

# Asymmetry in Media Spaces

Amy Voida, Stephen Voida, Saul Greenberg & Helen Ai He

Department of Computer Science, University of Calgary  
2500 University Dr. NW, Calgary, Alberta T2N 1N4, Canada  
{avoida, svoida, saul.greenberg, hahe}@ucalgary.ca

## ABSTRACT

In any collaborative system, there are both symmetries and asymmetries present in the design of the technology and in the ways that technology is appropriated. Yet media space research tends to focus more on supporting and fostering the symmetries than the asymmetries. Throughout more than 20 years of media space research, the pursuit of increased symmetry, whether achieved through technical or social means, has been a recurrent theme. The research literature on the use of contemporary awareness systems, in contrast, displays little if any of this emphasis on symmetrical use; indeed, this body of research occasionally highlights the perceived value of asymmetry. In this paper, we unpack the different forms of asymmetry present in both media spaces and contemporary awareness systems. We argue that just as asymmetry has been demonstrated to have value in contemporary awareness systems, so might asymmetry have value in media spaces and in other CSCW systems, more generally. To illustrate, we present a media space that emphasizes and embodies multiple forms of asymmetry and does so in response to the needs of a particular work context.

## ACM Classification Keywords

H.5.3. [Information Interfaces and Presentation (e.g., HCI)]: Group and Organization Interfaces—Computer-Supported Cooperative Work

## General Terms

Design, Human Factors, Theory

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Asymmetry, Media Space, Awareness, Reciprocity

## INTRODUCTION

In any collaborative system, there are both symmetries and asymmetries present in the design of the technology and in the ways that technology is appropriated. The telephone, for example, supports audio symmetry—a person on one end of the connection can hear everything at the other end and vice versa, in equivalent fidelity. Yet with traditional telephone

technologies, there is an asymmetry of knowledge about who is on the other end of the “line.” While the person who initiates the call knows whom she is calling, the person being called does not know who is on the other end of the line when he answers the phone. Social convention helps to mitigate this asymmetry; the person who initiates the call is expected to immediately identify herself (e.g., “Hi, this is Diane”). Recent technological innovations such as caller ID and customizable ring tones have also attempted to mitigate this asymmetry.

In Wikipedia, to provide another example, the transparency of work in the authoring process is symmetrical: any one individual contributing to an article can see the edits that any other individual has made and vice versa. Yet the initial perceived value of that authoring work is asymmetrical with respect to different authors’ relative levels of participation on Wikipedia; edits from anonymous authors are considered to be “inherently suspect so new users are encouraged to register and get user names” [5]. There is additional asymmetry in the distribution of work on Wikipedia, where fewer than 10% of the authors are responsible for more than 90% of contributions [33].

Both symmetries and asymmetries are clearly present in collaborative systems. Typical CSCW research, however, tends to focus on supporting and fostering symmetries. Asymmetries are frequently either overlooked in the research literature or considered a design challenge that must be addressed. Research in real-time shared editors, for example, focused on developing platforms for collaborative writing that enabled a synchronous symmetry of use, providing all authors, simultaneously, the ability to both browse and edit documents (e.g., [31]). Stefik et al. coined the acronym WYSIWIS (“What you see is what I see”) to describe the predominant form of symmetry engaged by the research community in this domain, a symmetry of content and media [39]<sup>1</sup>. More recently, the design and development of novel, collaborative technologies for domestic contexts has also foregrounded symmetry in design. Plaisant et al.’s shared calendar system, for example, was explicitly designed to foster symmetrical awareness of family schedules across multiple generations [34]. Clearly, symmetry can be a desirable thing in system design, supporting more tight-knit collaboration among

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<sup>1</sup>While some notable research has considered the asymmetries of roles in collaborative authoring (e.g., [25]), this research represents the exception rather than the rule.

colleagues in the workplace or increased empowerment for elders in multigenerational interactions.

Within the domain of CSCW, nowhere, perhaps, is the dialogue about symmetry more prominent than in media space research, where there is a strong emphasis on supporting and fostering the symmetrical use of these systems. Very little attention is paid to the role of asymmetry in design and appropriation. In this paper, we challenge the primacy of symmetry in media space research and in CSCW research more generally. We begin by unpacking the many asymmetries present in media space systems (albeit often implicitly) and discussing related design efforts to mitigate these asymmetries and to support more symmetry in system use. By way of contrast, we then unpack the many asymmetries present in the use of contemporary awareness systems. Here, we highlight empirical findings that describe the perceived value of these asymmetries. Finally, we present one example of a media space designed to embody and foreground many different, often overlooked, and sometimes highly valued asymmetries.

### ASYMMETRIES IN MEDIA SPACES

Throughout more than 20 years of media space research, a tension has existed between the asymmetries intrinsic to media space technologies and the desire for some degree of symmetry in how these systems are used. Gaver argues most explicitly that media spaces are an inherently asymmetrical technology: in face-to-face contexts, it is most commonly the case that if one party can see another, then the reverse is also true. Yet this is not inherently the case in media spaces, which afford...

...one-way viewing and listening to a far greater degree. In the everyday medium, to obtain visual information is usually to make information available; in media spaces, making information available is an independent act from obtaining it [13].

Within media spaces, then, it is possible to unobtrusively “glance” into a colleague’s office via a video link to assess whether it would be a convenient time to talk. But it is also possible to spy on a colleague, watching her video link over time without her being aware that she is being watched.

Mitigating the fundamentally asymmetrical nature of media spaces has been a constant refrain throughout the history of research on these systems, where designers and participants (often designers-cum-participants) work to facilitate some degree of symmetry in the use of these systems. Early on, the pursuit of increased symmetry was a thoughtful attempt to provide a balance of power between producers and consumers of awareness information and to support the communicative resources used by individuals to shape their performance in face-to-face communication (see also [20]).

Most commonly, this engagement with symmetry has manifested itself in the negotiation and re-negotiation of audiovisual reciprocity (e.g., “if I can see you, then you can see me” or “I agree to let you ‘glance’ in on me if you agree

to let me ‘glance’ in on you”) and in debates over whether this reciprocity ought to be sought through social and/or technical means.

The particular research dialogue about reciprocity in media spaces actually reflects multiple forms of asymmetry—an asymmetry of media and an asymmetry of engagement, for example. Here, we distill and unpack some of the different forms of asymmetry present in media space systems: asymmetries of media, fidelity, participation, engagement, benefit and place.

### Asymmetry of Media

The different kinds of content that individuals may share through media spaces create one kind of asymmetry—an asymmetry of media. The asymmetry of media is the most commonly discussed type of asymmetry in the media space literature. Researchers strove to achieve a symmetrical “reciprocity” in media use, where one individual reflected *in kind* the type of content that another individual shared: audio for audio and video for video. Violations of expectations about media symmetry were considered socially inappropriate. For example, when one media space participant was discovered to have “disconnected his camera in order to see others without being seen, this behavior was noted and censured by others in the community” [9].

Researchers aimed to mitigate the asymmetry of media through both technical and social means. The Cruiser media space, for example, had an explicit and enforced technical “reciprocity rule”—one could not glance into another’s video feed without being seen as well [36]. Technically enforced reciprocity was viewed as supporting social symmetry, grace, and privacy:

These design decisions are based on a philosophy of social symmetry derived from observations of everyday office life. In the real world, it is generally not possible to see without being seen. By preserving this characteristic of the physical world, we incorporate a certain social grace into computer-mediated interactions and provide an element of social privacy by ensuring that one cannot be observed surreptitiously [36].

Further efforts to ensure greater visual symmetry resulted in experiments with video tunnels, in which cameras and displays were configured so as to make it almost impossible to see the distant video feed on screen without being captured by the camera [38].

The asymmetry of media in media spaces is further highlighted by the extent to which media has been found to serve as a form of social currency. When media use is not symmetrical, studies have shown that individuals with “lesser forms of presence information” (e.g., static images in lieu of video) were neglected by other participants and felt, themselves, like “2nd class citizens” [35].

### Asymmetry of Fidelity

The different amount of detail provided in media spaces creates an asymmetry of fidelity. Asymmetries of fidelity

may be caused by inherent asymmetries in the fidelity of different media (e.g. static vs. dynamic images or variances in video quality, frame rate and resolution) or by personal preferences about how that media is (or is not) transmitted to others and displayed.

Media space research explicitly engaged with the asymmetry of fidelity by exploring the effects of blurred video as a safeguard to privacy while still providing awareness information [21, 30]. In addition, studies of the use of media spaces report participants “adjusting” video fidelity by manually covering their video cameras or turning their cameras around for periods of time [2, 30].

### **Asymmetry of Participation**

The varying degrees of participation in communities surrounding media spaces also create a form of asymmetry. In the PARC media space, only a subset of researchers owned end nodes, each explicitly asking to join in [2]. The act of “signing up,” as Dourish argued, was an implicit “acceptance of the social practices and norms which govern[ed] acceptable media space use” for that community [10]. Individuals who owned end nodes were at the center of the media space community and were recognized as participants in the media space. Individuals who did not own an end node but were still peripheral or even accidental participants in the media space community were generally not discussed in early media space research<sup>2</sup>.

More recent media space research has provided some concrete evidence that individuals who do not own their own media space nodes can also be legitimate participants in the media space, whether that participation is intentional or not. A study of the Notification Collage, for example, reported an instance in which an individual participated in the media space without knowing that the system existed:

One telecommuter reported seeing the lights come on after hours in the laboratory and watching a cleaning person (unaware that she was being monitored) going about her duties [16].

This account of media space use challenges any naïve assumptions about what it means to participate in a media space, more clearly disentangling varying degrees of participation from the ownership of a node.

### **Asymmetry of Engagement**

The breadth of attention and focus one may have with media spaces also suggests an asymmetry of engagement. Media spaces support a breadth of practices across a continuum of levels of engagement, from peripheral awareness to more focused interactions [2].

The asymmetry of engagement was also engaged explicitly in research through efforts to support socially negotiated, symmetrical use. The RAVE media space, for example,

allowed individuals to customize rules for media space interactions based around predefined services (e.g., a short, one-way video connection glance; a temporary, two-way audiovisual connection; an open-ended, long-term audiovisual connection office-share, etc...) [10]. While the rules enabled agent-based, technical mediation of system asymmetry, the symmetry in the system was negotiated within the social sphere as individuals with media space nodes had to both agree to a particular scope of engagement before it would be supported by the system.

### **Asymmetry of Benefit**

The varying degrees to which participants benefit from media spaces also create an asymmetry not typically discussed in the media space literature. We know that a collaborative technology “never provides the same benefit to every group member” [17]; media spaces are no different.

One cross-cultural installation of a document-based media space uncovered an asymmetry of benefit, caused at least in part by the inability of the media to “transcend social boundaries” [7]. This asymmetry of benefit drove participants at one site to sever the network connection and re-engineer their own local version of the media space.

Research has also shown that communication patterns vary according to work relationships; more communication, for example, travels down the organizational hierarchy than in the reverse direction [19]. Although many media spaces were used primarily by close work colleagues within a relatively flat organizational hierarchy (e.g., [32]), other media spaces were used across multiple levels of organizational hierarchies (e.g., [10, 16]). One might speculate, then, that there was an asymmetry of benefit of media spaces among individuals at different locations within this hierarchy.

### **Asymmetry of Place**

The varying cultural norms surrounding the use of media spaces in different contexts also create asymmetry. Early media space research often focused on the use of systems among symmetrical physical places: office-to-office or common area-to-common area. The asymmetry of place was more prominent in research that extended its focus to address the differential use of media spaces between office nodes and shared common areas (e.g., [2]). More recently, the asymmetry of place has been engaged in research that explores the differential use of media spaces both to connect home and office environments [30] as well as to connect cross-cultural office environments [7].

In summary, media spaces are an intrinsically asymmetrical technology [13]; numerous forms of asymmetries exist in both their design and use. In general, researchers have perceived these asymmetries as design challenges to be overcome. Consequently, much research in media spaces has focused on mitigating these asymmetries. We question the assumption that asymmetries in sociotechnical systems should consistently be mitigated and present a

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<sup>2</sup> There are occasional references in the media space literature to a “guest” being introduced to others over the audiovisual channel, but the guests’ experiences of the system were not considered part of the research foci.

counterargument about the potential value of asymmetries from the domain of contemporary awareness systems.

### ASYMMETRIES IN AWARENESS SYSTEMS

Looking to awareness systems—particularly, commercial systems that have been widely adopted and appropriated for awareness purposes—helps to shed light on the perceived value of asymmetry. In this section, we draw from the following classes of technologies:

- **Instant messaging** has been appropriated in numerous ways to provide awareness information. Instant messaging exchanges have been appropriated as a way of maintaining a “sense of connection with others within an active communication zone” [29]. Individuals have also monitored instant messaging buddy lists to create a sense of connection. In addition, instant messaging display names and status messages have been appropriated for providing updates of “momentary happenings” such as one’s current mood, location or activity [37].
- **Blogging** is a “means of relating [one’s] life to others by telling [one’s] continuing story in close to ‘real time’” [27]. These continuing stories are often motivated by a desire to update an audience with awareness information such as one’s “activities and whereabouts.” The activity of blogging also resonates with the often spatial- and community-oriented nature of awareness systems; in studies, “bloggers reached out to connect with and insert themselves into the social space of others in their personal social networks” [27].
- **Microblogging** is a more terse and volatile form of blogging in which the most common posts present awareness information such as an individual’s “daily routine or what people are currently doing” [22]. Similar to that of blogging, the goal of microblogging seems to be to “enhance one’s cyberspace presence, an elusive concept that seems to refer to being ‘out there’ (wherever ‘there’ is) as much as possible” [26].
- **Social Networking** sites such as Facebook<sup>3</sup> and Friendster<sup>4</sup> let individuals create profiles and links to others’ profiles. These profiles have been found to enable the peripheral awareness of individuals’ offline social networks [23]. Rather than being a static entity, a social networking profile may also be considered a more dynamic mechanism in support of awareness—“a communicative body in conversation” [3].

These technologies, while perhaps not built primarily to serve as awareness systems, have all been widely adopted and appropriated to that end. These systems are, in some cases, particularly valued because of the asymmetries they embody. Bloggers, for example, valued the asymmetry of engagement among themselves and their readers that the technology affords:

The relationship between blogger and reader was markedly asymmetrical. Bloggers wanted readers but they did not necessarily want to hear a lot from those readers.... Many bloggers liked that they could be less responsive with blogging than they could in email, instant messaging, phone, or face to face communication. They seemed to be holding their readers at arm’s length [27].

In the following sections, we distill and unpack multiple forms of asymmetry in awareness systems.

### Asymmetry of Media

There are numerous technologies commonly appropriated for maintaining awareness; this breadth of technology highlights the natural asymmetry of media used for purposes of awareness. Individuals likely do not employ all media and technologies in the production of their own awareness information, but many individuals are likely consumers of awareness information via a breadth of media that are produced by others.

Text is, perhaps, the most common medium for providing awareness information in instant messaging, blogging, microblogging, and social networking profiles. Photographs can be embedded within instant messages [40], blogs [8], microblogs, and social networking profiles. Broadcast video can be embedded in blogs (e.g., via YouTube<sup>5</sup>) whereas an instant messaging exchange can transition within the application to a video-based interaction (e.g., via Apple’s iChat<sup>6</sup>). Audio-based awareness information, specifically to what digital music an individual is listening, can be broadcast within instant messaging (e.g., Current Track<sup>7</sup>) or via blog widgets (e.g., the Now Playing Plug-In<sup>8</sup>). Locative information can be shared on blogs [27], photoblogs (e.g., via geo-tags), and microblogs (e.g., via Jaiku<sup>9</sup>). Instant messaging applications frequently provide information about whether a particular individual is online or offline as well as more micro-level awareness information about whether an individual is typing within the instant messaging application.

Asymmetries of media are common among social networking profiles. In Facebook, different individuals can attach different applications to their online profile; this kind of asymmetry allows participants to customize the way that they present themselves to others and serves to provide an extremely wide variety of awareness information to others in their social networks, ranging from books they have read to photos of places they have visited to donations they have made to nonprofit causes.

Different individuals likely prefer different media as producers and as consumers of awareness information; the breadth of media that can be utilized in this regard is surely

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<sup>3</sup> <http://www.facebook.com>

<sup>4</sup> <http://www.friendster.com>

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<sup>5</sup> <http://www.youtube.com>

<sup>6</sup> <http://www.apple.com/macosx/features/ichat>

<sup>7</sup> <http://sourceforge.net/projects/currenttrack>

<sup>8</sup> <http://sourceforge.net/projects/itunesnowplayin>

<sup>9</sup> <http://jaiku.com>

valuable. Yet this diversity can also serve to increase the asymmetry of media among participants in awareness systems. The perceived advantages and disadvantages of this breadth of media for providing awareness information remains an open area for research.

### **Asymmetry of Fidelity**

The fidelity of media, when appropriated for awareness purposes, is a function both of the detail conveyed by each piece of information as well as the frequency with which that information is produced. For example, blogs are generally used to provide richer information detail, whereas microblogs are often used to provide more frequent updates to awareness information [26, 27]. Nearly all appropriable media in instant messaging, blogging, microblogging, and social networking sites can be used to provide the degree of detail preferred by the producer, who controls what and how much is communicated. In the case of plug-ins and add-on applications, the asymmetry of fidelity is also based on what and how many add-on applications are downloaded, installed and used.

Readers of blogs can also exert influence over the asymmetry of fidelity. In many systems, readers can first view a headline and the first few lines of a blog post. They can then decide if they want to increase fidelity to see the detailed posting.

The asymmetry of fidelity is cited as being one of the advantages of blogging. Bloggers preferred that they and their readers maintain an asymmetric relationship with respect to the frequency of interaction: “Bloggers...wanted controlled interaction, not the fast-paced give-and-take of face to face or media such as instant messaging” [27].

### **Asymmetry of Participation**

A good deal of symmetry of participation has been explicitly designed into the use of most social networking sites. In Facebook, for example, one must create a profile and have either a mutually agreed-upon “friendship” or belong to the same affiliational network in order for either party to have access to one another’s awareness information. Similarly, the awareness information that is provided via instant messaging requires both parties to have compatible instant messaging clients. However, depending on the particular instant messaging client, asymmetries in buddy list membership can occur: one person may permit another to add her to his buddy list but not return the gesture. Alternately, one may include another in her buddy list but assign the individual to a group whose membership is rarely made visible on the screen.

More asymmetry of participation is present in blogs and microblogs, most of which are publically available with an Internet connection and a web browser. Blog readers do not have to be bloggers, themselves, in order to take advantage of any awareness information conveyed through blog posts. In fact, blog readers do not have to comment on blogs or otherwise make their presence known in order to take advantage of the awareness information conveyed.

Existing research tells us that varying degrees of participation are a common characteristic of many communities and that allowing and legitimizing these varying degrees of participation, from peripheral participation to central, expert participation are important for drawing in new members of a community [12, 24]. The ability to draw in new members to an individual’s social network was, in fact, one of the perceived values of blogging for bloggers:

They yearned to develop an audience beyond their personal social network. The occasional email from a stranger who responded to the blog was often satisfying and motivating [27].

The characteristics of blogs that enable the development of an audience beyond an individuals’ social network are the same characteristics implicated in its asymmetry of participation.

### **Asymmetry of Engagement**

There is a pronounced asymmetry of engagement within most of the technologies being discussed due largely to the publish-subscribe models employed. Producers of content—particularly bloggers—expend more attention and effort to generate awareness information than do consumers in tracking that content. Syndication mechanisms such as RSS serve to increase this asymmetry of engagement, at least somewhat, between producers and consumers.

Instant messaging status information supports more symmetry of engagement, as many clients automatically update availability status based on implicit activity such as keyboard or mouse input throughout the system. Yet, like media spaces, instant messaging is appropriated for a breadth of practices, from peripheral awareness to direct communicative exchanges. Studies of instant messaging use have documented differences between the amount of attention paid to a single instant messaging exchange by co-communicants [41]. The breadth of levels of engagement supported and accepted within instant messaging has been identified by respondents in multiple studies as being particularly valuable:

Together, ease of screening, delayed responding, and plausible deniability of presence allow recipients much more control over responding than with face to face interaction or the phone.... Instead of conversations taking place at the convenience of the initiator, IM allows genuine social negotiation about whether and when to talk [29].

“I use instant messaging because it feels immediate, but I don’t have to devote my immediate attention to it.... I can feel like I am having a conversation but I don’t have to... drop everything just to have that conversation” (participant quoted in [41]).

Similarly, the asymmetry of engagement has also been found to be highly valued in blogging. Blogs can be attended to (or ignored) when opportune. Bloggers articulated that blogs were valued, in part, because they are “not intrusive. No one is ‘forced to pay attention’” [28].

This observation by bloggers about the asymmetry of engagement is also confirmed by blog readers:

However, while a reader can “get away” with not reading every post without much notice, it is more obvious when there are lapses on the part of the blogger. Though expectations and obligations may not be symmetrical, the activity of blogging nevertheless exerts social pressures on both bloggers and readers [1].

### **Asymmetry of Benefit**

Research on the use of awareness systems does not provide much insight about the degrees to which different participants benefit from these systems. What this research does convey, however, is the striking asymmetry of the nature of benefit—that there is a disparity among participants, particularly between producers and consumers of awareness information, about what benefit they receive from using the technologies. We hypothesize that this asymmetry is due, at least in part, to the many different ways these systems are appropriated: as awareness systems, as computer-mediated communication media, as virtual projections of one’s identity, etc.... Whereas one individual might find value in the awareness information, others might find value in alternate appropriations of the technology. Bloggers, for example, may produce content that is valued by others as awareness information, but they may produce that content because they value the ability to influence others or to release emotional tension [27].

### **Asymmetry of Place**

Awareness technologies—instant messaging, blogging, microblogging, and social networking sites—do not provide continuous connections among discrete physical places. Instead, they construct an alternate, virtual environment where awareness information is shared and other communicative and collaborative exchanges can take place. As a result, the physical places where these technologies are used can be widely asymmetric—from one’s private office to a crowded bus stop to an anonymous cybercafé.

The increasing mobility and ubiquity of technology has led to an increasingly diverse set of places in which these technologies are being used. This increased diversity of placeful technology use has the potential to lead to an increased asymmetry of place among participants. This increased asymmetry may enhance the value of these technologies for maintaining social connections: rather than posting (or receiving) a status update once or twice a day, the mobility and ubiquity of these technologies make it possible to maintain awareness within social groups at a much more continuous pace.

### **THE ME-DIA SPACE**

Although there are numerous asymmetries present in media spaces, the majority of media space research focuses on mitigating asymmetries to support more symmetry in system use. Our review of research on the use of awareness systems, however, revealed that some of these same asymmetries are, in fact, part of the reason why these

technologies are so highly valued. Research and development in media spaces might be well served, then, to reconsider the prevalent emphasis on mitigating asymmetries and, instead, to engage those asymmetries as valuable points in the larger design space.

As an example, we present one particular media space that, instead of striving for increased symmetry, takes explicit advantage of these asymmetries. To be clear, we do not argue that the media space we present is somehow a “better” media space. Rather, we present one specific instance of a media space designed for one very specific work context in which asymmetries constitute a valuable asset in addressing specific social needs.

Our design is motivated in large part by the diversity of personal tolerances for traditional media spaces. Whereas some individuals may be perfectly content to work in long-term, media space-enabled “office shares” with their colleagues (e.g., [11]), we are cognizant that other individuals may be either reluctant participants or may very rightfully refuse to set foot in an environment where cameras are present. In this matter, we agree wholeheartedly with Bly, who more than two decades ago recognized that...

With media spaces, one size does not fit all: To build systems that reflect the changing needs of user communities means they must fluidly be able to accommodate open styles of working as well as closed and private ones [2].

We were motivated to address not only the need for improved communication and awareness for the teleworker who advocated for the development and deployment of the system, but also to address the concerns of reluctant members of the community who were uncomfortable being continually captured by video links in open or shared spaces.

### **ME-dia Space Design**

Our “ME-dia Space,” in which the emphasis on the word “ME” signals the asymmetry of participation at the heart of the system, is designed for a part-time teleworker, “Dave.” With the ME-dia Space, our goal is to project aspects of Dave’s presence into the workplace on the days when he is working from home. In particular, the ME-dia Space connects Dave from his home office to his work office. Dave’s colleagues can then exploit the physical features of Dave’s office to communicate with him. When Dave is in the work office, his door is open (see Figure 1). Colleagues see him and drop in to say hello or engage in informal meetings.

*Dave commutes over an hour one-way to work several days a week. Today, as he does during the remainder of the week, Dave is working from home. As he settles in at his home office, Dave clicks a button in a window on his desktop computer. Approximately 100 km away, his work office door swings open. Diane, one of Dave’s colleagues, arrives at work and notices Dave’s open door. She pokes her head in to say “Good morning” and sees a slow frame*



rate video of Dave in his office at home. As she waves to him from the doorway, a quiet notification goes off in Dave's home office—he has a visitor. Dave bumps up the frame rate of his video feed and he waves back, beckoning Diane in. Diane walks into Dave's office, takes a seat at Dave's desk and puts on a headset.

"Good morning, Diane...glad I caught you!" Dave and Diane take a moment to sort out a last-minute change to a budget proposal they are working on. Diane volunteers to call a vendor to get one last quote and promises to touch base with Dave later in the day.

A half hour later, Diane, with information on two different options from the vendor, walks by Dave's office. His door is open, but she sees on the video that Dave is on the phone. Diane decides to wait for a better time to interrupt.

Around noon, Diane joins her colleagues for lunch in the common area outside Dave's office. Dave's door is closed; he must have stepped away to have lunch, as well. Finished with her sandwich and listening to another colleague's story about her daughter's science fair project, Diane notices that Dave's door is opening. Everyone at the table turns to wave; Dave waves back. Diane excuses herself and walks into Dave's office to share the two options the vendor had presented.

The ME-dia Space is unlike a traditional media space that would connect Dave directly to the offices of his colleagues. Instead, it connects two spaces associated with Dave to one another, operating similarly to the PARC Media Space when it was appropriated by a participant to maintain an open link between his permanent office in Portland and his guest office in Palo Alto [18].

Our ME-dia Space is implemented as a two-node media space, providing a dedicated audio and video link between a teleworker's home office and his office in the workplace. There is nothing unusual about this audiovisual link; while it is custom coded, it is similar to many other two-way, desktop media space technologies. What is unusual in the ME-dia Space design is that while video is always on, audio is not; a call must be established (via a simple button press).

Great care has been taken to position the video display and camera for use both inside and outside of the physical constraints of the work office. The video display is positioned such that the full-screen video image from the

home office is visible from the common area outside the teleworker's work office (Figure 1). The camera in the workspace node is also pointed out the office door, providing the teleworker in his home office with a very coarse overview of movement in the workplace office's common area. Additionally, the furniture in the work office is arranged so that when someone comes in and sits down, she will be centered in the camera's field of view.

In addition to the audiovisual streams typically exchanged between media space nodes, the ME-dia Space nodes also share a data channel (implemented via a shared, distributed dictionary data structure [4]). Through this data channel, the teleworker can control a variety of configuration options for the workplace node, including the degree of blurring applied to the video channel [30] and the frequency that video frames are exchanged between the nodes when the ME-dia Space is not actively being used for a conversation.

The data channel also provides remote access to a Phidgets InterfaceKit [15] attached to the workplace ME-dia Space node. The InterfaceKit hosts several physical components, including a commercial, accessibility-oriented swing door opener and a Phidgets motion detection sensor (Figure 1). The door opener is controlled remotely using Phidgets, allowing the distant teleworker to open or close the door at will. The door state becomes an awareness mechanism (see also the Telepresence "Door Mouse" [6], although our implementation is distinct and affords remote-operability, a novel contribution of this research). The motion sensor is suspended directly over the entry area just inside the workplace doorway; the motion value returned by this sensor is sent over the data channel and is used to notify the remote teleworker when a colleague enters, moves around in, or leaves the workplace office space. This sensed motion helps to compensate for the lack of everyday audio cues that signal the arrival of visitors when the teleworker is working from home (recall that audio is not always on).

In the ME-dia Space, we combined traditional audiovisual media space channels with motion sensing and door actuation capabilities to provide a variety of awareness horizons for both the teleworker and his colleagues when the ME-dia Space is in use (see Figure 2). At the coarsest level of granularity (shown in orange), the ME-dia Space allows the door to be remotely opened or closed to provide workplace colleagues with an awareness of the teleworker's general availability and to provide the teleworker with a coarse awareness of activity in the common area. This awareness horizon exploits many of the physical affordances and location attributes of the physical office. At an intermediate level of granularity (shown in green), low-fidelity video of the remote teleworker is displayed to passersby near the workplace office and motion detection information in the vicinity of the workplace office door is conveyed to the teleworker's home office to indicate when someone might be "dropping by" to initiate a conversation. At the highest level of granularity (shown in purple), workplace colleagues can fully enter the office, sit down,

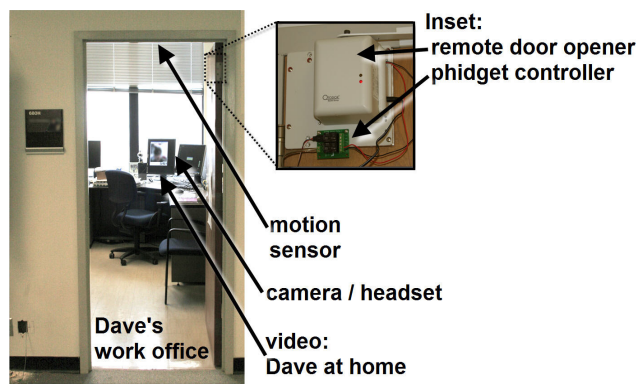
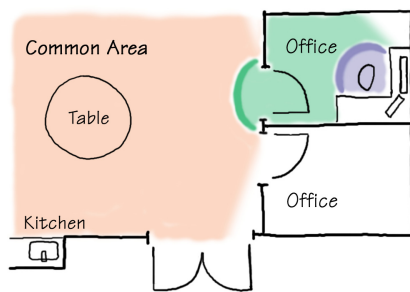


Figure 1. Looking into the ME-dia Space office node.



**Figure 2. The ME-dia Space awareness horizons.**

and converse with the teleworker over the high-fidelity audiovisual links provided by the ME-dia Space.

### **Asymmetries in the ME-dia Space**

While conceptually straightforward, the ME-dia Space emphasizes and embodies multiple forms of asymmetry.

#### *Asymmetry of Media*

The traditional audio and video channels employed in the ME-dia Space exhibit the same degree of symmetry as many of the previously published systems in the media space literature. Both audio and video channels are exchanged reciprocally between both ME-dia Space nodes.

However, the design of the ME-dia Space does introduce additional asymmetry of media in two significant ways. First, the remotely-operated door is a medium controlled by the teleworker that provides awareness information about his in/out status. While others in the office can open and close that door, they rarely do so without permission; traditional social mores hold that the door is controlled by the owner of the office. The teleworker, in return, does not have access to the symmetrical in/out status information of his colleagues; his field of view is restricted to what is visible through the doorway. Second, the teleworker has access to sensed data about the presence of individuals in his doorway that is not reciprocated for his colleagues.

The asymmetries of media present in the ME-dia Space are important as they amplify the presence of individuals into the different physical spaces in ways that provide situationally appropriate awareness to participants at both end nodes.

#### *Asymmetry of Fidelity*

The information detail that is provided via video in the ME-dia Space can either be symmetric or asymmetric. The video from the office camera is always sent unblurred, so that the teleworker can see who is in his office and so that he can maintain coarse-level awareness information about activity just outside his office. The reciprocal image from the home office can be unblurred, exhibiting symmetry, or blurred, exhibiting asymmetry. The teleworker typically only blurs the image projected from the home office in ‘do not disturb’ situations, such as when he wants to signal that he is there but not as open to visitors or when he wants to safeguard the privacy of another family member who is also present in the home office.

In the ME-dia Space, there is also an asymmetry of control over media fidelity. The teleworker maintains all control over the frame rate of the video, which can be toggled between a low-fidelity setting of one frame every three seconds and a high-fidelity setting which operates as fast as individual frames can be captured, encoded, sent over the network, decoded, and displayed (typically, several frames per second). The low frame rate is typically used to save bandwidth when no colleagues are around the work office; the high frame rate is typically used to carry out informal meetings and other focused interactions.

The asymmetry of fidelity in the ME-dia Space is a critical accommodation to the different social needs at the different locations of the end nodes. The variability of video fidelity in the home office reflects previous research findings about the privacy needs of other family members when media spaces are used in domestic environments [30].

#### *Asymmetry of Participation*

The asymmetry of participation is, perhaps, the most predominant asymmetry in the ME-dia Space. Both end nodes of the ME-dia Space are owned and largely controlled by one individual, the teleworker (hence the “ME” in ME-dia). The ME-dia space is an asymmetrical extension of the presence of this teleworker (when working at home) into the physical environment of his office space.

No other participants in the ME-dia Space own their own node in their own physical space. Rather, they use the physical office and office doorway of the teleworker as a way to mediate their participation in that space. Some participants are more central to the community surrounding the ME-dia Space; these individuals work in tight collaboration with the teleworker and use the media space more proactively. Other individuals are much more peripheral to the community. These individuals know about the ME-dia Space and can “read” the awareness information (e.g., if Dave’s door is open, he is at work in his home office). They may eat lunch at the table in the common area and video of their coarse movements might be projected in to the teleworker’s home office, but they may never elect to intentionally use the ME-dia Space for themselves.

The asymmetry of participation was the driving impetus behind the design of the ME-dia Space and was a critical asymmetry leveraged in the system’s design to allow members of the community to be more peripheral participants in the ME-dia Space.

#### *Asymmetry of Engagement*

Our implementation of the ME-dia Space both requires and enables different degrees of engagement from its participants. Because the teleworker is responsible for both nodes of the ME-dia Space, he also incurs most of the costs involved with keeping the awareness information provided by the system up-to-date (e.g., making sure that both nodes are running and remotely opening and closing his work office door). The teleworker is also tasked with maintaining



control of the frame rate of the video feed which, in the context of everyday use, requires either attending to the status of the motion sensor or a low-fidelity video feed.

No additional work is required of other participants to publish their awareness information. If they walk into the teleworker's office doorway, this information is communicated implicitly to the teleworker.

The system also supports a breadth of degrees of engagement among participants, providing coarse information about the teleworker's availability that can be completely ignored or attended to as frequently as circumstances warrant.

#### *Asymmetry of Benefit*

The ME-dia Space provides the greatest benefit to the teleworker, since using the system allows him increased flexibility in where he can work. By using the system, he can project his presence into the workplace office on days when he elects to work from home.

Yet the system also provides some benefit to the teleworker's colleagues, as they can choose degrees of participation and engagement with which they are most comfortable. In addition, the virtual presence of the teleworker may have other advantages. Existing research shows a correlation between the prevalence of telework and co-worker dissatisfaction [14]. An increase in face-to-face interaction has been shown to moderate this dissatisfaction. It may be the case that mediated interactions such as those supported by the ME-dia Space may also reduce dissatisfaction and thus benefit co-workers.

#### *Asymmetry of Place*

The asymmetry of place was a significant influence on the design of the ME-dia Space. Distinctions between the use of media spaces in domestic and work environments have been explored in great detail by Neustaedter and Greenberg [30], and the design of our system has been significantly influenced by their findings and design recommendations.

Unique to the ME-dia Space prototype is one additional characteristic motivated by the asymmetry of place: the ME-dia space is only "on" when serving to transport the owner of the spaces from one location (in this case, the home office) to another (the workplace office). This design decision takes advantage of the established social mores surrounding the accessibility and use of the teleworker's work office. Where it might previously have been perceived as intrusive for colleagues to initiate conversations with the teleworker when he was working from his home office, the asymmetric nature of the ME-dia Space allows the shared social cues of the work office to be applied across the distance spanned by the ME-dia Space.

#### **CONCLUSION**

In this paper we have made the following contributions:

- We have identified six different forms of asymmetry present in media spaces and awareness

systems—asymmetries of media, fidelity, participation, engagement, benefit, and place;

- We have identified examples of media space research directed toward mitigating these asymmetries as well as contrasting examples of empirical findings citing the perceived value of these asymmetries in awareness systems; and
- We have designed and deployed a novel media space that foregrounds many of these forms of asymmetry.

To be clear, we do not argue that asymmetry is "better" than symmetry. Symmetries and asymmetries—whether they play out in the technical sphere, the social sphere, or, more likely, in some combination of the two—are both vital and important resources in design.

Our primary message, then, is quite straightforward. Asymmetries can be valuable assets in the design of media spaces—and perhaps in other CSCW systems, more generally—and as such, they ought to be explored alongside symmetries as part of the active design space of collaborative systems.

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#### **REFERENCES**

1. Baumer, E., Sueyoshi, M. and Tomlinson, B. Exploring the role of the reader in the activity of blogging. In *Proc. CHI '08*, ACM Press (2008), 1111–1120.
2. Bly, S., Harrison, S. and Irwin, S. Media spaces: Bringing people together in a video, audio, and computing environment. *Comm. ACM* 36, 1 (1993), 29–47.
3. Boyd, D. and Heer, J. Profiles as conversation: Networked identity performance on friendster. In *Proc. HICSS '06*, IEEE Computer Society (2006).
4. Boyle, M. and Greenberg, S. Rapidly Prototyping Multimedia Groupware. In *Proc. 11th International Conference on Distributed Multimedia Systems*, Knowledge Systems Institute, Skokie, IL, USA (2005).
5. Bryant, S.L., Forte, A. and Bruckman, A. Becoming Wikipedian: Transformation of participation in a collaborative online encyclopedia. In *Proc. GROUP '05*, ACM Press (2005), 1–10.
6. Buxton, W.A.S. Living in an augmented reality environment. In K.E. Finn, A.J. Sellen and S.B. Wilbur (Eds.), *Video-Mediated Communication*, Lawrence Erlbaum Associates, Mahwah, NJ, USA, 1997, 363–384.
7. Churchill, E.F. From media spaces to emplaced media: Digital poster boards and community connectedness. Media Space: Reflecting on 20 Years Workshop at CSCW 2006. Banff, Canada, November 4–8, 2006.
8. Cohen, K.R. What does the photoblog want? *Media, Culture & Society* 27, 6 (2005), 883–901.

9. Cool, C., Fish, R., Kraut, R. and Lowery, C. Iterative design of a video communication system. In *Proc. CSCW '92*, ACM Press (1992), 25–32.
10. Dourish, P. Culture and control in a media space. In *Proc. ECSCW '93*, Kluwer (1993), 133–146.
11. Dourish, P., Adler, A., Bellotti, V. and Henderson, A. Your place or mine? Learning from long-term use of audio-video communication. *Computer-Supported Cooperative Work* 5, 1 (1996), 33–62.
12. Fitzpatrick, G. *The Locales Framework: Understanding and Designing for Wicked Problems*. Kluwer, Dordrecht, The Netherlands, 2003.
13. Gaver, W.W. The affordances of media spaces for collaboration. In *Proc. CSCW '92*, ACM Press (1992), 17–24.
14. Golden, T. Co-workers who telework and the impact on those in the office: Understanding the implications of virtual work for co-worker satisfaction and turnover intentions. *Human Relations* 60, 11 (2007), 1641–1667.
15. Greenberg, S. and Fitchett, C. Phidgets: Easy development of physical interfaces through physical widgets. In *Proc. UIST '01*, ACM Press (2001), 209–218.
16. Greenberg, S. and Rounding, M. The Notification Collage: Posting information to public and personal displays. In *Proc. CHI '01*, ACM Press (2001), 514–521.
17. Grudin, J. Groupware and social dynamics: Eight challenges for developers. *Comm. ACM* 37, 1 (1994), 92–105.
18. Harrison, S., Bly, S., Anderson, S. and Minneman, S. The media space. In K.E. Finn, A.J. Sellen and S.B. Wilbur (Eds.), *Video-Mediated Communication*. Lawrence Erlbaum Associates, Mahwah, NJ, USA, 1997, 273–300.
19. Haythornthwaite, C., Wellman, B. and Mantei, M. Work relationships and media use: A social network analysis. *Group Decision and Negotiation* 4, 3 (1995), 193–211.
20. Heath, C. and Luff, P. *Technology in Action*. Cambridge University Press, Cambridge, UK, 2000.
21. Hudson, S.E. and Smith, I. Techniques for addressing fundamental privacy and disruption tradeoffs in awareness support systems. In *Proc. CSCW '96*, ACM Press (1996), 248–257.
22. Java, A., Song, X., Finin, T. and Tseng, B. Why we Twitter: Understanding microblogging usage and communities. In *Proc. Joint 9th WebKDD/1st SNA-KDD Workshop on Web Mining and Social Network Analysis at KDD 2007*, San Jose, CA, August 12–15, 2007.
23. Lampe, C., Ellison, N. and Steinfield, C. A Face(book) in the crowd: Social searching vs. social browsing. In *Proc. CSCW '06*, ACM Press (2006), 167–170.
24. Lave, J. and Wenger, E. *Situated Learning: Legitimate Peripheral Participation*. Cambridge University Press, Cambridge, UK, 1991.
25. Leland, M.D.P., Fish, R.S. and Kraut, R.E. Collaborative document production using Quilt. In *Proc. CSCW '98*, ACM Press (1998), 206–215.
26. McFedries, P. Technically speaking: All a-twitter. *IEEE Spectrum* 44, 10 (2007), 84.
27. Nardi, B.A., Schiano, D.J. and Gumbrecht, M. Blogging as social activity, or, would you let 900 million people read your diary? In *Proc. CSCW '04*, ACM Press (2004), 222–231.
28. Nardi, B.A., Schiano, D.J., Gumbrecht, M. and Swartz, L. Why we blog. *Comm. ACM* 47, 12 (2004), 41–46.
29. Nardi, B.A., Whittaker, S. and Bradner, E. Interaction and outercation: Instant messaging in action. In *Proc. CSCW '00*, ACM Press (2000), 79–88.
30. Neustaedter, C. and Greenberg, S. The design of a context-aware home media space for balancing privacy and awareness. In *Proc. Ubicomp '03*, Springer (2003), 297–314.
31. Olson, J.S., Olson, G.M., Storøsten, M. and Carter, M. Groupwork close up: A comparison of the group design process with and without a simple group editor. *ACM Trans. Information Systems* 11, 4 (1993), 321–348.
32. Olson, M.H. and Bly, S. The Portland experience: A report on a distributed research group. *International Journal of Man-Machine Studies* 34, 2 (1991), 211–228.
33. Ortega, F., Gonzalez-Barahona, J.M. and Robles, G. On the inequality of contributions to Wikipedia. In *Proc. HICSS '08*, IEEE Computer Society (2008), 304–310.
34. Plaisant, C., Clamage, A., Hutchinson, H.B., Bederson, B.B. and Druin, A. Shared family calendars: Promoting symmetry and accessibility. *ACM Trans. Computer-Human Interaction* 13, 3 (2006), 314–346.
35. Romero, N., McEwan, G. and Greenberg, S. A field study of Community Bar: (Mis)-matches between theory and practice. In *Proc. GROUP '07*, ACM Press (2007), 89–98.
36. Root, R.W. Design of a multi-media vehicle for social browsing. In *Proc. CSCW '98*, ACM Press (1988), 25–38.
37. Smale, S. and Greenberg, S. Broadcasting information via display names in instant messaging. In *Proc. GROUP '05*, ACM Press (2005), 89–98.
38. Smith, R.B., O'Shea, T., O'Malley, C., Scanlon, E. and Taylor, J. Preliminary experiments with a distributed, multi-media problem solving environment. In J.M. Bowers and S.D. Benford (Eds.), *Studies in Computer-Supported Cooperative Work: Theory, Practice and Design*. Amsterdam: North-Holland, 1990, 31–48.
39. Stefik, M., Foster, G., Bobrow, D.G., Kahn, K., Lanning, S. and Suchman, L. Beyond the chalkboard: Computer support for collaboration and problem solving in meetings. *Comm. ACM*, 30, 1 (1987), 32–47.
40. Volda, A. and Mynatt, E.D. Six themes of the communicative appropriation of photographic images. In *Proc. CHI '05*, ACM Press (2005), 171–180.
41. Volda, A., Newstetter, W.C. and Mynatt, E.D. When conventions collide: The tensions of instant messaging attributed. In *Proc. CHI '02*, ACM Press (2002), 187–194.