Are we 'Beyond being there' yet?

Towards better interweaving epistemic and social aspects of virtual reality conferencing

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ABSTRACT

Interactive virtual conferencing has become a necessity in adapting to travel reductions during the global pandemic. This paper reports experience with a recent 5-week VR conference with participants from academia and leading industry experts. Drawing on Activity Theory and Installation Theory, a structural grid for virtual conferencing activity analysis is described. We argue that for successful interactive virtual conferencing, the installation must facilitate both the development of knowledge and informal social interaction, the 'epistemic' and the 'relational'. We focus on three specific aspects of the conference activity—onboarding, networking, and intersession transitions—to highlight key issues and illustrate the process of design thinking based on distributed architecture. We discuss lessons learned to inform this fast-growing field: provisions for meaningful social interactions remain underdeveloped in current conferencing systems.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Interaction paradigms; Virtual reality; Human computer interaction (HCI); Interaction paradigms; Collaborative interaction; Collaborative and social computing; Empirical studies in collaborative and social computing;

KEYWORDS

Installation for Virtual Conferencing (IVC), Activity Analysis

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1 INTRODUCTION

We argue that to warrant the success of interactive virtual conferencing, the installation must facilitate both the development of knowledge and informal social interaction, the 'epistemic' and the 'relational'. We support this argument based on Installation Theory and activity analysis. More precisely, this paper explores future specifications of Installations for Virtual Conferencing (IVCs), building on a recent 5-week VR conference with participants from academia and leading industry experts from four continents, the Stanford media-X Global Innovation Leadership Program (GILP). While some findings are specific to the platform used, the specifications and design recommendations have a more generic value. Social interactions are a major motive for attending conferences, but provisions for them remain underdeveloped in most current VR systems, which primarily cater for functional information exchange. Section 2 sets up the problem of virtual conferencing with past experience of the authors in the domain, and the most recent case that serves as the main basis for this paper. Section 3 describes a structural grid for analysis, drawing on Activity Theory [23] and Installation Theory [14]. Section 4 explicates three specific aspects of the conference activity - onboarding, networking, and transitions - which highlight some key issues and illustrate the process of design

thinking based on distributed architecture. Section 5 discusses the lessons learned, which can inform this fast-growing field.

2 FROM PHYSICAL TO VIRTUAL CONFERENCING

Conferencing, whether it may be in the realm of meetings, congresses, workshops, or seminars, is a complex of cultural practices which entails knowledge transfer and acquisition of new skills. It also comprises social activities such as identity performances, knowledge and social networking, and recreation [21], which build social and cultural capital [5, 15]. Conferencing relies on two channels. First, the formal channel: presentations, and other formally organized information transfers. Second, the informal channel: chats, serendipitous events, local visits, introductions to new people, strengthening existing links, sharing a collective experience, and, thus, belonging to a community ("I was there, too!"). Conferencing is not a mere transfer of information, it is also a social process that leverages personal relations. In short, collaboration during conferencing, physical or virtual, is best understood as a "dual-problem space that participants must simultaneously attend to and develop as a content space (consisting of the problem to be solved) and a relational space (consisting of the interactional challenges and opportunities). [...] One needs to be able to monitor and evaluate one's own epistemic process while tracking and evaluating others' epistemic processes" [3:310–311].

The Covid-19 pandemic has expanded previous trends to use computer-based technologies to support learning and social interactions [12, 27]. These built upon electronic media innovations for education, as when, some 40 years ago, Stanford's Engineering School published in *Science* a new distance learning technique using unrehearsed, unedited videotapes of regular classroom courses for instructing small groups of students assisted online (audio) by paraprofessional tutors while watching the tape [11]. Since these ancestral experiments, corporate and academic researchers have experimented with technology-based solutions for social computing, distributed learning, and collaboration. Performance improvements on distributed professional teams were operationalized "virtually across five discontinuities of time zone, geography, organizational units, culture/ language, software tools, and work processes" [18]. The time factor was identified as the greatest influence on productivity [1]. Persistent "transactive memory spaces" were created for contextual synthesis of information by remote teams, in the early 2000's [24]. Early synchronous and asynchronous multi-user implementations of virtual environments revealed the importance of information exchange, communication tools, change-conflict resolution mechanisms, and versioned-document repositories to maintain context and interactivity for distributed collaboration and learning [19]. They also provided insights on organizing and executing collaborative knowledge work among distributed colleagues in virtual environments [25, 26].

The importance of social interactions between conferencing actors is not a novel finding. To facilitate trust building among team members, additional functionality for social interaction and collaboration in the relational space has already been added in later software-as-a-service platforms [32]. Participants can be represented by avatars they control in real time, adopting a first-person or third-person perspective (these can even be photorealistic virtual doppelgängers [2]). Experimental studies of transformed identity in virtual environments revealed that priming, mimicry and stereotype formation were highly operational in VR social interactions [8–10, 34] and particularly relevant for communities created around virtual worlds [17].

IVCs have proven effective at supporting various learners and types of learning experiences like problem-solving, decision-making, and information retention [e.g. 13, 27]; a recent literature review provides insights into the role of social interactions in virtual learning spaces [31]. Furthermore, IVCs allow practicing acquired skills in a safe 'virtual space' and gaining confidence through repeated practice before applying them to real-life, which is particularly relevant for life-long learning and continuous career development [13]. Despite these promising findings, however, IVCs leave vast room for improvement. We illustrate and analyze this with observational data obtained from our recent virtual conferencing experience.

3 COMPONENTS OF VR-BASED CONFERENCES: A GRID FOR ANALYSIS AND DESIGN

In November-December 2020, the annual mediaX Global Innovation Leadership Program (GILP) was held in an IVC that leveraged insights from a 2007 workshop on Building Effective Virtual Teams [30], research results, and several years of online instruction. The IVC we used was a dynamic 3D virtual world platform consisting of approximately 400 interoperable components designed to support a variety of interactive simulations in which users engage with each other in real time as unique, customisable avatars, accessed through a web interface. Between the main sessions participants worked in groups in the IVC and in video calls (see the supplementary material for a detailed illustration). Five days of conferencing and a series of parallel workshops that took place over 5 weeks were followed by six debrief sessions including all authors, a detailed feedback questionnaire for participants, and in-depth interviews with 26 presenters and participants. Although participants reported being very satisfied overall ("Way beyond expectations. Content and theory, plus orientations and support. Total Package! Blew my head away. Despite the glitches, far better than video call." P8), the experience was exhausting and frustrating for organizers at times because of the design of the IVC.

The 'dual-problem space' of content and social relations [3] offered an opportunity to observe the situated activity and action pathways of this IVC. Also, learning theories informed by activity theory foundations remain significant anchoring-points for IVCs and collaborative learning processes, given the nature of VR environments [33]. We analyze conferencing activities with two frameworks that facilitate understanding participants' activities (epistemic and social) and the development of design recommendations for the installation: Activity Theory enables breaking complicated and distributed processes into manageable chunks, i.e. tasks. Installation theory describes how activities are "channeled" (supported and controlled) in each chunk by three layers of components, and how these can be changed to modify activity and improve the quality of experience.

Activity theory considers activity as an oriented trajectory from a given state (conditions given) to a consciously represented expected final state (goal), driven by internal motives (urge to reach an internal state of satisfaction) [20, 29]. The trajectory of activity is a succession of small problems to be solved (tasks), which can each be seen as reaching a local subgoal in the conditions given by the environment. Activity is subject-centric: performed from the perspective of the subject, in the context of layers of affordances that shape action pathways [16, 22, 23]. Installation theory is a framework to analyze the determinants of action. At a given point of activity (attending a lecture), participant behavior is channeled by three types of components: local affordances (chairs, tables, displays), embodied competences (previous knowledge and skills for interpreting the situation), and social regulation (institutions and local rules, e.g. stay quiet and listen). Note that embodied competences and rules are part and parcel of the installation; its distributed architecture is incomplete without them. The combination of these three layers creates, by feed-forward and feed-back, a narrow tunnel of possible behaviors for the actor. This is why people behave as expected. Installations are: "Specific, local, societal settings where humans are expected to behave in a predictable way. (. . .) The components are distributed over the material environment (affordances), the subject (embodied competences) and the social space (institutions, enacted and enforced by other subjects). These components assemble at the time and place the activity is performed" [14:428].

Based on activity theory, we have analyzed the conference activity of participants as a series of tasks with subgoals, paying attention to the affordances of IVCs (see Table 1). To demonstrate, we focus here on the perspective of a presenting participant; future analyses should also consider organizers, facilitators, logistic planners, and tech support. Each task should, but may not yet be supported by specific installations that are sets of matching affordances, competences, and social regulation that channel participants into the expected behaviors. For instance, timetabling requires calendars, knowledge of geography and travel constraints (e.g. visas, holidays, time zones), and rules (dates for submission, dates of conference, fees, etc.). These channel participants into planning their participation in the appropriate space/time frame and taking dispositions to attend. Each task, further, comes with specific motives and goals. For example, motives when scheduling for a classic face-to-face conference might be, beyond attending the conference, to avoid stress in travel, keep extra time for visits, travel with colleagues, minimize costs, etc. Experienced organizers thus design the installation to facilitate satisfaction of these motives (special rates, guidance for transport, booking, visa issues, etc.).

Redesign with Installation Theory starts with listing the pain points as they arise along the activity pathway, then looking at what causes problems, searching which components in each layer are lacking or faulty, and finally addressing issues by changing some components, e.g., one may supply the function with a software affordance if there is no human support; provide social support or train participants to compensate for a missing affordance or competence. Organizers should examine in advance the different layers of the installation to ensure they offer good support both in the content and in the relational space. While this can appear complex for IVCs, this task becomes considerably easier with the help of the grid presented in Figure 1.

At each step of the activity (e.g. Orientation) we consider the actors with their goals and motives, what contribution is expected from them, what reward they get as compensation. Then, we check that these contributions/rewards are well supported by the installation's three layers. For example, the actor is the participant, her goal is to get directions, logistical and technical information, and solve administrative issues. The reward is to get admission to the conference, recognition of status, peace of mind for planning, documents facilitating epistemic function and signaling tags. Similar analyses can be done for student helpers, organizers etc. We check for each task if the IVC's components do indeed channel the desired activity (viz. to scaffold, guide, constrain, control). Artefacts (e.g. lists, name tags, orientation booth) and rules (e.g. timetable) are components of the installation which, together with embodied competences (e.g. literacy, politeness rules), enable participants to play their role and reach their goals. Effective design ensures the right set of components are available for participants, with contributions balanced by rewards. More generally, an installation can be modified in any of its three dimensions (affordances, competences, social regulation) by design of artefacts, education, training, communication, and regulation.

4 SOCIAL FACILITATION DURING A VR CONFERENCE: DESIGN SPECS AND ILLUSTRATIONS

We now look in more detail at the opportunities and pitfalls we encountered during the GILP VR conference, detail how current IVCs are conducive for successful content and social learning (or not), and suggest design considerations and enhancements. We focus on the social activities that are under-designed in the current IVC, although they are essential motives for participating. We examine three activities especially relevant for VR conferences: onboarding, transition spaces/times, and networking/connection. Interestingly, some of these activity processes occur at several different steps of the classic conference script. For the sake of brevity, the detailed grids based on Figure 1, which list problems encountered in performing various activities and where installations were lacking, are not presented; instead, a summary of issues and possible solutions is provided. Since remote conferencing software tends to emphasize delivery and reception of content, installations are usually well-equipped for participants' collaboration in the *content* space. But there is ample room for improvement, when it comes to the *relational* space. IVCs underuse opportunities to integrate into online spaces some of the affordances and prompts for spontaneous social exchanges and serendipitous events that conferences in physical spaces offer naturally. Meeting other participants need not be limited to scheduling meetings or small talk over a drink; it can be built into the installation and facilitated. While some of these issues are solved in other environments or have been fixed since, we argue that most IVCs are not at their full potential yet when it comes to behavioral rules and competence-building facilities. The purpose of this paper is to illustrate our call for more relation-friendly IVCs, not to modify a specific one.

Table 1: A non-exhaustive list of tasks while conferencing

	Task	Activities
1.	**Awareness**	Getting info/invitation: there is a conference at this time and place, about these topics.
2.	**Timetabling**	Planning, booking, solving authorization issues (clearance from organization, funding).
3.	**Preparation**	Writing, reviewing and editing paper, coordination with organizers and tech support.
4.	**Transfer**	Travelling or exploration of the digital platform; may include getting and testing the display installation. (This phase is a bit different for IVCs because tests can start early.)
5.	**Orientation**	Creating more detailed activity plans once more aware of resources on-site.
6.	**Presentation**	Speaker to audience, data display, moderation, speaker interaction in panels.
7.	**Audience Interaction**	A good presentation usually includes interaction with the audience, e.g. Q&A.
8.	**Breaks & Transitions**	Social interaction, transfers between sessions, networking, physiological pause, keeping in touch with "normal work".
9.	**Workshops**	N to N participant interaction, producing collective outputs for proceedings.
10.	**Visits & Socializing**	Visits, tours, meals, and other activities and opportunities to meet like-minded people and to network.
11.	**Travelling back**	Changing settings, uninstalling software, and rearranging work-stations.
12.	**Follow-up**	Storage/retrieval of material and contacts from the conference, edition of material produced based on the conference for later publication.

Activity steps	Actor	Actor's motives	Contribution from actor	Actor's reward	Installation: Affordances	Installation: Competences	Installation: Regulation
Step 1	*Actor X*						
Step 1	*Actor Y*						
Step 2	*Actor X*						
Etc.							

Figure 1: Grid for the analysis of the installations

4.1 Onboarding (Steps 4 & 5 of Table 1)

Although participants need not travel physically to attend virtual conferences, the relevant affordances must be introduced to them for the conference to work properly, including elements in the physical (e.g. rooms, seating), psychological (e.g. competences, skills), and social (e.g. local rules, "expected behaviors") layers. Virtual environments add a level of complexity to the onboarding process as participants must get acquainted, understand, and learn to use the technology at their disposal. This ranges from audio/video or connection settings to avatar appearance, moving, performing basic gestures, interacting with other avatars, and so on. Ideally, participants are assisted by those organizers who planned those affordances and facilitators who maintain and explain them. The ratio of facilitators to participants should not be underestimated, since all novices must be educated and trained. For 30 participants, we had 6 facilitators for tech support, and 6 for onboarding on the first day of the conference even though no participant was fully novice. In fact, an IVC requires just about as much support personnel as a brick-and-mortar conference: it is a facility in its own right.

In physical conferences, participants require some basic level of induction to the space; scheduling, or rules that will govern their time during the event that is provided by signposts, hand-outs, audio calls, etc., but also relies on 'physical' embodied competences for walking, chatting etc. For VR conferences, some of these basic principles hold, although information about the physical environment is replaced with information about the systems that will be used. On the most basic level, this means testing and fixing sound, video, screen sharing, and optimizing multiple displays. Interactive participation may also include walking, performing gestures, interacting with other avatars, avatar customization, and so on. Allowing enough time for participants to master these preparations is crucial to help them feel at ease and avoid disruptions. Prior testing and having contingency plans and anticipatory repair strategies on all layers for such failures is essential, as is flexibility when addressing and resolving emergent issues, or providing a clear and timely explanation (and moving on) when an issue cannot be solved. Unlike in physical conferences, technical failures can exclude participants from the conference. Hence, it is essential to have a second space, a trouble-shooting "back channel", where access to the IVC can be repaired and backstage conversations take place. During the GILP2020, for example, there were 736 independent utterances over four days of conferencing (between 133 and 216 per day) in the main back channel alone, and there also were several small group channels. Specific onboarding times and resources must be allocated and scheduled with consideration of different time zones (for organizers and participants). In this way, onboarding sets in motion relationship-building between participants and organizers,

and between participants, before the conference begins ("I got to know my new 'self' and the organizers in advance", P16; "Would have been lost without it. Felt good to be familiar with facilitators before the start", P6).

4.2 Networking/connection (Steps 7, 10 & 12 of Table 1)

IVCs hold many opportunities, but also pitfalls when it comes to connecting participants with each other. Some of these may appear innocuous at first glance. When someone is taking a break in a physical conference, this is clearly visible when departing for the restroom, being on a phone call or taking a nap on the sofa. IVCs often do not offer dedicated places to 'park' an avatar or indicate that the owner is not present ("A ghost feature so your avatar could be removed without having to log out", P15). If a participant has unsuccessfully approached several 'afk' (away from keyboard) avatars, the initiation of new conversations will likely decrease. Clarifying which interactions one can have with an 'afk' avatar, and social rules around them are important design choices. Making those explicit could be part of onboarding and inform the social regulation layer of the system. More generally, the conventions for informal interactions in IVCs may not yet be well understood. Supporting such rules with affordances that facilitate requests for contact (as developed in social/dating apps) is suggested.

Furthermore, virtual conferences need informal spaces for social interactions between participants. Queuing for lunch, discussing the quality of the coffee, but also going to a bar after the conference or bumping into fellow attendees in the hotel lobby are but a few examples in which small talk can spark great conversations and perhaps lead to innovation and new research. Additionally, affordances that result in crowd stirring effects (such as random seat allocation) may encourage serendipitous encounters.

A third factor for successful networking is connected to informal conversation, which helps create connections with new acquaintances. In physical interactions, participants can easily modify the reach of their voice. Some IVCs solve this issue by fading or fixing the reach of speech. Yet, such a constraint limits the opportunity for two conversations happening in parallel when many avatars are close to each other. This creates problems when multiple groups of participants in the same space desire concurrent independent discussions and becomes even more salient for exchanging hearsay or discussing the work of other attendees. Knowing who is currently listening in a virtual space is often not easy and may lead to the illusion of a private conversation, when there is actually a much larger audience. Affordances that allow for communication targeted to specific people, can easily be reintroduced by design (received selection by click, sotto voce speech-to-text messaging, etc.), and we advise to always have an administrator in the space who can mute unwanted communication and noise in public channels. While Augmented Environments have added information to interactive objects, useful descriptions of people (bios, keywords, shared contacts, etc.), as implemented in gaming and social environments like World of Warcraft or Second Life, are yet to be integrated into IVCs. These affordances could take the format of click-and-save photo-bios, wearable tag clouds [34], and conversation scheduling functions.

4.3 Breaks and Transitions (Step 8 of Table 1)

Conventions for transitions between agenda items have become widely accepted for physical conferences. In IVCs, transitions are subject to several complications. For presenters, technical issues with slides and media formats get overshadowed by microphone, camera, connection, or firewall issues. Beyond that, transitions may require participants to take control of their avatars and move to a different space. It is important to keep in mind that problems during transitions can take up a lot of time and cause delays and repeated interruptions by latecomers to following sessions. Therefore, planning generous transition times is prudent. It is further important to note that while transitions in physical settings double as opportunities to stretch or use the restroom, we found that this is not the case in online environments, either because participants are dealing with technical issues, or because they spend the break time working (particularly catching up on Emails; "Networking breaks turned into real breaks in the real world", P17). Thus, scheduling specific breaks that allow (or actively ask) participants to move their body and take a break from their computing device is necessary.

Second, transitions between sessions in physical conferences also serve an important function for the relational space, as they allow participants to mix and mingle, to discuss upcoming sessions, and for 'happy accidents' in general, meeting old friends or making new ones. IVCs provide, in theory, ample opportunity to socialize during transitions. In our experience, however, issues with avatar control as well as problems with establishing private communication channels, as discussed above, encumbered the natural occurrence of such exchanges. More importantly, quick travel, teleport, or automated transitions, intended to streamline the mobility experience for participants, preclude these exchanges from happening naturally as virtual hallways, even if they exist, remain empty. Transitions need to be considered carefully and tailored to the IVC so that they can fulfil their overt purpose and enable the conference to run smoothly, as well as facilitate the important social and networking functions they provide in physical environments. Installations for transitions must be *designed*.

5 LESSONS LEARNED

Existing IVCs are successful at creating a shared content space for participants, but have so far overlooked the relational space with a few notable exceptions [7, 28]. Looking back on 30+ years of remote conferencing now, we are still far from being "beyond being there" [12]. As we are still dealing with the same issues as we did at the very origins of SIG-CHI, to guide the readers when working in or designing IVCs, and to prevent them from making the same mistakes we made, we share some lessons we have learned from our IVC use:

1. Even though IVCs are digital, a facility remains a facility: Spaces need explicit (and signed) design. Different installations need to cater for different activities (transitions, social spaces, etc.) A VR facility manager is indispensable, as are agents charged with maintenance, orientation, control, and so on.
2. Remember an IVC, as an installation, has three layers. Affordances (the software) are only one layer. Embodied competencies and social regulation must be catered for.

3. Use the onboarding process to test if the three layers of the IVC are functional: Are there the right affordances (physical)? Can participants maneuver the virtual spaces (embodied competences)? Does everyone know and follow the rules (social)?
4. Communication back channels are essential for organizers and participants to run the conference and solve issues. Design them with as much care as the main space.
5. Cater for the social space, not just the content space. Provide space, time, and conversation tokens for informal interaction; augment avatars with informative tags (research keywords, afk notices, etc.)
6. Users of IVCs exist in two worlds at once. Plan and organize breaks.
7. Until a common VR culture (*VRtiquette*) is set up, rules of conduct must be made explicit during onboarding and reminded throughout (e.g. mute when not speaking).
8. Virtual conferences are a different thing than physical ones, not a substitute. Use IVCs wisely for what they can offer, rather than trying to emulate physical installations.

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