention (Bailenson, 2021). Additionally, simple VC tools are limited in reproducing the social

aspects of the workplace (Purdy, 2022). Employees miss being in a room with work colleagues and feeling physically connected to one another (Serhan, 2020).

To overcome challenges such as limited social connectedness, researchers suggest meeting in virtual environments accessed through HMD, also called VR metaverse (e.g., Abdullah et al., 2021; Hennig-Thurau et al., 2022). The VR metaverse allows users to experience online meetings more realistically by relying on immersion (Duan et al., 2021). Although using the VR metaverse provides some promising possibilities for designing meetings more effectively, there are some downsides. First, health issues can impede the adoption of such VR metaverse meetings, as health experts warn about potential health problems when wearing HMD continuously for longer than 30 minutes (UK Government, 2020). Second, prices for headsets remain high, and the software infrastructure is still error-prone due to the nascent stage of the HMD market (Q.ai - Powering a Personal Wealth Movement, 2023).

Virtual hybrid meetings have been developed to overcome such limitations and to allow all employees to collaborate in a virtual room. Virtual hybrid meetings are a specific format of virtual meetings where the virtual conference room, such as Horizon Workrooms, can be entered via an HMD and a 2D video interface (e.g., Meta Quest Remote Desktop-App) (Marr, 2022). In these hybrid meetings, avatars represent employees who access the virtual meeting room via HMD, while a camera livestream depicts the employees who join the meeting with a traditional VC application. Figure 1 illustrates such a hybrid metaverse meeting.



Many organizations may prefer virtual hybrid meetings over pure VR meetings due to cost and health-related barriers associated with VR technologies. Nevertheless, VR meetings received increasing attention from scholars (e.g., Abdullah et al., 2021; Hennig-Thurau et al., 2022; Khojasteh & Won, 2021), while research on virtual hybrid meetings remains highly underrepresented. Extant literature shows that collaborating in the VR metaverse may impact the participants' feeling of embodiment and flow (Biocca, 1997; Mennecke et al., 2011; Van Schaik et al., 2012) and improve virtual collaboration compared to VC solutions. Further, researchers explored that the VR metaverse could increase participants' social presence, exhaustion (Hennig-Thurau et al., 2022), and cybersickness (Breves & Stein, 2023). However, there is a lack of research on the extent and direction to which virtual hybrid meetings affect these experiences. We address the following research question to fill this research gap: *How do virtual hybrid meetings affect their participants?*

To answer our research question, we are planning a between-subject experimental study as our main study. By emulating a virtual collaboration meeting in a VR, a VC, and a virtual hybrid setting, we will compare employees' experiences, well-being, and performance across all possible formats of virtual meetings. Our main study will examine subjective well-being as a key employee-related outcome variable, specifically emphasizing the participants' emotional states (Diener et al., 2010). Recent research suggests that with better emotional well-being, individuals perform better during meetings (Oswald et al., 2015). Therefore, our main study will also shed light on the role of well-being in enhancing meeting performance in terms of perceived team performance, creativity, and quality of interaction regarding the task solved (Hennig-Thurau et al., 2022).

This short paper follows an exploratory approach to lay the groundwork for guiding our main study by identifying the perspectives and areas fruitful for investigation. Specifically, this short paper discusses how hybrid meetings can impact employees' meeting experiences, which in turn may impact meeting performance mediated by well-being. Together, our short paper and the planned experimental study contribute to theory and practice in several ways. For theorists, we set the foundations for understanding how hybrid meetings can support a cohesive sense of togetherness and make hybrid group work more effective. To bolster our theoretical contributions, we integrate our conceptual findings with insights from embodied social presence (ESP) theory and flow theory. For practitioners, we provide applicable guidelines on designing productive virtual hybrid meetings.

Theoretical Background

Embodied Social Presence Theory

ESP theory was initially proposed to analyze individual-level communication in virtual worlds that allow for the representation of the physicality of the human body and the space around it. The theory's central tenet is that the human body is a crucial instrument for communicating with others and participating in social activities (Mennecke et al., 2011). ESP theory states that the degree of embodiment – the degree to which all bodily characteristics (e.g., body shape) and expressions (e.g., physical movements and gestures) are represented in the virtual space – affects the perceptions and experiences of users as it determines their level of cognitive preoccupation (Leveau & Camus, 2023; Mennecke et al., 2011; Miao et al., 2022). For example, a 3D avatar has a higher degree of embodiment than a 2D video depiction and should be more stimulating for the user's mind (Biocca, 1997; Elsharnouby et al., 2023). The theory uses these insights to explain the impact of the degree of embodiment on social presence, self-presence, and spatial presence during activity-based social interactions in virtual environments (Mennecke et al., 2011).

Firstly, social presence can be defined as the “sense of being with one another” (Biocca, 1997). Secondly, self-presence describes “users' mental model of themselves inside the virtual world” (Biocca, 1997). Thirdly, spatial presence, also referred to as physical presence or sensory engagement, is defined as “the degree to which the senses are engaged or connected to the interface” (Biocca, 1997). The theory suggests that users with a high degree of embodiment in the virtual environment tend to have higher levels of social presence, self-presence, and spatial presence (Biocca, 1997).

The application of ESP theory to our study is beneficial because it provides a framework for understanding potential differences in user experience, well-being, and performance across different types of meetings that are characterized as specific combinations of meeting format (VR, VC, hybrid) and form of embodiment (avatar, video depiction). By considering the sense of social presence, self-presence, and spatial presence that participants experience in each type of meeting, the theory can inform the design of the virtual environments used in the study and facilitate the assessment of their performance outcomes.

Flow Theory

Because flow is an essential experiential mechanism that shapes and explains emotional well-being and performance (Bartholomeyczik et al., 2023), we draw on flow theory to understand how meeting formats and user embodiment affect participants' flow. Flow, initially introduced by Csikszentmihalyi (1975), is referred to as a “highly enjoyable psychological state that occurs when people are engrossed in an activity” (Drengner et al., 2018). It results in hedonic outcomes (e.g., enjoyment) and impacts learning and attitudes (Nah et al., 2011). In the past, the dimensions of flow were used inconsistently (Drengner et al., 2018; Norsworthy et al., 2023). In line with Drengner et al. (2018), we conceptualize flow as loss of self-consciousness, transformation of time, concentration on the task at hand, and action-awareness merging. The authors describe flow as an intensely engrossing experience, spanning from mild engagement to complete immersion. Immersion, the highest state of a flow experience, is characterized by deep physical and mental connection in the present moment, making an environment feel more proximal (Haj-Bolouri, 2023).

This study examines to what extent the different combinations of meeting formats and forms of embodiment influence the flow of employees as a further key experience in addition to the presence-related

experiences suggested by ESP. Enhancing flow is a powerful means to improve employees' well-being and meeting performance since many employees encounter difficulties entering or maintaining a flow state (Bartholomeyczik et al., 2023).

Research Approach

In our planned main study, we will conduct a 2 (embodiment: avatar vs. camera livestream) × 3 (meeting format: VR vs. virtual hybrid vs. VC) between-subject experiment in which we simulate a work meeting. We provide an overview of our three planned studies and the corresponding four treatment groups in Figure 2. In each study, we will randomly assign the participants to one of four treatment conditions. In study 1, we will compare the effect of avatar vs. camera livestream embodiment within hybrid meetings on meeting experiences and performance. In study 2, we will compare the effects of a camera livestream embodiment in hybrid meetings with a camera livestream embodiment in VC meetings. Study 3 will compare the experience and performance effects of avatar embodiment in hybrid meetings with avatar embodiment in VR meetings. Due to the low adoption rate of avatars in VC meetings, we will not compare avatar embodiment in VC meetings with avatar embodiment in VR or hybrid meetings.

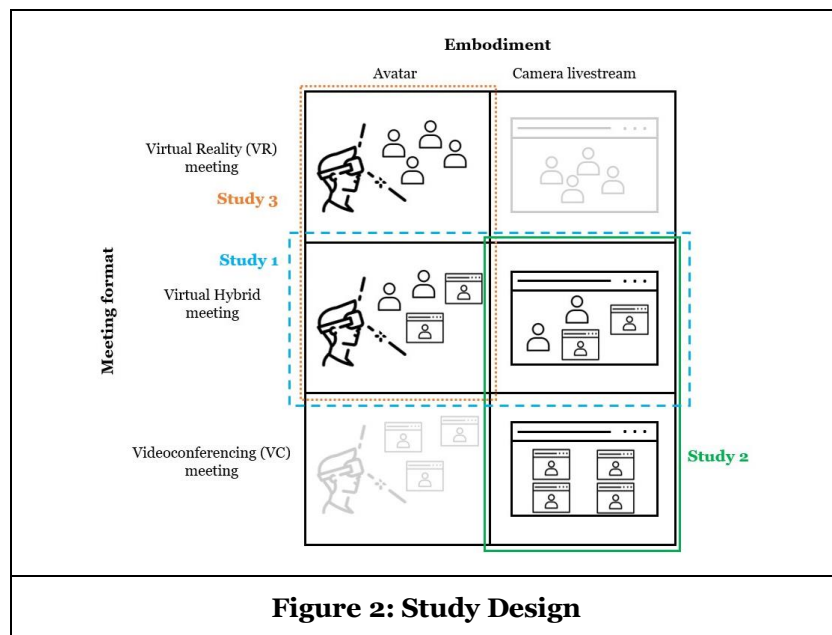


Figure 2: Study Design

After the experiment, participants will take an online survey to measure several constructs concerning their virtual meeting experiences. We will recruit at least 116 participants and assign them into groups of six, with 3 participants each represented by an avatar and a video livestream. Due to the novelty of the VR metaverse as a research topic, we decided to initially explore different perspectives and dimensions of hybrid meetings to establish our research model and to prepare our main study. The results of this explorative pre-study will be presented in the following section.

Explorative Pre-Study

Throughout the explorative pre-study on hybrid meetings, the participants needed to solve three different collaborative tasks, capturing the diverging task requirements of real-world workplace collaboration. In the first task, participants received five estimation questions, and they were given three minutes for each to agree on an answer, as this is the standard for estimation tasks established in the literature (e.g., Abdullah et al., 2021). This “intellective task” was mainly focused on group interaction to solve problems with a correct answer. In the second task, a “decision-making task,” the groups were asked to find a solution for a plagiarism scenario. It involved agreeing on an ethical matter with no objectively correct answer. In the third task, a “mixed-motive negotiation task”, the groups were asked to find mutual agreements for different

aspects as part of a party-planning committee. As participants had to agree on aspects that stood in correlation (e.g., entrance fee and amount of catering), participants had to employ multi-issue negotiations, requiring high communication and interaction intensity. Participants spent 15 minutes working on each task type, and the experiment lasted approximately 45 minutes per group.

As typical for an online lab experiment (Fink, 2022), we recruited 16 graduate (business) students and asked them to participate in four emulated work meetings, with four participants each. The 16 participants were, on average, 24 years old, and 57% identified as female. Graduate students are desirable for pre-tests as their younger demographics are usually associated with higher technology usage (Vogel, 2019). As the virtual (hybrid) meeting technology is still in its infancy, early users must be more tech-savvy than users of more mature technology versions. Hence, we expect graduate business students to be an appropriate proxy for future virtual hybrid meetings in an organizational context. In each experiment, two participants were embodied as avatars and used a 'Meta Quest 2' headset to join the hybrid meeting. The remaining two participants were embodied via a camera livestream and joined the meeting via the Horizon Workrooms web application. During the experiment, the participants were required to complete the previously introduced three tasks. Afterward, the participants embodied as avatars (VR participants) remained in the VR setting to discuss their hybrid meeting experiences. The participants embodied via camera livestream (VC participants) were interviewed via Zoom. In the following, when quoting their feedback, we refer to them as interview participant (IP).

Insights on Flow and Social Presence in Hybrid Meetings

The exploratory study serves as a foundation for our full-fledged experiment. The most striking and counterintuitive findings are presented below to stimulate a discussion about hybrid meetings and to suggest avenues for future research, as they provide valuable insights into participants' perceptions of hybrid meetings.

Insight 1: The display settings of VC participants severely impact their meeting experiences.

In horizon workrooms, VC participants can use a grid view, which enables them to see all other participants simultaneously. Additionally, horizon workrooms allow VC participants to center the virtual room or the presentation in full-screen. In the latter two cases, VC participants are displayed in small tiles. VC participants with the full-screen VR room setting described the meeting as more interactive (IP4,7,8) and had the feeling that "everyone is present and working together on one task" (IP8). Interestingly, only the full-screen virtual room setting distinguishes the hybrid meeting for VC participants from Zoom meetings. IP1, with a full-screen presentation setting, states: "Well, I have to admit, because the whole screen was the presentation, (...) it made no difference for me at all [compared to a Zoom meeting]".

With the full-screen virtual room, VC participants felt more immersed and present in the VR room than participants with a grid view. Participants noticed the gestures used by avatars, the direction of gaze, and experienced fewer disadvantages of VC meetings (e.g., more formal turn-taking, longer backchannels) (e.g., Abdullah et al., 2021). Consequently, participants perceived an improved conversational flow (IP1, IP2, IP5, IP6, IP7, IP9, IP10, IP13). Thus, the advantage of increased visibility of social cues in VR settings also extends to VC participants. Thereby, hybrid meetings may blur the line between VR and VC meetings. Moreover, participants of video conferences are increasingly focused on themselves, which can be mitigated by certain features of virtual hybrid technologies (e.g., merging video-livestreams with avatars) (Bailenson, 2021; Ratan et al., 2022).

Insight 2: Virtual hybrid meetings increase social presence, also for video participants.

Our participants indicated that virtual hybrid meetings increased the social presence of VR participants (IP1, IP2, IP5, IP6, IP9, IP10, IP13, IP14), which is in line with existing research on VR metaverse (e.g., Duan et al., 2021; Hennig-Thurau et al., 2022) that states VR meetings are, in terms of certain qualities, more similar to face-to-face interactions rather than VC meetings (Abdullah et al., 2021). However, many VC participants reported feeling no social presence during the hybrid meetings, as IP11 described: "I was like a 'spectator'. So, of course, they could also interact with me, but yes, there was a certain barrier, I would say." While IP11 visualized the virtual hybrid meeting in the grid view, the VC participants who viewed the virtual room full screen had contradicting experiences. Surprisingly, those individuals reported an increased social presence, as one VC participant described: "I felt like I was in the same room with the

people. So, I didn't feel any difference, even though I didn't have an avatar, but saw you on my computer" (IP4). This is counterintuitive as we would expect VC participants to feel socially excluded as they did not share the avatar embodiment. Still, they felt socially embodied if they experienced the virtual room full screen.

This finding contradicts existing studies' conclusion that 2D platforms usually lead to a lower social presence than VR platforms (e.g., Hennig-Thurau et al., 2022) due to limited social cues (Bailenson, 2021; Bonfert et al., 2022). For instance, gestures are rarely used in 2D meetings (Abdullah et al., 2021). VR meetings, on the contrary, are expected to lead to increased physical mobility, which includes more head movements and further visual, auditory, and haptic stimuli (Hennig-Thurau et al., 2022). In this context, our findings indicate that virtual hybrid meetings can expand the visibility of social cues displayed by avatars to VC participants. This is further supported by the participants' insights, citing the gaze direction of avatars as an instrumental benefit compared to VC Meetings (IP 4, IP8, IP11, IP16).

Insight 3: Virtual hybrid meetings reduce the feeling of being watched, promote psychological safety, and lead to a loss of self-consciousness.

During VC meetings (e.g., on Zoom), participants usually see all other participants in a grid view. This function often leads to a sentiment of "being watched" during those meetings, as several participants described during the interviews (IP1, IP2, IP4, IP9, IP10, IP11, IP15). Within the virtual hybrid environment, VC participants reported feeling less watched. As one VC participant described: "I would probably feel more observed in a Zoom meeting than in the virtual workroom because in the workroom, from my perspective, the two [avatars] were looking at each other and only sometimes in my direction, but not all the time, as it is the case in a Zoom meeting" (IP15). This perception was echoed among all the VC participants, reporting they felt much more at ease (IP1:2, IP4, IP7:11, IP13, IP15). Further, they also mentioned that knowing where the avatar participants looked "eased the atmosphere and [...] took away all the tension" (IP11). This is consistent with previous research that has acknowledged that the gaze in videoconferencing does not realistically depict social interactions and can have undesirable social consequences (Bailenson, 2021). However, possible solutions have been addressed to hide the self-view within the calls to reduce awareness of being watched (Bailenson, 2021). We are the first to identify the impact of the social counterparts' representation as avatars on the perception of being watched in virtual meetings.

Furthermore, hybrid meetings supported the VR participants' meeting experience. Like VC participants, VR participants felt much safer being embodied as an avatar, not a video stream. Specifically, they reported feeling an increased sense of anonymity that distanced themselves from their depiction (IP1:2, 9:10, IP13). IP2 described it followingly: "So for me, I've never had the feeling at a Zoom meeting that I can be and feel so physically involved, but still somehow have a kind of anonymity." This is in line with the findings of other studies suggesting an increased sense of privacy in VR meetings (Bonfert et al., 2022). Further studies have already indicated not showing the face is a major advantage of VR meetings, which gives participants more confidence (Khojasteh & Won, 2021; Yoshimura & Borst, 2021). We frame this occurrence as psychological safety. Psychological safety can occur when individuals create an environment in which they confidently engage with each other (Bartholomeyczik et al., 2023; van den Hout et al., 2016).

All participants, independently of their depiction, described they were not concerned with what others may have been thinking about them regarding their actions. This statement relates to a loss of self-consciousness (Drengner et al., 2018), which is one dimension of flow (Guo & Poole, 2009).

Insight 4: Virtual hybrid meetings decrease convenience for VR participants.

While VC participants enjoyed that they could observe where avatars were looking at, VR participants complained about having to "look from right to left, all the time between the video conference, the other participant and the whiteboard" (IP10). While on VC platforms, one can see all participants and shared content at once, virtual spaces emulate the physical environment where one must turn to observe different corners of a room. Even though this is normal for real-world environments, VR participants felt limited in their flexibility and, after all, their comfort and convenience (IP1, IP10, IP13). Bonfert et al. (2022) show that discomfort can lead to lower performance in virtual meetings. Other than exhaustion or cybersickness, we would not have expected VR participants to experience discomfort. Hence, mitigating the drawbacks of re-introducing limitations from a physical environment (e.g., not seeing everything simultaneously due to

a reduced field of view) should be a driving force for the design of virtual rooms and should receive further attention from research.

In sum, all four insights strongly contribute to answering our research question as they illuminate different experiential outcomes for meeting participants. Collectively, all four insights underline that hybrid meetings blur the distinction between VR and VC meetings. Due to increased social cues, hybrid meetings are superior for VC participants compared to classic videoconferences. Compared to VC meetings, hybrid meetings increase social presence. However, due to the reduced field of view and reintroduction of physical environment constraints, hybrid meetings might reduce comfort for VR participants.

Expected Contributions and Future Research

After gaining insightful and partially counterintuitive feedback on hybrid meetings through our exploratory study, our next step aims to advance our understanding of hybrid meetings. We will conduct a large-scale online lab experiment by recruiting at least 20 groups of 6 people. In these groups, participants must solve tasks in a virtual hybrid meeting, a VR meeting, and a VC meeting (see Figure 2). Subsequently, participants will complete a survey that measures their social presence, self-presence, spatial presence (Makransky et al., 2017), flow (Guo & Poole, 2009), as well as well-being (Diener et al., 2010), and perceived meeting performance (Hennig-Thurau et al., 2022), as we discovered these to be the most influential aspects in our exploratory study. Further, we will control for cognitive load (Leppink et al., 2013) and cybersickness (Kennedy et al., 1993).

Our study provides theoretical and practical contributions. We advance knowledge on how to best organize hybrid VR collaboration. We, therefore, capitalize on and improve two different theories. We combine ESP theory with flow theory and can better explain how users feel and experience meetings in different scenarios. Typically, research has explored the involvement and social presence solely in VR worlds. Research has not connected both 2D and 3D formats. By accomplishing this connection, we consider the views of 2D meeting members that experience a 3D meeting from another perspective and vice versa. This also provides a novel contribution to flow theory. Once we complete our experiment, we can answer, among other questions, how flow can be induced through the hybridization of technologies (like taking place at meeting platforms involving 2D and 3D elements). So far, it has been primarily considered how single technologies elicit flow.

Further, we contribute to the literature involving the well-being of individuals during online collaboration by uncovering the influence of embodiment, i.e., avatar vs. video livestream embodiment, on employee experience, well-being, and meeting performance. The insights on how well-being in hybrid meetings constitutes can expand the conclusions of ESP theory as we consider settings in which multiple forms of virtual embodiment are simultaneously present.

Our paper not only lays the foundation for future explorations into VR metaverse collaboration on an individual level (i.e., experiences, well-being, and performance) but also on an organizational level. Our insights will support organizations implementing VR meetings while considering constraints such as cost and health issues. These implications will help organizations in increasing overall meeting productivity. As the planned study will be an online lab experiment with high internal but lower external validity, future research should replicate the findings in a field experiment.

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