# Making Space for Social Time: Supporting Conversational Transitions Before, During, and After Video Meetings


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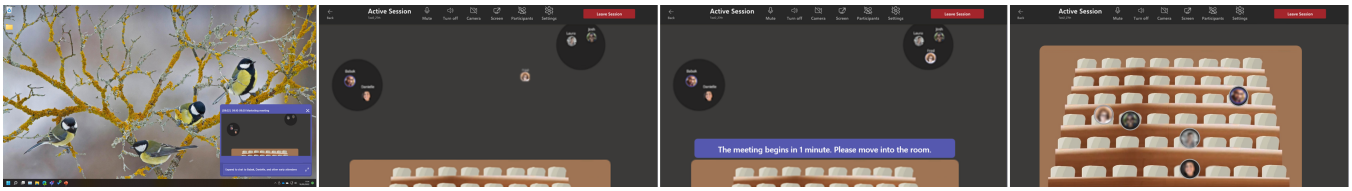


**Figure 1: An idealized pre-meeting flow in a Conversational Transition prototype. Seeing that others are informally gathering before the official meeting time (far left), the user expands the wandering space (middle left) and joins two others in a bubble for some pre-meeting small talk. Then seeing the notification that the official meeting will soon begin (middle right), all users move into the auditorium (far right).**


## ABSTRACT

Unlike meetings in person, it is a well known but still unsolved problem that in traditional videoconferencing people just appear and disappear [56]. The lack of Conversational Transitions (CTs) is unnatural and also limits the both ritualistic and spontaneous small talk of collegiality and productivity that happen in transitional moments. We report a design investigation of the pros and cons of a CT-Space UI that that intertwines spatial and temporal metaphors to support a range of conversational transitions before, during, and after meetings, but, crucially, might also fit into standard periodic workplace practices rather than require all-day connection. We explore the comprehensibility of visual transitions in space, how spatial audio supports transitions, blending spatial and temporal metaphors, and fluid and visible group clustering. We argue that CTs should be a standard requirement for videoconferencing services.



## CCS CONCEPTS

• **Human-centered computing → Human computer interaction (HCI)**.

## KEYWORDS

videoconferencing, meetings, transitions, approaching, leave-taking, small talk, spontaneity, serendipity, pre-meeting, post-meeting, breakouts

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## 1 INTRODUCTION

Traditional videoconferencing applications start and stop participants' presence in meetings abruptly. This is unlike the in-person experience of transitioning into and out of conversations, in which moving physically towards and later away from a cohort of people provides natural time for the proxemics of social engagement and disengagement [25, 31]. As well as enabling comfortable changes of state from no-talk to talk and vice versa, this also makes time for generating and maintaining common ground and social bonds through small talk [15]. In the context of organizational meetings, pre- and post-meeting small talk facilitates collegiality and coordination that underlie productivity [19, 26, 63]. [1] The lack of Conversational Transitions (CTs) in video meetings, at both the granular level of approaching and leave-taking and the logistical level of transitions

[1] Small talk helps productivity as long as it does not take up a disproportionate amount of the meeting time, is appropriate to the institutional context, and is inclusive.

into and out of official meeting talk (pre-, post-, or during meetings), has long been known to the HCI research community as an unnatural constraint in comparison to in-person meetings [52, 56].

This paper reports on a design investigation of a prototype supporting transitional behaviors in institutional video meetings. Our investigation is not concerned with the particular mechanics or implementation of CTs intrinsically. Rather, we probe the comprehensibility of a model for augmenting a combination of time and space within which CTs can be experienced, and their benefits obtained. From our own use and two sessions of informal testing with sets of potential users, we explore issues around the visual self-explanation of transitions, how spatial audio supports the understanding of transitional dynamics, the use of spatial and temporal metaphors for transitions, and fluid and visible group clustering. Below we present a background to CTs for meetings, describe our prototype and reactions to it, and discuss the broader implications.

## 2 BACKGROUND

We use the umbrella term Conversational Transitions (CTs) to refer to the wide range of transition concepts that are relevant to the meeting as a physical experience. CTs are based in peoples' ongoing needs for the solidarity created by phatic communion [9]. At the granular level this involves comfortable management of the transition from non-interaction to full interaction, and back [33, 34], also known as contact negotiation [13, 56]. It occurs in concert with proxemics, the physical approaching and leave-taking that negotiates social engagement and disengagement [25, 31]. At the conceptual level this involves establishing and consolidating interpersonal relationships [50], often the province of so-called 'small talk' [15, 16].

Phatic communion happens at work just as much as it happens outside – it is the basis of workplace collegiality throughout the day [16] and often happens pre- and post- meetings. For example, research on university meetings has found that pre-meeting small talk consisted of topics unrelated to the university or the specific meeting business, such as the weather, family and friends, or personal problems [63]. In conjunction with markers that indicate transitions in out and out of the official business of the meeting [6], small talk is part of the way in which meetings themselves get started and ended.

Prior work has also found links between small talk and the subsequent quality of official meeting business [2]. Even just a few seconds of interaction set the stage for the rest of the conversation [22, 24], with initial statements heavily affecting group outcomes and conversation [19]. Further, pre-meeting talk [26, 64] is used for a range of quite specifically productive purposes ranging from the conceptual (such as game-plans) to logistical (such as presenter order). These purposes are more content driven than small talk, and relate directly to the imminent business at hand. Post-meeting talk is often similarly purposeful, reflecting on the meeting's business outcomes [6].

Serendipity in the workplace has also been found to have potentially positive effects on collaboration, the discovery of novel information, peer bonding, coordination, and productivity [43]. These lightweight interactions [62] often happen at high-traffic areas such as kitchens, watercooler, hallways, and, crucially *the spaces outside meeting rooms* before and after meetings [29]. The lack of time and space for spontaneous and serendipitous talk was felt acutely during the COVID-19 enforced transition to all-remote work [20, 30, 41]. Video meetings offered one of the few times when colleagues could be sure of being together but, as noted above, most video meeting software did not support CTs, leaving meeting attendees to awkwardly fit small talk into official meeting times – or, as time went by, drop small talk altogether in an attempt to claw back time among an increased cadence of meetings [59].

In sum, there is value in having time and space for engagement that is adjacent to the meeting, observable by the meeting cohort but without the full engagement of all cohort members, with topics ranging from totally unrelated to related to the meeting.

Translating CTs and impromptu interactions into computer-mediated settings has a reasonably long history, but with limited impact on commercial systems. Research based on traditional videoconferencing and media space interfaces [4, 5, 10, 17, 29, 56] has used methods such as video that fades in, or footstep sounds to indicate 'approaching', and either person or system-generated notification of co-presence. Leave-taking has been less explored, but Awarenex [58] provided a "Goodbye" button to start a public countdown, instead of the traditional "Close" button that would immediately terminate contact, making time to negotiate last-minute communication [56]. Table 1 describes how previous systems cited in the literature afforded approaching and leave-taking.

However, these systems were not designed to support features similar to in-person approaching or leave-taking, such as proxemics or spatialised audio [25, 44]. In terms of proxemics, mirror metaphors have been studied to understand how remote participants could negotiate understanding how close or far remote participants were in terms of personal space [11, 12, 14, 39] and their intentions to engage [49]. More recently, Sousa et al. [52] developed a design in which participants were represented through a bubble shadow metaphor in the common remote space. Whenever participants were close enough, a combined larger social bubble would be created containing the bubbles of both participants, indicating that participants could engage in conversation. A related design incorporated specfically demarcated group conversation pits into their spatial 2D top-down prototype, and again when users came close together an active display of a bubble surrounds them [48].

Related to proxemics, spatial audio improves the identification and distinction of individuals when there are large number of participants [1], even has a positive effect on remote participant general comprehension when the speakers are wearing face-masks. Spatial audio has been used to enable naturalistic CTs in a larger digital environments such as games and virtual worlds for a significant period of time [8, 46]. There are a wide range of technologies that allow to simulate more accurately spatial location of sounds compared to regular mono or stereo audio of traditional video meetings. Examples can be distance attenuation of audio sources in a virtual environment, multi-channel speaker distribution in a physical room [46], or binaural algorithmic solutions for headphones recreating 360 degrees of audio positioning [8]. Distance attenuation is by far the simplest and provides a marked improvement over traditional audio.

| Name | Description & Goal | A/V | Approaching | Leave-taking | Pre-meetings | Sub-rooms | Post-meetings |
|---|---|---|---|---|---|---|---|
| Montage [57] | Desktop videoconferencing interface affording extended contact initiation metaphors. | Both. | Video glance fade-in together with audio sound. | Last exchange, then close window. | Nothing before approaching | Not allowed | Nothing after leave-taking |
| Piazza [29] | Desktop videoconferencing interface affording spontaneous interactions | Both. | Glance interface fading-in an image of incoming user. | Last exchange, then close window. | Nothing before approaching | Supported with 'Project Room' interface. | Nothing after leave-taking |
| Awarenex [56] | Desktop instant messaging app affording contact negotiation and leave-taking. | Audio | Message preview on top of window. | Good-bye button that initiates leave countdown. | Nothing before approaching | Not allowed | Support for 'tap on the shoulder' during good-bye countdown to arrange a post-meeting discussion |
| Open Messenger [5] | Desktop instant messaging app affording gradiual initiation of interaction for remote workgroups | Text. | Users can gather availabiltiy by observing others' avatar rotation and a blurred preview of their desktop. Users then can initate an interactive chat or leave a message | Last exchange, then close window. | Nothing before approaching | Supported thorugh different tickets. | Nothing after leave-taking |

**Table 1: Academic Videocall Software Supporting Conversational Transition Metaphors**

The combination of spatial audio with spatialised navigation metaphors has become a common trend in recent systems such as Spacial Chat or Gather (see Table 2). These interfaces all use some form of spatial audio in conjunction with a movable avatar on a very simple digital background color or pattern. Avatars can be represented in more or less detail and audio can be spatialised with more or less accuracy, but they all share a common purpose to represent approaching and leave-taking among participants in the same virtual space. Unlike a fully denotative spatial metaphor system such as Gather, the bubble interface does not require a fully realized environment but provides value at least in terms of approaching and leave-taking. Pre- and post- meeting talk are not explicitly provided for in such systems, they are simply assumed to be a byproduct of the spatial affordances.

## 3 SPATIALITY AND TEMPORALITY

The background literature indicates that CTs are easily enacted in physical space, and thus it is not surprising that new services such as Gather, Rambly or Topia try to emulate it in a denotative naturalistic spatial metaphor. These systems look like a 2D video game, and participants are embodied avatars that can move around in relation to each other and fixed background elements. The denotative naturalistic spatial metaphor, navigating one's avatar from one illustrated room to another, is at its most powerful when it replaces not only meetings, but all the time between meetings. That is, time is assumed to operate as it does in the real world, such that the system proposes *persistent usage* throughout the day. However,most workers currently experience video meetings as a service that they use *periodically* throughout the day within a diverse work ecosystem of other activities. Given this, we decided to explore whether CTs might be provided in a 'container' that could otherwise be scheduled and accessed like a traditional video meeting. In that sense, we wanted to *make space for social time* by *making time for a social space*. We hoped that this novel metaphorical combination might involve limited impact on work practices throughout the day – and, indeed, could be agnostic to the calendar and other workplace communication systems – but have a positive impact on comfortable collegiality and productivity.

At base, our prototype follows the metaphor of the bubble interfaces mentioned above [18, 42, 48, 53]. Unlike the *denotative*, literalised space of game-style interfaces such as Gather, Rambly or Topia that show demarcated rooms and hallways, 'bubble' interfaces such as Cozy Room, OhYay, BubbleVideo or Spatial Chat are more notional 'wandering spaces' with abstracted user representations that promote dynamic clustering of participants and have the attendant value of making approaching and leave-taking visually and auditorially explicit and transitional (e.g. people get closer, audio gets louder) instead of a binary appearance and disappearance. The bubble metaphor has been previously explored in the literature and is typical for proxemics visualization [52], social distance [32] and social translucence [7]. Adam Kendon studied how the social distance among participants in a face-to-face conversation created an imaginary circular 'F-formation', which participants behaviourally responded to both in its inside and vicinity [32]. The concept of a 'bubble' formation is different from the one of social awareness [51], as investigated by Bradner and colleagues with their Babble

| Name | Description & Goal | Spatial Metaphor | User representation | A/V | Spatial Audio | Approaching & Leave-taking | Sub-rooms |
|---|---|---|---|---|---|---|---|
| Cozy Room [18] | Browser-based audio-conferencing for free peer-to-peer spatial audio environments | 2D top-down virtual world. | Coloured non-humanoid blob. | Audio. | Distance attenuation. Limited binaural audio. | Users can approach or leave each other by dragging their avatar. Voice gets stronger or quieter depending on distance. | Explicit creation of graphical rooms inside session instance. No effect on audio. |
| Gather [21] | A browser-based videoconferencing application for large group gatherings | 2D top-down virtual world. | Pixel avatars. | Both | Sharp start/end when approaching/leaving. | Users approach or leave each other by moving their avatar with arrow keys. Other users' videos fade in or out depending on distance. | Explicit delimitation of virtual spaces. Complete control on audio and video |
| OhYay [42] | Browser-based video-conferencing application for social gatherings. | 2D backgrounds with navigation schemes per room. | Videofeed in geometric shape per room. | Both. | Distance attenuation | Users can approach or leave each other when the dragging navigation scheme is enabled. | 'Portals' to subrooms in session instance. Complete control on audio and video |
| Mozilla Hubs [28] | Browser-based 3D virtual space for remote gatherings in desktop and VR. | 3D virtual world. | 3D avatars. | Both. | Distance attenuation. Binaural audio. | Users approach or leave each other by moving their avatar with arrow keys or by teleporting. The webcam video can be attached to avatar or to world. | Explicit delimitation of virtual spaces or 'portals' to other instances |
| Rambly [23] | A browser-based videoconferencing application for large group gatherings | 2D top-down virtual world. | Pixel avatars. | Audio. | Distance attenuation. Limited binaural audio. | Users approach or leave each other by moving their avatar with arrow keys. | No |
| Spatial Chat [53] | Browser-based video-conferencing application for social gatherings. | 2D top-down virtual world. | Videofeed in circle shape. | Both | Distance attenuation per room. | Users can approach or leave each other by dragging their avatar or teleporting. Voice gets stronger or quieter depending on distance. | Explicit through right-hand panel. Teleportation between sub-rooms. |
| Topia [60] | Brower-based video-conferencing virtual space for social gatherings | 2D top-down virtual world. | Faceless humanoid. | Both | Distance attenuation. | Users can approach or leave each other by clicking on the map or by teleporting. | 'Portals' to subrooms or through UI panel to teleports between instances. |

**Table 2: Commercial Videocall Software Supporting Conversational Transition Metaphors**

interface that was intended to convey social translucency, a construct characterised by visibility, awareness and accountability [7]. We decided to explore a 'wandering space' (see Figure2.a) with just a small amount of more structure, to *connote* a space outside a meeting room. We hypothesised that two forms of structure would be needed - spatial and temporal.

Spatially, we hypothesised that in an otherwise abstract space, there would need to be a visual focal point that represented an official meeting area. For this we used a simple graphic of auditorium seating, to indicate a sense of place for formal meeting behaviour in contrast to the other informal behaviour. We explored its size and where/how it should be placed (See Section 4.3.3 below). However, simply creating a blank space with a subset meeting space might not provide enough of a cue as to what to do outside of the offical meeting time, and not provide incentive for pre- and post- meeting talk that might be different to what is possible in a standard videoconference. As such, we hypothesised the need to also enforce a temporal dimension that would intersect and interact with the spatial dimension.

The temporality that we explored was two-fold. Firstly, our design works as an extension of a regularly scheduled calendar video meeting, rather than a persistent instance of a virtual space. Secondly, we wanted to emulate the time available by the physical need to move through a hallway/lobby to a meeting room and vice versa, the time in which pre- and post- meeting talk might occur in person. Our solution was that participants should be scheduled to spend the *total meeting time* in the 'wandering space', but only a portion of that time should be the official meeting time. They would be nudged into the *potential* for pre- and post- meeting talk by an enforced time buffer between total meeting start time (e.g. 9:00am) and the 'official meeting' start time (e.g. 9:10am), and vice versa at the end of the meeting (See Figure 1 for an example of the pre-meeting nudge and flow). The non-meeting 'wandering space' is accessible throughout the total meeting time, so participants may move freely out of and back into the 'official meeting' at any time – joining 'early', leaving 'late', or even moving out to huddle during a meeting. Thus the underlying overall hypotheses are, firstly, that without such a nudge, institutional users accustomed to traditional video meetings would have no incentive to enter or leave a meeting 'early' or remain 'late' , and secondly, that such small doses of peripheral access to CT spaces may be sufficient to obtain their benefits.

# 4 SYSTEM DESIGN PROCESS

We built our prototype to enhance the meeting experience of fully remote large meetings by incorporating more natural elements from CTs, such as approaching and leave-taking, proxemics and spatial audio. The documentation of our research process for further replication is one of the contributions of this paper.

## 4.1 Collaborative Sketching and Iterative Testing

We held all-remote regular meetings between the research teams in the UK and the US for roughly four weeks. Meetings were arranged once a week and lasted for approximately 60 minutes. We annotated sketches and usage scenario storyboards that were being produced after each meeting. The following themes emerged in the final accepted design from sketching iterations and project requirements:

(1) **Making space for time.** Support for 'contained' spatial buffers before and after scheduled calendar meetings that provides a mixing space for 5 minutes before and after the 'official' meeting starting and ending time, echoing what could happen in a corridor before and after a face-to-face meeting. The space is not persistent after post-meeting time.
(2) **Pre-meeting and end-of-meeting transitions and interactions.** Enable a user to talk with a sub-group of attendees before a meeting starts, with a graceful transition to it. Similarly, support end of meeting transitions that allows people to quickly select and start a follow-up meeting.
(3) **Spatial sound design.** Support transition metaphors with sound cues and spatial audio to perceive proximity and location from other users inside our non-persistent virtual environment.

Once agreed on a initial concept, we ran weekly informal internal one hour tests among the co-authors of the paper for six weeks, where we discussed design and technical aspects of the prototype. In the last week, we ran two 30 minute informal tests with 8 (6 female, 2 male) and 5 participants (4 female, 1 male) respectively from our lab, where we discussed about the prototype elements and CTs in an unstructured manner. The additional participants had experience with existing videoconferencing tools (Microsoft Teams, Zoom) and were not given any information about how the prototype worked during testing.One of the authors acted as a moderator and participants were requested to transition between pre-meeting time to meeting time and from meeting time to post-meeting time every 3-5 minutes as the moderator explored and observed transition timings with them. Preliminary design implications were synthesised from observations and notes taken during the informal testing sessions.

## 4.2 Implementation

We used the Unity 3D game engine to implement the prototype. The networked requirements (i.e. remote session management, remote audio-video conferencing) were implemented using an early version of the Microsoft Mesh Unity package [37]. Microsoft Mesh as a technology was well-suited choice because it supports granular telepresence metaphors such as avatars, navigation in shared spaces, objects, multiple video streams, and spatial audio. To implement spatial audio, we used the Microsoft Spatializer Unity package [38], which provides a head-related transfer function (HRTF) algorithm for binaural audio and a distance-attenuation algorithm for voice gain. We modified the attenuation rolloff curve from the default logarithm into a custom non-linear logarithmic-style curve that would better suit the dimensions of the Wandering Space.

## 4.3 Prototype Elements

The prototype has a series of elements to support transitions into and out of remote meetings spaces and incorporates a time metaphor. Users have the ability to control when to approach or take a leave in a natural fashion, and to perceive the proximity of others and the status of the meeting (i.e. has the meeting actually started or are participants still mingling outside of it).

*4.3.1 User Video Bubbles.* User Video Bubbles are the elements representing a participant inside of the Wandering Space and allow them to navigate the space and be seen by others. When a user is not sharing video from the webcam, their User Bubble is represented as a coloured circle containing the initials of the user's name (Fig 2.b). When the user enables the video option, the webcam's video feed would occupy the circle. However, due to time constraints, the implemented prototype displayed a rectangle containing the webcam's video feed appearing on top of the coloured circle (Fig 2.d). As the user talks, a volume indicator is represented by a white coloured circumference that grows from the border of the user's bubble (Fig. 2.f).

*4.3.2 Social Bubbles.* Social Bubbles are the semiprivate space in which two or more participants can have pre- or post- meeting talk. They are represented as a circle that is created in the background when at least two User Video Bubbles get into each other personal space (Fig. 2.b), similarly to how the social bubble concept works in [48, 52]. Social Bubbles dynamically disappear when the last two User Video Bubbles within interpersonal space leave from the Social Bubble. The Social Bubble grows bigger as participants join into it (Fig. 3.a), and grows smaller when participants leave from it (Fig. 3.b). The increase or decrease in size and the participants inside is publicly visible information to others. However, the contents of the discussion of the Social Bubble can only be heard at full volume for participants inside of the bubble.

Participants can transition into and out of Social Bubbles by dragging their User Video Bubble inside or outside the Social Bubble by holding the left-mouse button. Each time the user joins a Social Bubble an audio tone plays for the occupiers of the Social Bubble and a zoom-in animation plays on the approaching user's screen for 2 seconds (Fig. 3.a). On the other hand, when a participant leaves a Social Bubble a leaving tone plays for the occupiers of the Social Bubble and a zoom-out animation plays on the leaving user's screen for 2 seconds (Fig. 3.c). These audiovisual cues are designed to convey a sense of approaching and leave-taking in a similar way to the approaching footstep sound and fade-in video feed from Montage [57] or Piazza [29]. Social bubbles can only be created in the Wandering Space, which is all the abstract area outside of the main meeting auditorium.

*4.3.3 Main Meeting Auditorium.* The main meeting is represented as a visualisation of an auditorium (Fig. 2.c), differentiating it from

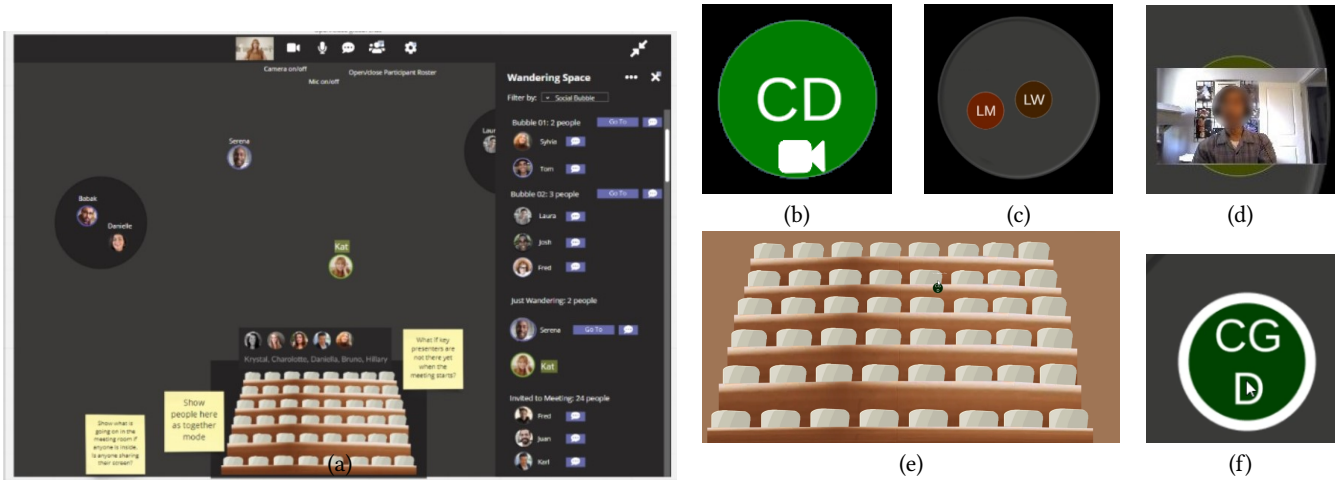


**Figure 2: (a) Annotated Sketch of the Interface. (b) User Video Bubble. (c) Social Bubble. (d) User Video Bubble with video on. (e) Main Meeting. (f) User Video Bubble showing volume indicator.**

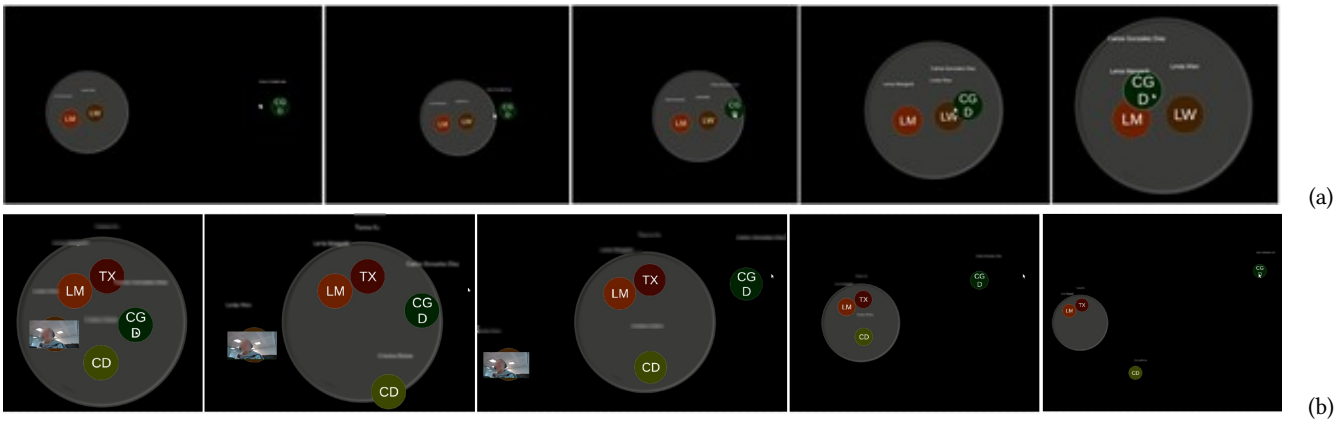


**Figure 3: Transitions animations in the 'wandering space': (a) zoom-into a social bubble and bubble grow, (b) zoom-out of a social bubble and bubble shrink.**

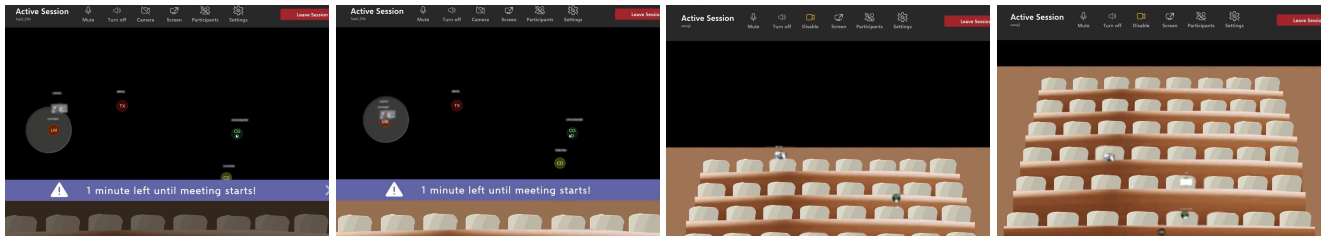


**Figure 4: Pre-meeting into meeting transition animations: (a)-(b) announcement and auditorium lights up, (c)-(d) vertical view scroll makes the auditorium occupy most of screen space and leaves the 'wandering space' visible at the top of the screen.**

the surrounding Wandering Space and focusing its intent as the place for the cluster in order to have the 'official meeting' [54]. The 'official' space does not have to use the image of an auditorium, and the official meeting can take forms other than a one-to-many presentation; one can use any image that sufficiently distinguishes it from the informal, fluid nature of the Wandering Space. Here, the choice of an auditorium is illustrative, since the formalised

interaction that takes place in such a venue stands in clear contrast to the ad-hoc nature of the wandering space.

Once participants navigate into the main meeting auditorium, they can select their own seat at any time during the meeting by moving their User Video Bubble. We wanted to ensure that our time metaphor transition that marked the start of the 'official meeting' did not programmatically disrupt informal pre-meeting conversations, as can happen in current versions of videoconferencing 'breakout rooms' [35]. We also didn't want users be abruptly transitioned outside of the auditorium once the meeting ends. Hence, we settled on a design in which the auditorium occupies the 15% of the bottom part of the screen and only shows the first row of seats with the colour dimmed down. An announcement appears at the bottom of the screen on top of the auditorium shortly before the scheduled calendar meeting starts (Fig. 4.a), and a similar announcement occurs as the meeting is about to end. These extra notifications are intended to be very clear signals for different uses of time, and that people would need to navigate around the space (from Wandering Space to auditorium and back) if they wanted to follow the naturalistic conventions of moving from a hallway into a meeting room, and out during the meeting or once the meeting had ended. This leaves participants to follow social conventions appropriate to their institution or culture.

Once the meeting starts, the first row of seats is strongly illuminated (Fig. 4.b). The change in the auditorium illumination was intended to guide participants' eyes to the bottom of the screen and indicate that participants can transition into the 'offical meeting' in a subtle way, similar to the in-person scenario. Once participants navigate into the first row of seats, a visual transition vertically scrolls the view of the screen down for 3.5 seconds so that the auditorium occupies roughly 80% of the screen and the Wandering Space occupies roughly a 15% of the top screen (Fig. 4.c-d), thus always leaving a hallway/lobby analogue in the Wandering Space and allowing people to still have a sense of who is approaching or leaving the auditorium. Participants can leave the meeting by dragging their User Video Bubble outside of the auditorium space to the top of the screen, which triggers a reversed vertical visual transition. We also implemented a settings roster in which participants can control the room illumination. When the clock reaches the scheduled ending time of the meeting the lights dim darkening the auditorium, but participants can alter that behaviour through the settings roster effectively 'extending' the meeting.

*4.3.4 Spatial Audio.* Spatial audio was implemented to strengthen navigation, proximity, and social interaction cues when using the prototype. A non-linear modification on volume gain was constantly applied to all participants voice as soon as they entered the wandering space and while they remained outside of a Social Bubble or the auditorium. As soon as two or more participants gets close enough to each other, a Social Bubble would be created and gain would reach to the maximum for participants inside of the Social Bubble, thus creating a sort of 'exclusive' voice channel that can only be heard at full gain while being inside of the Social Bubble and at a lower gain from the outside. The volume gain modification was intended to reproduce the effect of hearing someone louder or quieter as you get closer or further away from them, as it would happen in a physical hallway before entering the meeting room. The volume gain modification was also intended to make it difficult for outsiders to hear the conversation taking place in a Social Bubble and requiring the interested participant to approach closer to the border of the Social Bubble to better understand the talk inside. This approaching movement behaviour shows intent from the interested participant and is easily perceived by the occupiers of a Social Bubble as their screen shows what is close to border of the bubble (Fig. 2.c). Participants close enough to a Social Bubble can be heard at a lower gain from the inside, and so do other Social Bubbles that might have been formed closed enough. The non-linear modelling of distance attenuation of voice gain thus creates a 'background chatter' effect from participants outside a Social Bubble, which was design to be unobtrusive for participants inside a Social Bubble. Voice gain was not modified for participants inside of the same Social Bubble or inside the main meeting space. Once a participant enters a Social Bubble, all participants in the same Social Bubble can hear each other plus the newcomer at full gain. Similarly, any participants present in the main meeting space will hear each other at full gain, and any newcomers will be heard at full gain. Once the 'official' meeting starts, the occupiers of Social Bubbles can hear at full gain the occupiers of the auditorium, but not in the opposite way. This sound design decision ensures that the privacy of the pre-meeting talk is respected, but at the same time ensures that participants are aware of the meeting talk and are subtly indicated to transition out of their pre-meeting talk. This is because, despite the fact that serendipitous pre-meeting small talk can improve the meeting experience, business meetings time needs to be used productively to focus on the meeting agenda [63]. At any other time (i.e. the 'official' meeting hasn't started or it ended), occupiers of Social Bubbles can't hear the auditorium talk at full-gain. Furthermore, users could perceive audio direction through the constant use of binaural audio regardless of voice gain.

# 5 REFLECTIONS AND IMPLICATIONS

## 5.1 Pros and cons

In small-scale user testing sessions, on the pro side, the prototype taught us that users enjoyed quickly moving around to join and leave bubbles during pre- and post- meeting periods. This took very little learning and was fun – a crucial value for boostrapping usage, especially if such a system is to be implemented as a new concept in otherwise normal work practices.

Similarly, users enjoyed choosing their own seats and moving seats in the auditorium during the meeting. Even though all audio was not spatialized as strongly in the auditorium as it was in the Wandering Space, so that everyone would hear a presenter and other attendees clearly no matter where they were seated. Our testers commented that enabling people who were close in the auditorium to whisper to one another would be an additional useful feature.

Although our background research did not specifically explore planned and ad-hoc huddles during meeting time, our users freely moved in and out of the 'official meeting' to talk to one another and with the *assumption* that the 'official meeting' would persist regardless of their movements. That they found that the 'official meeting' was always available, and, indeed, that others could observe people moving and out of the 'official meeting' while it was occurring

was a somewhat unexpected bonus to the value of a CT-enabled Wandering Space. It helped us realise that beyond pre- and post-meeting talk, such a space could reduce the abruptness of current breakout room implementations. The sense of a *persistent meeting* instead of a *persistent world* is strong plus for the prototype, as it forms the basis for an understanding of CT fluidity.

On the con side, there were limitations on the way we conducted the testing, and these had flow-on effects.. We did not have the capacity to set up the full context of a scheduled meeting link that was joined just as any other meeting might be, and the meeting that was held was feedback on the system itself, rather than an actual presentation as would fit the auditorium context. Further, although Microsoft Teams notifies users with a system notification in the bottom right corner of their screen whenever the first person joins a meeting, we did not have time to implement that in our prototype. As such, our testers also did not see, as they might have in the idealised view shown in Figure 1, a preview of people entering the Wandering Space preparatory to having an 'official meeting'.

What we found, then, was that when testers first entered the Wandering Space, they enjoyed its freedom so much that the 'official meeting' start transition was not self-explanatory, even though it is similar to how game spaces or SocialVR environments have lobby areas [36]. We had to repeatedly explain that the notification about the meeting started was a nudge for them to move from one place to another and from one form of engagement (informal) to another (formal). So, while even a blank Wandering Space *was* comprehensible through self-exploration, the combined space-time metaphor for an 'official meeting' as a subset within a 'total meeting time' *was not*, despite both verbal notifications and distinct changes to the auditorium graphic (brightening, enlarging etc.). Design changes may well help here, but so too could enabling the full calendaring capability and holding an actual meeting.

Similarly, despite being told repeatedly to imagine that this was just like a standard video meeting that could be scheduled like any other, but with additional capabilities, most testers had trouble grasping that they might access such a space multiple times in a day. The assumption was that this would be a persistent replacement, despite its deliberately extreme graphic limitation to avoid the denotation of a persistent world. This, again, could well have been a problem with the testing setup, but it points to the larger issue of changing mindsets around traditional video meetings. In some ways, a denotative naturalistic spatial metaphor such as the video game environment of Gather, since it is so different to standard video meetings, helps *re-set* assumptions.

On the other hand, as fun as that re-set can be, especially when novel, it has some drawbacks. First, as noted above, this use of a system is very different to standard institutional remote meeting processes. Most workers currently experience video meetings periodically. While a persistent world has a clear upside for CTs, the change in behaviour required to attend constantly to one's avatar representation in the space is quite high – potentially adding a cognitive load and a sense of unnecessary work, not to mention some ongoing computational and network load, which are already strained for some home workers. Certainly systems such as Gather *can* be used periodically, and indeed most research in fact report favourable ratings based on limited sessions of use per day rather than literal all-day usage [40, 61], but we do not yet have findings on the effects or value of long-term, daily, weekly, monthly and longer usage. Second, if the most value does stem from persistent usage, then this kind of system may intensify the immobility that is a major factor in meeting fatigue [3, 45]. This creates a trade-off between the value of CTs in the online world and an employee's physical comfort and wellness in the real world. Finally, for such systems to have maximum benefit then all users need to use the same persistent spatial world. Inevitably, the more heterogenous one's work contacts are, the more likely that many are not using the same system (indeed, some colleagues even within organizations do not use the same meeting systems [27]), reducing the value of the persistent spatial world. It is an open question, then, whether all the effort of persistent denotative spatiality is required to achieve the benefits of CTs.

## 5.2 Implications for Design

**Visual self-explanation of transitions:** The visual animation of transitions (i.e. zoom-ins or zoom-outs) can help users discover the social dynamics in the environment. Similarly, the wrong design can obstruct explainability or be biased to one form of exploration and not another.When compared to previous systems proposing new approaches to approaching and leave-taking (e.g. [56]) that are more abstract than those in fully denotative naturalistic systems, our prototype perhaps performed worse when used by totally naive users because it blended two different navigational/meeting logistics concepts. We thought that the blank Wandering Space might be confusing compared to the concreteness of the auditorium illustration as a meeting room (and one familiar to those who have used Microsoft Teams Together Mode, as this is the current default background). However, in the blank Wandering Space, our avatar navigation and social bubble creation was highly spatial and driven by user curiosity. It was easy and fun to learn, even by accident, as users started to move their mouse. However, the meeting room notification, illumination, and need to actively move in to the meeting room were not obvious (even when it was placed in the center of the Wandering Space). Indeed, it was seen as a spatial obstacle to go around rather than something into which they could go. While we expected some level of explanation would be needed, we underestimated the impact of very stark differences between the two areas. We could, of course, have simply drawn a Gather-style illustration, but our goal was to find the limits of what could be abstractly connotated. Clearly, the answer lies between our version and something more denotative.

**Spatial audio supports the understanding of social dynamics:** Spatial auditory cues such as distance-attenuation alterations or binaural perception (i.e. someone can be progressively heard better on my right ear by navigating to the right) need to be carefully designed to differentiate wandering space use from perceived meeting status (i.e. amplifying the voice-gain of users in the main meeting when the meeting starts may help 'call in' those outside it). Gather and related systems provide broadcast capabilities via specific areas on their maps, replicating podium and audience microphone set-ups from the real world. Our prototype attempted to obviate the need for specific areas in the auditorium space, and was successful insofar as no tester complained about being heard/not heard during the time in the auditorium area. Of

course, this does not prevent problems such as audience members interrupting speakers, but our system has at least the promise that social protocols from the in-person world experiences of meetings may be plausible in video meetings. More broadly, this study reinforces the value of even simple distance attenuation spatial audio in video meeting systems, and how it provides a strong and fairly low-cost (in both engineering terms and user cognitive load) method for reinforcing the proxemics of CTs [32]. This comes with a grain of salt, though, as in this case sound is reinforced by/reinforces visuals. This system, like most denotative naturalistic spatial worlds, needs considerable work to be accessible to blind and low-vision users [55].

**Abstract spatial metaphors and transitions:** Spatial metaphors can elicit transitions without the need of representing real-life spaces. In our case, we found that transitioning between social bubbles, which are abstract space representations was understood better than transitioning to the main meeting auditorium. Similarly, comfortable transitions can help participants form smaller groups visibly to others. It can allow moderators to fluidly direct users into smaller groups, or ad-hoc clustering from participants. Phatic communion [33, 34] itself doesn't require visuality – we have been beginning and ending telephone calls without visual aids for decades, even teleconferences (with some difficulty). Clearly, though, visuality, even when abstract, is an anchor for understanding. However, even as collaboration technology seems to be heading for ever-more complex graphical representations, including a metaverse of 3D visualizations, the benefits of abstractions should not be forgotten. Crucially, abstraction enables scalability, both in terms of the number of users who can be served and savings in computational energy. Environmental sustainability is touted as strong value proposition for remote work, and we would argue that exploration of the boundaries and possibilities of abstract interfaces for enabling CTs should be considered as relevant as – and perhaps an enabler for – accessibility.

## 5.3 Implications for Practice

More broadly, our work provokes questions around the trade-offs between online sociality, offline sociality, meeting productivity, and fatigue. If poorly scheduled, and expectations poorly managed, the adoption of pre-meetings might increase the burden of being online, placing pressure on individuals to be on time for pre-meetings. This would take time away from, as one reviewer described it, "*creating real space between meetings to be in the Real rather than more fixed focal length attention on a screen*". A prior study of remote work [47] found that when managers added mandatory social time, employees regarded it as an obligation that they resented or were anxious about. Is a 'more is more' approach to addressing the shortcomings of online meetings therefore flawed from the outset? While our study does not contribute new empirical evidence, we can suggest a best practice, namely, that the usage of a pre-meeting feature should be intentionally built into the original intended duration of the meeting. For example, rather than add a 5-minute pre-meeting to a 30-minute meeting, thus creating a 35-minute obligation, organisers should allocate the first 5 minutes as a pre-meeting and shorten the 'official' portion of the meeting to 25 minutes, thus alleviating some of the tensions.

Many meeting practices emerge out of group dynamics and corporate culture, but the formalisation of interaction by meeting technology places increasing power and responsibility in the hands of meeting organisers and facilitators. Videoconferencing platforms often begin with the assumption that the meeting creator alone determines the date, time, and location of a meeting, thus it seems a natural extension to assume that the meeting creator must also be responsible for scheduling pre- and post-meeting interactions. In their selective application of organisational guidelines to schedule 5-10 minutes of breaks between meetings, organisers have already become *de facto* curators of offline time. We are not uncritical of this gradual disenfranchisement of meeting attendees, but exploring this idea further is beyond the scope of this paper. we hope, however, that systems that make time for social space as an option rather than an obligation may also increase the power for remote meeting attendees to develop new social protocols, some like those in-person, others adapted to what is abstractly possible.

## 5.4 Limitations

Our findings are limited to our own use of the system and informal internal tests with 13 participants. This was not a rigorous user-evaluation, but it supported the initial design requirements and taught us, in a limited and non-generalizable fashion, about the tension between spatial metaphors and pre- and post- meeting transitions. Additionally, the early version of Microsoft Mesh didn't allow for the local user to see their own video feed once shared, and we worked around it by displaying a camera icon on the User Video Bubble when the camera was on.

# 6 CONCLUSIONS

This paper explored a design enabling a range of Conversational Transitions adjacent to meetings, using a novel approach intersecting time and space. Our prototype implements visual animations and spatial auditory cues to indicate when a user is transitioning between spaces. We synthesised three preliminary design implications for approaching and leave-taking from our prototype usage over a period of six weeks and two informal tests with 13 lab colleagues where we observed casual meetings.

Future research should explore questions such as: Do these metaphors make the beginning and ending of a meeting feel less abrupt? Do people feel there is value in talking to smaller groups of people before and after the meeting? Do they feel there is value in enabling fluid and observable planned and ad hoc huddles during meetings? Is the transition into the main meeting and being able to choose your own seat valuable? How does the spatial disposition and transition into the 'official meeting' affect understandability? Is the ability to negotiate contact during leave-taking valuable? Regardless of the design choices, we hold the strong belief that the benefits of CTs should make them a first-class requirement for videoconferencing software.

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