

Constructing Space

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Abstract

This chapter chronicles the growth of the author's understanding of MediaSpace through his 20-year experience with coupling spaces using video. Key ideas from research studies and practice are presented, and contrasts with other genres of communication are made. The implications for distributed collaboration are explored.

Introduction

This chapter sketches my experience with MediaSpace over the years, and the conceptual discoveries I have made in the process. These ideas are not new, but they were to me at the time, and they may surprise you as much as they did me.

A brief history

In the early 1980's, in the Cognitive and Instructional Sciences group at Xerox Palo Alto Research Center, as part of my work with Lucy Suchman on what it is to operate a machine, I was using video to make records for helping to analyze people interacting with copiers [Suchman 1987]. We used the perspective and methods of ethnomethodology [Heritage 1984] and interaction analysis [Jordan and Henderson 1995], based in careful observation and fine-grained analysis of the fine-grained workings of human activity [Suchman 1983]. This was a video record of human activity for the purpose of analyzing that activity later.

At the same time, Bob Stults and Steve Harrison in the Advanced Design group (NAME??? – by the 90's we were “Design, Use and Shared Spaces,” but this was well before that) were working on a different problem that also involved video. I remember them showing me, as someone also interested in both video and human interaction, various experiments which, in retrospect, I now think of as the roots of MediaSpace. They were recording designers designing, less for the purpose of analysis, and more with the intent of enabling designers to pick up the thread of an interrupted design session and continue from where they left off.

A thread that these different, but co-informing, uses of video had in common was an appreciation of the fact that human activity takes place in physical space. Further, space matters in understanding activity. My discipline, Human-Computer Interaction (HCI), arose from the study of technology (computer science) and cognition (psychology), and tended to locate the interesting action between the thinking and interaction devices of humans and machines. Not really much place for space there. Yet our video observations of people operating copiers had to capture the full space surrounding the machine, or we missed not only the work of managing paper (originals, supplies, and copies) but also of fixing paper jams. Similarly, the study of designers designing involved paper on tables and sketches on whiteboards. Most importantly, we learned that both making copies and designing were social activities; here again space was essential. Our sharing experiences and arguing over lunch were probably important to the subsequent courses of both of these pieces of work.

The first encounter with MediaSpace itself was a couple of years later, in 1985. Now the video was live, used to connect designers who wanted to work together but were not physically together. The original motivation was to “fix” PARC's beautiful, personal, but isolating offices; designers wanted to be able to work to-

gether without having to get up and hike to other offices. With MediaSpace, people had video connections between offices; using controls on their workstations, they could quickly connect to any office on the system.

By 1986, PARC's Palo Alto MediaSpace had gotten coupled over continuously-operating (24/7) video connections to the Mediaspace at the PARC's Portland site. This inter-connecting of MediaSpaces was important to me because it showed that the practices of local MediaSpace could be extended without significant change to offices at multiple sites.

In 1987, when opening PARC's site in Cambridge, England, we decided to install MediaSpace throughout. This decision was driven by three factors: the successful experience with coupling other PARC labs (specifically Palo Alto and Portland), space connectivity problems (six fairly separate pods on three floors), and the desire to observe ourselves as part of our research. PortHoles, an application using images from MediaSpace, provided snapshots of all MediaSpace ports at once, yielding a sense of the EuroPARC offices as a single space. For research observation, MediaSpace could support observation within EuroPARC.

However, we faced a new challenge: EuroPARC and PARC were separated by eight time zones. On the face of it, this time-offset rendered the 24/7 coupling of the sites with MediaSpace less valuable for working together. More importantly, however, for folks at both sites, the MediaSpace supported a constant presence of "the rest of PARC", producing the extraordinarily valuable sense of being part of a single whole. Perhaps this was particularly important for me, because, as liaison between the sites, I was living in both places; wherever I was physically, I had strong reason to be engaged with what was happening at my other office. In addition, the MediaSpace not only supported the work at EuroPARC, it became the subject matter. In particular, the Khronica event manager (a sort of calendar application on steroids) system used the MediaSpace to deliver its alerts, for example by slowly increasing the sound of the tinkling of teacups as afternoon tea time approached and showing the Commons filling (or not!) with people.

In the early 90's, back at PARC, I was working with Annette Adler whose office was remote from mine in the building. Because moving offices at PARC often required an act of god or more, we solved the problem by making a private MediaSpace. We coupled our offices by directly connecting a camera in each of our offices to a monitor in the other office using a pair of coax cables. This "direct office share" configuration lasted for nearly a year. [Adler and Henderson 1994] We came to think of ourselves as working in a single room having two doors onto two different hallways, with a funny problem in handing things to each other. Colleagues, managers, visitors, and cleaning staff all experienced this direct office share differently, often with amusing results. People came to my door to talk to Annette. When my office was empty, people who came in looked at things, and even adjusted clothing, being unaware or forgetting that the other "half" of the office was still occupied. Simultaneously, with a somewhat different implementation, Victoria Bellotti and Paul Dourish were running a similar experiment at Eu-

roPARC; their experiences aligned with, and complemented, ours [Dourish et al. 1996].

From 1991 to 1994, I led a Xerox-wide architecture project. For the first 2 years, we gathered for a week to work together to negotiate and align understanding and plan the next segment of work. This involved large groups of people flying somewhere in the world every few months, staying in hotels, and driving on strange sides of the road. In January of 1993, MediaSpace began to change all that. At Bill Buxton's urging, we got the first video codecs that worked at dial-up ISDN-line speeds, and connected spaces instead of jumping on airplanes. Delayed, and a little choppy, the images created havoc with fine-grained interactions, like interruptions and restarts. But being connected was great. At first, we worked in conference rooms equipped with videoconference equipment; all project members attended, but some attended remotely. Soon, however, most sites installed MediaSpaces, and people held working sessions over this dial-up MediaSpace between the get-togethers. The rhythm of interaction on the project changed from months between in-person workshops to days between MediaSpace meetings. The work moved much faster, with less need for long-range planning, and with quicker response to outside change. Toward the end of the project, workshops had dropped to once or twice a year.

Around 2000, I did some consulting for Sun Microsystems on videoconferencing based on my experience with MediaSpace. Sun was spilling out of Silicon Valley and the Workplace Effectiveness Group (a research group in Sun's facilities organization) was concerned with how Sun employees would work together at a distance. At Sun it was generally felt that videoconferencing was a pretty bad way to work, to be avoided if at all possible. However, certain groups were using it with singular success and loving it. It didn't take long to discover that what the successful groups were doing was using videoconferencing equipment to create dial-up MediaSpace. They were connecting small conference rooms and sitting around a virtual table spanning the rooms. Working with psychologist Lynne Henderson, I studied what made this so successful. [ref to VC/CR chapter]. Based on our resulting understanding, and our MediaSpace experience, we adjusted the videoconferencing equipment to support the MediaSpace notion of coupling rooms. We were successful enough at this that the groups asked whether we could extend this practice to their all-hands meeting. This led to a number of large-room trials, resulting in a configuration that placed the rooms in a kind of ring in virtual space, each room both in front of and behind the other. Although this configuration is unrealizable in physical space, it directly supports extending the practices of an all-hands meeting held in a single room to the larger virtual room.

Some discoveries

As a result of, and in the midst of, these encounters with MediaSpace in a number of different forms, I continued to be surprised by MediaSpace. New aspects of the practices of coupling spaces continued to emerge, long after I thought I under-

stood what MediaSpace was about. Despite its apparent conceptual simplicity, for me MediaSpace has become a very rich idea. Here's the way I see it.

Bridging distance

At the heart of the matter, MediaSpace lets people work with other folk who are some distance away. It is interesting to note that the distances that were bridged in the earliest MediaSpace were often only a few yards. The designers felt that walking between private offices was a real pain; you ought to be able to simply adjust your position to open – usually continue – an interaction with a co-worker. The direct office share configuration was used to connect spaces that were hundreds of feet and floors apart; and I have worked in offices that are part of MediaSpaces that spanned many time zones. However, I believe that it is the existence of a distance to be bridged, rather than the extent of that distance, that is at the heart of MediaSpace's offering.

Bridging time: NOT!

MediaSpace for me has not been about time-shifting activity, making experiences available later. On occasion, I have used the fact that I was in MediaSpace as a cheap way to make records of the activity taking place; after all, the video was there, and simply connecting a recorder (or two) was conceptually and often technically easy.

However the move to making recordings is not socially easy. Working on-camera with a record is a different experience than working without one, in that with a record the work may possibly become available for someone other than those present. My experience has been that making a record may distort the activity being recorded, and unless getting a record is required, it is usually not worth doing.

It is also the case that the images used to implement MediaSpace are not necessarily those you would want as the record. For example, this brings pressure to compromise the positioning of the MediaSpace cameras, often making neither the MediaSpace nor the recording work well. All the MediaSpaces that I have found effective have been entirely about connection in realtime.

Bridging people: not necessarily

Because MediaSpace enables people at a distance to work together, we often tend to imagine that the people using the MediaSpace have to be there for MediaSpace to be useful. One of the earliest learnings was that MediaSpace was also helping people to know when other people were *absent*. I remember a manager challenging me whether MediaSpace was really necessary to talk to someone whose office was just down the hall. I reminded him that saving the time and ef-

fort of all the trips down the hall when the other person was either not there, or was busy on the phone, or was with someone else, was very effective indeed.

With PortHoles, seeing dark rooms was as important as seeing lighted ones. An unoccupied yet lighted room suggested that checking again soon might be rewarded. That knowledge was invaluable over eight time zones; and it was also valuable with spaces just down the hall.

Connecting spaces

What MediaSpace connects is spaces. The camera captures everything in the space; the monitor presents it in the space at the other end. The microphones convey sound to the remote audio output. As a result one space is accessible from the other.

However, the connection is partial. Access is visual and aural. Handing something physical across media space doesn't work. You can't smell. You can't touch. The connection is limited in its reach. Some places in most rooms with MediaSpace are off-camera. The sound may be better or worse in different parts of the room. And visual space is not the same as aural space. People call out to people they cannot see, both in the room, and also down the hall outside the room. Sound from down the hall is available at the remote end. I was amazed when people came to my door to find out if the Jazzercise class had started in the Health Center which was down the hall from Annette's office.

Non-office spaces were also important. The Commons was an important space in PARC's Pod 26, and also at EuroPARC. It was no one's office, but was a place where people gathered. At times I have seen people point a MediaSpace camera down a hallway. (Cruiser, an exploration of enabling walking remote hallways, was entirely based on that idea. [Root 1988])

Although it is tempting to think of MediaSpace as connecting people, in my view, MediaSpace is best understood as being about connecting space.

Constructing spaces

Although it is natural to focus on connecting spaces, I think it is better to think of MediaSpace as a way of making a single virtual constructed space out of a number of component spaces. This is like the virtual space created by a phone call: the "there" in "Are you there?" refers not to the place where the other person is, but rather to the virtual space of the phone call. This constructed space is created in people's minds by the telephone connection and the practices of talking. The constructed space vanishes when the connections are broken. All players in the component spaces are in the constructed space; they share the space.

One of the things that makes videoconferencing difficult is that videoconferencing facilities (the component spaces) and practices do not lend themselves to the easy mental creation of a single constructed space. Everything keeps one focused on "we here" and "they there". MediaSpace can be much more powerful be-

cause it provides for treating all the spaces as extensions of every component space.

Constructed spaces

Some connected spaces are “always on,” and make the beginning of interactions easy. In the Direct Office Share, Annette would ask a question (“Lunch?”) and I’d respond (“Meet you upstairs in five minutes.”). No “hello” to get started, and no need to say “goodbye;” we were both aware of the other in the space and could just use the space for talking.

However, when using Dial-up spaces (e.g., for meetings in the Xerox architecture work, or in our distance collaboration study at Sun), there is active work required to make the connection and construct the space. At Sun, the study group had automated the whole startup process, so that flipping a single switch would set up the connection to the other space. More notable yet was the timing of when this switch was flipped: the first person into the room at either end was expected to flip the switch on; and the last person out at either end would flip it off. This practice might increase the cost of technical communications, but it also ensured that the constructed space was in place for everyone, not just during the formal discussion, but also during the informal yet critical socializing before and after the meeting where the work of the meeting is also done.

It is interesting to note that this practice of supporting the whole meeting broke down when the rooms were being used continuously: then the socializing tended to happen in the halls outside the room at each end independently. When the meetings started, the only people who had any sense of completeness were those who had been in the previous meeting and were staying on for this one. We recommended scheduling time between meetings.

As part of setting up, what should the camera see? In a single physical space, you can usually tell who is present, and can hear them speak. A constructed space has to be created to provide the same capabilities. If the door into the room is off camera, someone arriving or leaving may not be visible. Sometimes people think this is good because it prevents interruptions from propagating to the other end. I think it is bad, for exactly the same reason. With practiced MediaSpace users, when people arrive or leave it is often noted – even announced – to the other end. When possible, it is best to have the door on-camera, that is, toward the presentation end of the room.

Similarly, hearing in even a single physical space may not be uniformly good, and people develop practices for working around it. For example, people learn to ask for repeats when they cannot hear. Similar work-arounds must be developed in constructed spaces. For example, one of the most disruptive practices in meetings is for people to “sub-group” – hold conversations that are not available to everyone. In a local room, sub-grouping is always visible, and social practices can be put in place to manage it. In constructed space, sub-grouping may be invisible to those who are remote. This is particularly bad: the goal should be that everyone

has access to everything. By maintaining awareness of group interaction, equal access can be provided (“Is there something you want to share, John?”). By leveling the playing field, everyone gets all the information, and everyone feels included.

Arranging the rooms

It takes thought to arrange the component spaces so that they contribute effectively to the constructed whole. The constructed space needs to be shaped by the activity in which one is engaged (e.g., a chat, a working session, a presentation, an all-hands meeting).

When connecting my office to others in MediaSpace, I found that I often wanted the camera to be in different places: looking at my whiteboard, looking at my screen, looking at a small working table around which a small number of us would gather, looking down on a document. I set up a number of cameras and a switcher in my office so that I could quickly switch the view that I was providing to others.

When connecting small conference rooms, the conference room practices to extend to the connected room are sitting around the table and discussing, or listening to a presentation. Because it takes effort to move video equipment around a room, and because doing so is disruptive, getting a single configuration is desirable. I have found that most videoconferencing rooms are set up so that the monitor (with the camera perched on top) are at the “presentation end” of the room, the end where the screen and other presentation equipment is positioned. For MediaSpace, I have found that I want the monitor and camera at the other end of the room, the end opposite the presentation end, with the table between. The video equipment thus couples the tables in the two small conference rooms end to end, with presentation ends at the “outboard” ends of the constructed room. This often requires long cables because meeting support people usually don’t think of putting the videoconferencing equipment there. It also requires having a long cable to permit the “document camera” to be at the presentation end of the room. In my experience, document cameras come with a 10 foot cable, indicating just how deeply the idea of the video as presenter is built into the videoconference thinking. (see other paper).

When connecting large rooms, the practice for all-hands meetings was to set large rooms with a stage (the presentation area) at one end, and lines of chairs facing it. Most interaction was presumed to be between the “presenters” on the stage and the “audience” in the chairs. However, in reality, people in the audience also interacted with each other. This was generally achieved by turning to face each other. To extend these practices with MediaSpace required letting audiences in each site see both stages, presenters on both stages see all people in audiences at all sites, and somehow let people in audiences at all sites turn to see everyone. To achieve this, we also wanted to use the same small-room video equipment, both

for reasons of cost and for being able to use both small and large rooms as part of the arrangements for both small and large-group meetings.

Through a number of attempts, we developed a configuration that did the job pretty well; interestingly, it cannot be achieved in physical space. As in the small rooms, put the video-conference equipment at the “back” of the room, facing the stage. Allot half the stage for the second screen and project onto it the video image coming from the remote end. Unless you have a very large monitor as part of the video-conferencing equipment, also project the remote image on a screen at the back of the room. Each room is then conceptually behind the other, in a virtual ring. People look forward to see both the live local stage, and - through the screen - the remote stage. People can talk to other people in the local or the remote room by turning either forward or backward to face each other.

Hosting

MediaSpaces often span sites. When continuously-operating MediaSpaces break, or when intermittent MediaSpaces are started and stopped as at the beginning and end of a meeting, coordination support is needed. Additional channels of communication are required, and people are needed to make it happen. One good way of arranging this is to identify and publish contact information for “hosts” for each site, people who can be contacted when help is needed.

These arrangements have practical implications. In addition to all the communications equipment needed for video-conferencing, it is important to make sure that there is a telephone in the meeting room at each site. A fax machine to ship physical documents quickly between sites is also a plus. Telephone numbers for the remote hosts should be easily accessible.

Hosts provide two sorts of support: that which occurs outside the meeting and that which occurs within the meeting. Before and after the meeting and in the hallways during the meeting, hosts handle such everyday difficulties as rescheduling (changes at one end must be coordinated with folks at the other), interrupting (the meeting must be cut short, or messages need to be interjected), and providing supplies. Within the meeting, hosts handle difficulties with the technology and communications with remote hosts. Hosts should not be leading the meeting, as they must be able to fix things while the leader directs the activity.

The hosting role provides the connectivity and continuity between meetings that are part of a series. Each meeting produces information that informs the next: schedule, people who should be there, documentation that will be important. Further, because hosts are in the hallways after the meeting they can hear further thoughts about the meeting and use that in setting up the next.

The studies I did with Lynne Henderson at Sun showed just how important these roles were. We discovered this because, as observers, we could see the needs, and as people not participating in the work of the meeting, we could meet those needs without disrupting the activity (e.g., taking a document out to fax it to a remote site, or alerting hosts to changes in scheduling).

Our experience indicated to us just how important these often-invisible – even forgotten – roles are. Hosting is an essential part of MediaSpace.

Non-uniform spaces

Although uniformity is desirable in the constructed room, in practice there are many things that will inevitably be different at the different sites, and the constructed room will reflect these. Working in a constructed room requires taking these inevitable differences into account and adjusting joint practice accordingly. Over the years, experience revealed more and more of these. Here are some examples.

You can't do much about time zones. When trying to find a time for meetings between PARC (usually GMT - 8) and EuroPARC (usually GMT), a one-hour meeting at 9:00 in the morning in California was one hour before all could be relied upon to have gotten to work in Silicon Valley, and finished one hour after most people would be headed for the pub in the UK. And even at that, biological and social rhythms were not aligned: people on one end were bright-eyed and bushy-tailed, ready for the work of the day, where those at the other were ready for a pint. We also tripped over exactly when it was that Daylight Savings time (Summer time) came in and went out; it differs with country and state, and countries are aligned differently with each other in spring and fall.

You can't do much about weather: Outside the windows of the rooms, or in peoples minds if the room has no windows, the reality of a blizzard in Rochester, New York had to be made clear to the spoiled residents of Palo Alto. Meetings were cancelled early, so people could drive home. Correspondingly, the reactions of people to earthquakes shook up a number of meetings I was in: suddenly half the people in the (constructed) room were looking around at the lights and each other, checking whether it really was an earthquake and speculating on the size. Also, what constitutes a blizzard or a heatwave is a matter of negotiation: a foot of snow in Cambridge, UK is unremarkable in upper New York state, but surely it will be remarked upon in the constructed room.

You also can't fix culture: Any number of meetings have been scheduled only to discover that others will not be there because it is a holiday of one form or another (national, state, city). Corporate activities differ by location, even for the same corporation. People are embedded in their cultures and until they are practiced at it, forget that what's unremarkable to them may not be to others. Dress codes, speaking practices, punctuality all require awareness and negotiation. "Wow, that's tough; go have your cold beer!" "Cold?"

There may be nothing particularly new here for those who have worked with others at a distance. What struck me as interesting, however, was how much these non-uniformities between locations make the ends of the room different. When well constructed, the virtual room becomes one space. The trick is to remain aware of the non-uniformities without losing the sense of being in a single space.

Moving spaces

It seems to me that MediaSpace's constructed spaces are taken apart and created out of pieces. Just as I walk down the hall carrying the thread from previous work, my space carries with it a richer thread from meeting to meeting.

Particularly during the Xerox architecture work, I often attended meetings back to back. Some of these were with people at different sites. What we all learned was that sitting in Palo Alto, I could "drive" across Rochester much faster than those in Rochester could. Allen would leave a meeting in Henrietta a little early, saying he was headed for Webster. After the Henrietta meeting finished, I'd connect to the Webster meeting and tell them that Allen was on his way.

What I particularly liked was the ability to take with me to a meeting everything that I might possibly need there. Sitting in my office, my filing cabinets were at hand, as was my whiteboard with the work from other meetings.

Value of MediaSpace

Over the years, I have been part of many discussions on whether MediaSpace provided better communication than using telephones. Why pay the price of video when you can just use a conference phone?

The common argument, that video provides facial expressions, doesn't make sense to me, since the resolution is too low, particularly for the wide-angle, fixed-direction "room" camera positioning that is used in MediaSpace. Similarly, I have found that the argument for supporting heavy use of graphics is weak: rich documents are better supported with paper, because the video resolution is too low.

Instead, I believe that the value of MediaSpace is that it makes possible the distributed remote social construction of meaning, particularly agreements. You can tell who is in the room, and you can tell from body language the nature of their engagement. You can use the visual channel as a back-channel and not interrupt the speaker (e.g., give him a thumbs up). You can show disagreement, form coalitions, and give support using the visual concurrently with speaking (e.g., waving hands, jumping up and walking around, leaning back in disapproval or forward in engagement).

At the end, when agreement is reached, you can know that all agreed, and who agreed with reservations, and that they know that you know. MediaSpace supports the undeniable understanding that "you" were there and that you were part of the "we" that had the discussion and made the decision.

Conclusion

MediaSpace supports the construction of complex compound spaces out of distributed sets of local physical spaces. These spaces can be created with relatively simple usages of standard video-conferencing technology. And the practices that work in physical spaces can be extended with manageable effort and minimal change to enable similar work to be done together at a distance.

References

- Adler A, Henderson A (1994) A room of our own: experiences from a direct office share. Proceedings of CHI'94, Human Factors in Computing Systems. ACM, New York.
- Dourish P, Adler A, Bellotti V, Henderson A (1996) Your Place or Mine? Learning from Long-Term Use of Audio-Video Communication. *Journal of Computer Supported Cooperative Work* 5(1) 33-62
- Heritage J (1984) *Garfinkel and Ethnomethodology*., Blackwell, London.
- Jordan B, Henderson A (1995) Interaction Analysis: Foundations and Practice. *The Journal of Learning Sciences* 4 (1), 39-103
- Root R (1988) Design of a multi-media vehicle for social browsing. Proceedings of the 1988 ACM conference on Computer-supported cooperative work. ACM, New York.
- Suchman L (1983) Office Procedures as Practical Action: Models of Work and Systems Design. *ACM Transactions on Information Systems* 1 (4), 320-328
- Suchman L (1987) *Plans and Situated Actions: the problem of Human/Machine communication*. Cambridge University Press, Cambridge.