Informing and Performing: Investigating How Mediated Sociality Becomes Visible*

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This work is partially supported by funding from NSF grant IIS: 0713562

ABSTRACT

In the Human-Computer Interaction, Computer-Supported Cooperative Work and ubiquitous computing literature, making people's presence and activities visible as a design approach has been extensively explored to enhance computer mediated interactions and collaborations. This process has developed under the rubrics of "awareness", "social translucence", "social activity indicators", "social navigation", etc. Although the name and details vary, the central ideas are similar. By making social presence and activities more visible or perceivable, they provide social context for members to make sense of situations and guide their activities more informatively and

* The final publication is available at www.springerlink.com

appropriately. In this work, we introduce a class of visualizations called social context displays, which use and share graphical representations to depict people's presence and activity information with an explicit focus on groups. The aim of this work is to examine social context displays in use and contribute new abstractions for understanding how making social information more visible works in general. Through our first hand experience with user-centered design and empirical investigations of two social context displays in real settings, we uncovered not only how they provide social context to inform actions and decisions, but also how members perform and manage their self- and group-representations through the display. Drawing on Goffman's performance framework, we provide a detailed description of how people react and respond to these two social context displays, and reconsider some of the broader issues associated with computer-mediated interactions such as privacy, context, and media richness.

KEYWORDS

Context, Social Media, Public Displays, Computer Mediated Communication

1. INTRODUCTION

It is our everyday observation that people's presence and activities around us play an important part in constructing and defining the situation, which, in turn, further engages and shapes future participation. For example, the presence and absence of customers in a restaurant can communicate the popularity of the restaurant; the number of people at a bus stop suggests whether the bus is coming soon or not; a crowd of people on the street might reveal an accident; simply

knowing a few of our friends have joined an activity might also compel us to attend. We, as social creatures, all pay a great deal of attention to these signals around us. They provide social cues for us to make sense of the situation, motivate our participation, make informed choices, and structure our own activities.

Analysis from social science reveals more fundamental effects social group life can have on who we are and what we do, especially social groups of which we are members. Michel de Certeau, a French scholar, stated, "a relation (always social) determines its terms, and not the reverse, … each individual is a locus in which an incoherent (and often contradictory) plurality of such relational determinations interact." [De Certeau 2002, p. xi.]. Similarly, George Herbert Mead, an American philosopher and one of the founders of Pragmatism, argued, "the behavior of an individual can be understood only in terms of the behavior of the whole social group of which he is a member, since his individual acts are involved in larger, social acts which go beyond himself and which implicate the other members of that group" [Mead 1934, p. 6-7]. According to this perspective, humans are essentially social products. That is, we are shaped by the social group life around us.

Based on everyday observations and analysis from social science, researchers from the Human-Computer Interaction (HCI), Computer Supported Cooperative Work (CSCW), and Ubiquitous Computing (Ubicomp) communities have been exploring making social life more visible through technology to enhance computer mediated interactions, collaborations and connections. The assumption is that, since, in the everyday physical world, "the presence and behavior of other people ... have a powerful impact on his or her behavior, attitude, and feelings in those situations" [McGrath 1984], capturing and sharing that information through technology could also enhance our experiences in a mediated world. Example explorations include providing remote social awareness to support distributed collaboration [Dourish and Bly 1992], showing others' traces to guide navigation [Höök et al. 2003], and disclosing and sharing our presence to enhance intimacy [Strong and Gaver 1996]. With these explorations, various technologies are employed including media spaces [Dourish and Bly 1992, Bly et al. 1993], tangible interfaces [Strong and Gaver 1996], text messages [Consolvo et al. 2005], and visual displays [Mynatt et al. 2005]. A range of settings has also been explored such as distributed workplaces [Dourish and Bly

1992], homes [Mynatt et al. 2005], and mobile urban settings [Consolvo et al. 2005].

While everyday observations and social analysis seem to suggest that it is promising to render group social life more visible, it may also introduce a range of problems. After all, social information explicitly involves people, and use of people's information can easily evoke concerns with privacy, morality, control and ownership. Essentially, the intervention of technologies will introduce new issues. As Bellotti and Sellen [Bellotti and Sellen 1993] note, "Certain problems with privacy are closely related to the ways in which the technology attenuates natural mechanisms of feedback and control over information released." Grudin expresses similar concerns with the intervention of technologies, and points out that digitalized social information might lead to the erosion of situated actions, and the loss of controls associated with it, since things that used to be ephemeral become persistent, things that used to be local become global, and things that used to be in the past become present [Grudin 2001].

In order to understand how making group social life more visible actually works for the group, our approach has been to design and study displays showing group social information in real settings. We have been especially concerned with an approach called "social context displays". By social context display, we refer to a display that employs graphical representations to depict a group's presence and activity information to provide contextually relevant information for the group. This definition of social context displays is an extension to "social proxy" as defined by Erickson and Kellogg [Erickson and Kellogg 2004], except that it is not confined to online interactions. Compared to video [Dourish and Bly 1992, Finn et al. 1997], text messages [Consolvo et al. 2005] or tangible interfaces [Strong and Gaver 1996], graphic representations could scale easily, are cheap to implement, transfer and deploy, and are capable of representing complex structures and relationships. "Social context displays" also emphasizes "groupness" as the critical feature which provides a third-party view of the group, instead of a user-centered view, so it ensures a common ground from which users can draw inferences about other individuals, or about the group as a whole [Erickson 2003].

This work focused on studies of two social context displays. The first is a conference call proxy that is embedded in a meeting window showing people's

presence, activities and calling information while audio conferencing. The audio-conferencing system is called IEAC (IBM Enhanced Audio Conferencing) and has been deployed and voluntarily adopted by several thousand employees in IBM for months. We conducted an empirical study combining quantitative and qualitative approaches to understand whether and how various functions provided by the meeting window were used, and to what ends users deployed these functions. The second is a called Nomatic*Viz. This display shows people's whereabouts and status information and was deployed on a large display situated in a semi-public space. Our five-month field study of its use revealed not only how it supported awareness of the community, but also how it participated in creating new spatial experiences and how people performed and negotiated community- and self-representations through multiple simultaneous displays of personal status.

Through our first hand experience with empirical investigations in real settings of these two social context displays, we uncovered not only how they provide social context to inform actions and decisions, but also how members perform and manage their self- and group-representations based on resources provided by the display. Drawing on Goffman's performance perspective [Goffman 1959], this paper offers a detailed description of how people react and respond to these two social context displays. The performance perspective has helped us attain a deeper understanding of how and why these two displays work in certain ways. Following explorations of these two projects, we will turn to the broader concerns of performance in computer mediated interactions, and how it helps us in rethinking some of the associated issues such as privacy, context, media richness, and etc.

1.1 KEY NOTIONS IN GOFFMAN'S PERFORMANCE FRAMEWORK

Goffman proposed using the perspective of theatric "performance" to examine everyday social interactions. This perspective, compared to the traditional technical, political, structural and cultural perspectives in understanding social establishment, emphasized techniques of impression management, the principal problems of impression management, and the identity and interrelationships of several teams performing in a given establishment. The

perspective of performance as a theoretical construct has been widely applied beyond face-and-face interactions to computer mediated interactions, explicitly or implicitly [e.g., boyd 2002, Lederer et al. 2003, boyd 2008, Binder et al. 2009, Lampinen et al. 2009, Skeels and Grudin 2009, Turkle 2011]. Much of this related line of work discussed how the digital mediation complicates the supposedly easy and natural process of impression management that exists in face-to-face settings. Several factors are noted to contribute to the complication, including the gap between imagined and invisible audiences introduced in the computer mediated world [boyd 2008], the presence of multiple audiences within a single environment [Binder et al. 2009, Lampinen et al. 2009, Skeels and Grudin 2009], as well as the challenge to maintain interesting yet authentic impressions across multiple channels [Turkle, 2011]. While similarly resonating these themes, our work takes a step further and unpacks detailed and skillful practices people engage to manage their "faces" despite the complicated mediated environment.. In this section, we summarize some of the key notions from this framework that will be highly relevant to the analysis of our empirical data.

In his study of everyday social interactions, Goffman observed that when people are in each other's presence, they naturally try to glean information from each other. Based on one's appearance, behavior, and manner, they can learn a person's socio-economic status, competences, trustworthiness, and so on. Or, they will bring into play already gleaned information. Informed in these ways, they will know what they may expect from each other, and know the best way to act for a desired response.

He defined performance as "all the activity of an individual which occurs during a period marked by his continuous presence before a particular set of observers and which has some influence on the observers" [Goffman 1959, p.43], and used the notion of "front" to refer to "that part of the individual's performance which regularly functions in a general and fixed fashion to define the situation for those who observe the performance" [Goffman 1959, p.22]. He further distinguished different parts of front: setting, appearance and manner. Setting refers to the scenic parts of performance, and involves the physical layout, furniture, and other background items that supply the scenery and stage props for actions to play out. Unlike setting, which tends to stay put, appearance and manner are the "personal front" which tend to be identified with the performer

intimately, and will follow the performer wherever he goes, such as one's clothing, size, sex, age, facial expressions, and bodily gestures.

In everyday interactions, performers manipulate these front parts to influence the definition of the situation and evoke desired responses from the audience. He pointed to various practices in which performers engage to guide and control the impression others form of them. For example, performers may dramatize their performance by highlighting some facts that might otherwise be unapparent or obscure, thereby making the invisible visible, or diverting an appreciable amount energy from certain routines in order to express and communicate the desired meaning of these routines. They also tend to idealize their performance to incorporate and exemplify the officially accredited values of a society through obtaining and maintaining certain fronts and foregoing or concealing others that are inconsistent with the standards. In addition, performers also need to maintain expressive control of many different events, no matter how inconsequential, to make sure they are consistent and coherent with the overall definition of the situation. In these ways, performance is "socialized, modeled, and modified in order to fit into the understanding and expectations of the society" [Goffman 1959, p.35].

He argued that performance is a necessary and integral part of human beings, for humans are essentially social creatures. "As human beings we are presumably creatures of variable impulse with moods and energies that change from one moment to the next. As characters put on for an audience, however, we must not be subject to ups and downs" [Goffman 1959, p.56]. To him, all actions in the presence of others are performed, no matter whether it is with ease or clumsiness, with or without awareness, and with deception or in good faith.

However, unlike the theatric performance, which involves scripts and rehearsals, socialization requires individuals to learn to perform their parts in real life. After having been schooled in the reality, and having learned enough pieces of expression, we are more or less able to anticipate socialization and fill in any part that we need to perform. In short, performance is an inherent aspect of the nature of humans as social beings, and a necessary outcome of socialization. More importantly, performance is not just done by individuals, but many times also by teams, where the definition of a situation is sustained by the intimate cooperation of more than one participant. In a team performance, the performance

may not serve to express the characteristics of individuals but those of a task. Further, each member may appear in a different light in order to realize the team's overall effects. Team members may be related to each other by bonds of reciprocal dependence and reciprocal familiarity with each other to put on a coherent "show." In natural settings, for one reason or another, interactions often take the form of two-team interplay. So it is convenient to call one team the performers and the other team the audience. To sustain a coherent front within a team, two additional functions are needed. One is to bring team members back into line when a member's performance becomes unsuitable, and another is to allocate the parts in the performance to participants while defining the personal front in each part. Often, the team has someone who functions as a "director" who fulfills these functions.

For a particular performance, the place where a performance is given is called the "front region". In the front region, some aspects of activities are expressively accentuated and other aspects are suppressed to foster certain impressions. It is suggested that some aspects of performance are played to the front region, not to the audience. For instance, a church may embody certain rules of respect for sacred places. On the floor of a dress shop, a saleswoman is required to stand, keep alert, refrain from chewing gum and keep a fixed smile on her face. In work places, employees are expected to meet standards of decorum, such as mode of dress, permissible sound levels, prescribed diversions, etc. Relatedly, there is a "back stage" or "back region", which provides crucial support for the maintenance of the front stage. It is where a personal front is adjusted and team roles are checked. To some extent, backstage posturing contradicts the impression fostered in the front stage, and is where suppressed aspects make their appearance.

We can now turn to our two case studies to illustrate how this performance framework helps us to understand social context displays in use.

2. CASE STUDY: A SOCIAL CONTEXT DISPLAY FOR AN AUDIO-CONFERENCING SYSTEM

2.1 THE IEAC WINDOW

The IBM Enhanced Audio Conferencing (IEAC) is a VoIP-based audio conferencing system with two user interface components: the assistant and the meeting window. The assistant allows the user, in effect, to press three buttons on a phone to connect to his or her current conference call, without having to recall the call's number or passcode. Second, for users with access to a computer, the IEAC meeting window acts as a social proxy, shows who is on the call as well as who is speaking, and provides access to call-related functionality such as muting. These functions are enabled as follows:

A registered IEAC user dials a single number - using either a conventional or VoIP phone) and enters a single password (both, in practice, usually programmed into the user's phone and accessed via a button press). This connects the user to the IEAC assistant, which uses information extracted from the employee's corporate calendar (used throughout IBM as the standard way of scheduling meetings) to offer the user a choice of conference calls, beginning with the current meeting. Upon selecting a meeting by pressing "1", the user is transferred into the call (regardless of whether it occurs on IEAC's VoIP bridge, or is a traditional conference call service offered by an outside vendor). If the IEAC user has also installed the meeting window, a visual component that runs on top of the corporate instant messaging infrastructure, it will pop up on the user's computer screen 10 minutes before the call's start.

Figure 1 shows the meeting window for a small conference call. The central pane of the meeting window contains the social proxy, a minimalist social visualization that shows the state of the meeting's participants. It shows those "dialed into" the meeting (icons and names of participants are arrayed around a "table"), as well as those who were invited to the meeting (according to the calendar entry) but have not yet arrived. Attendees who are not registered IEAC users (and therefore use a number and meeting-specific passcode to dial in) show up as guests, as in the case of "Guest02". In addition to showing presence information, the conference call proxy shows who is "speaking" or, more accurately, which line(s) a signal is coming over and displays a "speech bubble" next to the appropriate icon(s); the icon also changes to indicate if the user is on mute or has disconnected. The conference call proxy also allows users to carry out actions. Clicking on another user displays a locally cached picture, job title, etc.;

right clicking on another user's icon provides a menu that enables a user to chat by text, open an associated directory record, or mute the other person.

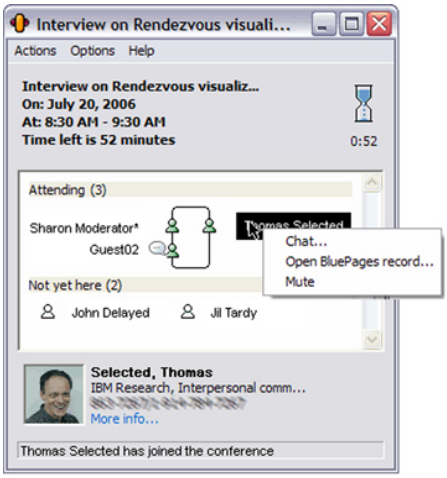

Figure 1. The IEAC meeting window.

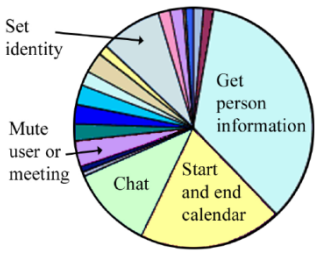

Figure 2. The relative use frequency of different functions.

IEAC was gradually deployed within IBM, via IBM's Technology Adoption Program, which allows any interested employee to try out systems under development. Crucially this means that IEAC users were self-selected. At the time when the empirical study was conducted, there were over 1,300 registered users of IEAC (they can set up calls and use its functionality), and 1,500 IEAC calls per day.

We used two approaches to study this deployment: analyzing logs to understand how various features were used and interviewing IEAC users to develop deeper understanding as to why they were used. We used two sources of log data. The first was the IEAC system log: it logged all calls, their durations and participants, and various low level events. The second source was the meeting

window server request log. This log was generated especially for this study and spans about six weeks. It captured requests sent from the meeting window to the server, resulting in a log of many (but not all) of users' interactions with the meeting window. If an interaction resulted in requests to the server (e.g., IM, directory or calendar access, muting, etc.) it was logged; if the software did not require interaction with the remote server (e.g., showing a cached thumbnail picture of each participant in the call) it was not logged. This system log is used to understand how the IEAC system is used and how the meeting window is used in relation to it. To develop in-depth understanding of its use, we used semi-structured interviews in context (conducted through the IEAC system itself) which covered three areas: We began by asking about the informant's job, location and conference calling experience; The majority of the interview was devoted to inquiring about the use of each of the functional elements of the meeting window, using the interview window as a probe, and asked for specific examples for each function; We ended by asking for feedback on how the system might be improved.

2.2 IEAC WINDOW IN USE

Overall, through the logging data analysis, we found that the meeting window was 'clicked' on for 15% to 25% of the meetings (about 300 out of 1,500 IEAC calls per day). This was a very conservative estimate of utilization, because we could not track when users simply looked at the window to get information from it. In addition, IEAC was just at its initial deployment stage, had critical mass issues, and the infrastructure was not completely stable. From the logging, we also learned what the most frequently used functions were (Figure 2):

View Person Information: This means that a user used the meeting window to open another person's entry in the corporate directory. About half the instances of directory use occurred just after the meeting started.

Start/End Calendar: This means that a user opened or closed a "mini-calendar" which showed his or her upcoming meetings. About a third of the time a calendar "open" event was followed immediately by an "open the meeting window" event,

suggesting that the calendar was being used to manually launch the meeting window.

Instant Message Chat: This event is logged when users use the meeting window to open a chat with another meeting invitee (chats initiated from a user's buddy list were not logged by IEAC). Chat showed no pattern relative to the meeting's start.

Set Identity: This happens when an identified user assigns a "guest" (a caller not registered with IEAC) an identity by right clicking their name. About half the instances of "Set Identity" occurred immediately after the meeting's start.

Mute: A user can mute herself, another user or everyone else on the call. Over half the instances of mute occurred in the first half of the meeting.

These data raised several questions. What caused these functions to be so heavily used? What was happening with respect to muting others, an action which seems potentially rude? How is chat being used in meetings? To answer these qualitative questions, we conducted semi-structured interviews and analyzed the results. We interviewed 10 informants. Our 10 informants were randomly selected from those who had recently used the meeting window, and they turned out to be heavy conference call users. This is not surprising, since users of IEAC have voluntarily adopted it, and since, as a global and highly distributed company, IBM contains a large number of people who work remotely, including a substantial percentage who work exclusively out of their homes (the IBM CIO's office estimates that on any given day, approximately 45 percent of IBM employees are operating from someplace other than a traditional corporate office). Of our 10 informants, 7 worked primarily out of their homes rather than offices (2 of whom were also frequent travelers), and 7 (not the same 7) played technical rather than managerial roles. It was not uncommon for our informants to report spending 4 to 6 hours a day on conference calls, with conference calls typically ranging from 5 to 10 people, though several reported occasional large scale calls ranging from 30 to 100 participants. Our interviews reveal a rich set of practices that are facilitated by IEAC.

Gathering Ancillary Information

According to the meeting window server request log, the most heavily used function of the meeting window was to bring up the corporate directory page. Although simply selecting a name provides a picture and brief job description (unfortunately the frequency of this was not logged), users often took the next step of bringing up BluePages, the corporate directory. Some informants reported looking up people even before the meeting started, as a way to prepare. BluePages provides far more detail than the default meeting window, including full job descriptions, lists of projects, and the person's co-workers, management chain, and organizational location. Most informants reported that they used it to learn "what people's roles are", "who they report to", or "where people 'fit' or 'belong' in the organization."

Why should people be so concerned about each other's roles? Our data suggests that such ancillary information, like the information gleaned in face-to-face interactions, helps in interpreting others' remarks and also shapes how people frame their own comments. Several informants reported checking out a person's directory information when his or her comments were interesting (or weird), as 8-TH said, "*This person's talking and I get curious and look up who they are and what they do. Sometimes, I am curious, 'OK, these people are weird. What are their motivations? Who do they report to?' That way, I get some perspective of where they are calling from.*" At the same time, in IEAC, people also determine what and how to speak based on their knowledge of their audience. As 7-TH put it, "*I wanted to know what their role was, because I don't like to discuss [my work] unless I am certain that the people participating are the correct representatives.*"

Another aspect of the meeting window that is helpful for people unfamiliar with each other is the small bubble that pops up when someone speaks. As expected, given the difficulty callers have in determining who is speaking [Yankelovich et al. 2004], our informants found the association of the speech bubble with a person's name very helpful. 6-TH said, "*The most frequent time I look... is when I hear someone talking and either I don't recognize their voice, or I want to identify their voice. So at the beginning of the meeting, I use it a lot - I identify people as they're joining the meeting. Subsequent to that, I look at it kind of idly to see who's talking.*" This is reinforced by the fact that several informants

grumbled about the lag between speech and the appearance of the speech bubble (the lag is a calculated choice to reduce system load).

In addition, the small picture and the name next to the icon also helped among unfamiliar people. Some commented that pictures served as memory aids. 1-TH said, "*Even [if] I don't necessarily ever see that person face- to-face, I can usually associate someone's face better than with someone's voice.*" So pictures seem to make more effective memory aids than voices. At the same time, some informants reported that the name allowed them to address another person by name, either on the call or when they finally encountered them face-to-face.

Our data shows that the presence of pictures not only serves practical purposes, but also has emotional effects. For example, some informants were quite passionate about the value of pictures, noting that they were especially important for those who worked from home. 1-TH declared: "*As a work from home employee I'm a big fan of [corporate directory] pictures because I almost never get to see everyone face to face...*" 3-TH agreed, saying "*I work from home and don't get to interact with people in person very often. It's nice to see what people look like; there are people I've worked with for years that I have no idea what they look like until [the corporate directory] started putting pictures up*." We ourselves also experienced the role of pictures, as stated by the informant 10-MO, "*I think it personalizes it. In a lot of cases you end up having phone calls with people who you never met in person...you know, this call has been a perfect example, I've never met either of you, the odds of meeting you are pretty slim, and yet I feel like I have a better sense of connection to you and the work you are doing just by looking at the picture of each of you. It makes it more personal; it is more human.*"

Goffman's framework explains and predicts this kind of information seeking behavior when in person and our data supports the presence of this effect in the conference call proxy as well. He describes this tendency as follows:

> "*When an individual enters the presence of others, they commonly seek to acquire information about him to bring into play information about him already possessed. They will be interested in his general socio-economic status, his conception of self, his attitude toward them, his competence, his trustworthiness, etc. Although some of this information seems to be sought almost as an end in itself, there are usually quite practical reasons for*

> *acquiring it. Information about the individual helps to define the situation, enabling others to know in advance what he will expect of them and what they may expect of him. Informed in these ways, the others will know how best to act in order to call forth a desired response from him.*" [Goffman 1959, p.1.]

In this way, people glean information about one's appearance, conduct and other traits and use it to inform forthcoming interactions. Our experimental studies show that the easy access to individual social information through the meeting window enables similar kinds of practices. The ancillary information including personal profiles, visual speech indicators, name labels and photos provide necessary perspectives for interpretations, help identify each other and enhance a sense of connection.

Informing Timely Joining of a Call

Almost all informants noted that IEAC made it easier to get to their calls. First of all, the popup window acts as a reminder for users to get to their calls in a timely manner. This is seemingly trivial, but was appreciated by most of informants. Its importance could be better understood if we know that the calls are usually embedded in busy schedules of contemporary IBM employees. 7-TH's comment is representative: "*I *love* that it pops up ten minutes before my meeting, because I get so deep into my [work] that I'll lose track of time*." Another informant used this feature along with his calendar to create staged reminders: *"[IEAC] reminds me ten minutes before [a meeting] and I am like 'OK, I've got like five minutes.' Then [my calendar] reminds me at two minutes. So I realize, 'OK, seriously, I really need to get ready to take the next call' kind of thing.*" [10-MO]. More interestingly, when asked for future improvements to IEAC, many requested a feature that would have the system call the participant rather than have the participant call into the system, as a way to further facilitate timely call joining.

The IEAC window also reveals the social circumstances of the overall meeting status, which supports joining the meeting in a timely manner. While the meeting time is often formally scheduled, in a conference call the decision of when to start the meeting is often a function of how many people have arrived, or

whether particular people have arrived. In IEAC, it is a common practice that once the meeting window pops up on users' screens, they will often monitor it to see when others join and then decide precisely when to join based on that. As 10-MO said, "*If I'm joining a call and I look at [IEAC], and nobody is in the room yet, I know everybody is running late, so maybe I don't have to rush too much ... if I am running over [on] my own call, I don't have to rush to get into the next one when there is nobody else there either.*" Similarly, 5-MO remarked, "*Sometimes if I'm late in joining a conference call ... I do bring up the visualization ... for instance, I may have been on another call or I am doing something I need to finish, I can join the call ... 10 minutes late, I ... bring up [the] visualization to see who else has joined, ... or to find a critical time to join the call.*"

We experienced this phenomenon during the interviews, which we conducted using IEAC. We typically dialed into the meeting about five minutes early because we didn't want our informants to have to wait for us. However, many of them noticed our presence and immediately dialed in, apologizing for being late. Others double-clicked on our names and IM'd us to say they'd be a bit longer.

Supporting Team Performance in Audio Conferencing

As Goffman pointed out, performance is not just carried out on personal terms, but many times, performance is done in cooperation with multiple participants. He refers to a set of individuals who cooperate in staging a single routine as performance team. We found the conference call proxy effective in supporting team performance by enabling moderators to direct the meeting more effectively, by facilitating performance between teams through back stage chat communications, and by fostering more accountable behavior through increased visibility of individual presence and actions.

Informing Meeting Management: As in many goal-oriented collective activities, there will usually be directors who play important roles to ensure the coherence and efficiency of the whole group. Goffman discussed several functions that a director can help fulfill for a team to perform coherently and efficiently. For example, one function is to bring back into line any member of the team whose performance becomes unsuitable.

Our data suggests that the conference call proxy helps directors or moderators to execute these duties through the chat function that provided a way to communicate social context privately. The conference call social proxy allows participants to see who is present, who just arrived and who is late, which helps the moderator to be aware of the overall situation and make informed decisions and coordination, rather than having to repeatedly ask, "Who just joined?" As one of our pilot interview subjects explained, "*as a moderator of a call it is nice for me not to say 'who just joined' or have to go back to my calendar to see who are all I invited or to see who wasn't there yet. From my visualization, I know who is not here."*

Interestingly, the social proxy provides indirect value even for those who do not see it, because many moderators make a practice of monitoring the proxy and announcing who has arrived. 7-TH said, "*Several times there has been a delay between when I see [someone's name] popping up and when they actually announce themselves, so I could announce to everyone, 'Here's so and so.' As you know, on some of the calls, people might be late, especially with the directors, [who] are coming from a prior call. Someone might say 'Where is so and so?' In that case, I might know ahead of time that they are joining the call, and be able to say 'Here they come'.*"

If not enough participants are present, or critical people are still absent, the moderator can use the integrated chat mechanism for coordination. A typical example is when the moderator opens a chat with someone who has not yet arrived. 3-TH reported "*Actually that is one thing that the visualization does help with: You can very easily figure out who is not on the call yet, you know, you have that whole list of people who are not here yet… if they were critical to the call, I would probably ping them and say, you know, 'Are you joining the call'?*" Similarly, 6-TH said, "*Let's say somebody hasn't joined the call yet and I'm expecting them to be here because they have accepted (the invitation), then I*

select the name and double-click on it, and IM them directly from there to say 'Hey, are you joining the meeting' or whatever. Instead of having to go to look up [in the corporate directory] or whatever, so that is helpful." By providing 'communication handles' for all participants in the meeting, the social proxy makes coordination via chat a much lighter weight process; this is particularly useful because moderators are often dealing with multiple issues when starting a meeting.

Unexpectedly, the small bubble in the IEAC visualization is not just used for speaker identification but also used to detect sources of noise and to ensure good audio quality. Problems with audio quality may be due to a participant calling in from a noisy place, a poor cellular connection, or a participant who breathes heavily while hurrying through an airport (not to mention the occasional person who falls asleep and begins to snore on a cross-time zone call). The meeting window's social context display supports dealing with audio quality problems in two ways: first, it makes it easier to detect the source of the problem; second, it provides a means of control. Several informants reported diagnosing the source of annoying background noise by watching the conference call proxy and correlating the appearance of the 'speech bubble' with the noise. Once the source of the noise was identified, the person could be informed, or if necessary, another person could mute him or her. Muting another person is useful when the person is using a telephone without a mute function, when they are asleep, when the caller has temporarily left the phone (and background noise occurs), or when a person has put the call on hold (not realizing that her telephone service plays 'on hold' music). About half our informants reported putting others on mute.

Fostering More Accountable Behavior: The maintenance of the overall coherence of the joint enterprise does not just rely on a central agent, but also comes from distributed local effort. In studying IEAC, we found one of the most popular features is "Set identity". People who attend a call, but are not registered with IEAC, show up in the conference call proxy with the label "Guest". "Set identity" allows any registered IEAC user to right click on the "guest" name and assign it an identity from the set of not-yet-here invitees (if an employee), or a label (e.g., "CIO, Company X") if from outside IBM. Although this is not foolproof, as it relies on a person to assign the identity, it appears to be sufficient for normal purposes. A number of our informants mentioned that they customarily

assigned identities to guests as they showed up at the start of the meeting, which is consistent with the log analysis showing that about half the uses of "set identity?" occur immediately after the start of the call. It is worth noting that when one person sets the identity of a guest, everybody can see it, and it is also valuable for those who are late and miss the introduction phase of the meeting.

In addition, a shared visualization that gives people mutual awareness of each other's activity enables participants to be held accountable for their actions. The use of the IEAC meeting window to maintain the meeting boundary demonstrates this point. In addition to making sure that invited people are present, another reported use of the conference call proxy is to ensure that others are not present. Sometimes, especially in large meetings, people are supposed to attend for one part of the call, and then leave. This boundary is graciously maintained simply by means of the social context display showing who is on the call. 7-TH said: "*One thing I find interesting is that you can't hide... [If] you're on, you are on. No sneaking in on a call. ... There are times ... when some of the participants... the topics may have finished, but participants still want to stay on the call to discuss the particular item or issue, and there are times when you cannot be one hundred percent sure that everyone has left the call (when they) should have left the call, but with IEAC, when everyone is using IEAC, you know who is disconnected.*" While many informants weren't very concerned with confidentiality, those who were - for example consultants who assemble bids and vet contracts - were very concerned. While there is a feature in IEAC that allows participants to lock the meeting, this technical mechanism seems too inflexible to work effectively, since it is fairly common for participants to join a bit late. Rather than locking out latecomers, people preferred to manage meeting attendance socially As a matter of fact, not that many people were aware of the existence of this technical mechanism.

Chat as Backstage Channels for Performance between Teams: The use of instant messenger as a backchannel during the meeting is another example of how local effort contributes to overall coherence. Informants described a variety of backchannel chat behaviors, often noting that they preferred to privately consult a colleague rather than disrupting the meeting. Sometimes the ability to speak privately was valued for saving face - for example, to avoid appearing as though one hadn't been listening or hadn't fully understood the conversation.

Informants also described tag-team behavior, in which chat allowed one person to act on another's behalf. 3-TH described playing a role as a backup to someone doing a presentation: "*so if someone asks a question that the presenter doesn't know the answer to I'll use [IM] to find out the answer while they're still on the call.*" In a less cooperative example, 1-TH describes how he used chat to 'encourage' another person to provide him with information that he could tell he would soon be asked for: "*So I'll ping the person that was supposed to respond to me [prior to the call] and hasn't yet. 'Hey did you read my email? Give me an answer now!' That would be good because probably in five or ten minutes I'm going to be asked a question and I'm going to have to ask you [publicly] anyway*."

More generally, informants spoke of using chat during a call to make sure that they were "on the same page" with their colleagues. 4-TO: "*I feel free with my management to express my opinion when it's just them and I, but when everybody's on the call it is best to reserve those opinions… a lot of time those will be the [chat] conversations that will be going on ... conversation with my management to express that I don't agree with them.*" Similarly, 5-MO said "*It can be useful to be able to have a private discussion about the merits of what someone is saying, and to confer with team members... generally my habit in conference calls, especially if it is with multiple organizations ... there are things we talk about on the call, and then we use IM in trying to arrive at an understanding, or sharing info that can't be openly shared on the call.*" It is useful to remember that meetings aren't just among people but among organizational units. 7-TH: "*We've had a few cases where we had [division X] folks on a call, and we were meeting with people in [division Y] who had to sign off on [X's] requests. We might have a few folks sending IM messages back and forth to answer questions, to be prepared to answer questions that [Y] were asking, etc. We'd IM back and forth to get info across, or to remind folks to ask specific questions.*"

2.3 CASE STUDY SUMMARY

In summary, our interviews revealed a rich set of practices that are facilitated by the conference call proxy in IEAC. The meeting window facilitates

the business of the meeting, showing who is speaking, enabling users to gather information about others, and allowing users to coordinate with one another (either by taking cues from who is speaking, or via private chat). It provides a new capability in allowing a not-yet-dialed-in caller to 'watch' as people arrive, to be aware of the social circumstances, and to thus gauge exactly when to join the call. It is also important in ensuring coherent team behavior during a call. It helps directors and moderators to manage the call and get it off to a smooth start. Call moderators find it useful in monitoring the arrival of participants, and its chat functionality provides a ready means of summoning the tardy. It also provides new ways to ensure that the conditions are right for the call to get under way. On the social side, the conference call proxy makes it easier to detect lurkers who shouldn't be present, or who were supposed to leave; on the technical side, it permits the diagnosis of the source of annoying background noises, and provides social and technical means (private chat with the noise source, or simply muting the noisy line) for remedying the problem. In these ways, the conference call proxy supports various aspects of individual and team performance in an audio conference.

3. CASE STUDY: NOMATIC*VIZ

The work on the conference call proxy suggests that the social context display is helpful for members to carry out a collective activity informatively and coherently. It also demonstrates that Goffman's performance framework can be easily extended and applied to the understanding of social context displays in use. However, its exploration was situated in a formal organizational setting, and was based on social traces on virtual spaces - presence in an audio conferencing system. To provide a more robust application of Goffman's framework, we continued our investigations outside of a formal organization and in a more ad-hoc environment. We designed and built a social context display called Nomatic*Viz which shows people's location and status information in a large display situated in a shared community space.

3.1. NOMATIC*VIZ AND THE STUDY

Nomatic*Viz is part of a distinctive status broadcasting system called Nomatic. Figure 3 shows the conceptual usage model of the system. The whole Nomatic system is composed of two components, a context-aware software tool called Nomatic*IM that is installed on individual laptops, and collects and provides status data, as well as a situated public display called Nomatic*Viz which is deployed in a shared community space, and shows peoples' status. In this section, we will describe Nomatic*IM and Nomatic*Viz in detail.

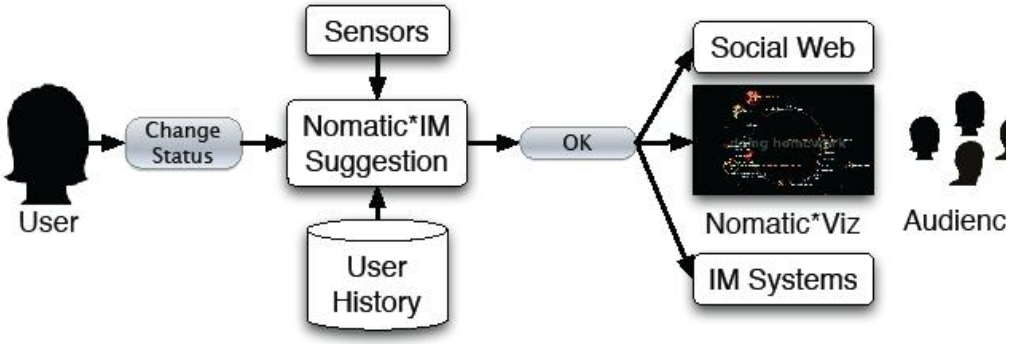

Figure 3. When a user wants to change status, possibly at the prompting of the system, Nomatic uses sensor data to provide suggested status messages. When a user selects a status message, it is sent to many different status broadcasting systems and Nomatic*Viz.

Nomatic*IM uses a wide variety of built-in sensors on a user's laptop to sense aspects of a user's context. Unlike IM presence cues, which are almost raw sensor data (e.g., "idle"), Nomatic*IM, whose interface is shown in Figure 4, uses machine learning to present a list of predicted status descriptions for the user to choose from. The status messages are combination of a user's place, activity and mood and are predicted based on current sensor readings and the user's history of status entries. Additionally, when the system independently thinks that the context has changed or after a period of inactivity (two hours by default), it will remind users to update their status. The goal is to allow users the freedom to richly express their current context without requiring more than a couple of mouse clicks in the best case [Patterson et al. 2006]. The selected status entry is then broadcast to a wide variety of IM systems (e.g., Skype, AIM, Yahoo! etc.) and Nomatic*Viz.

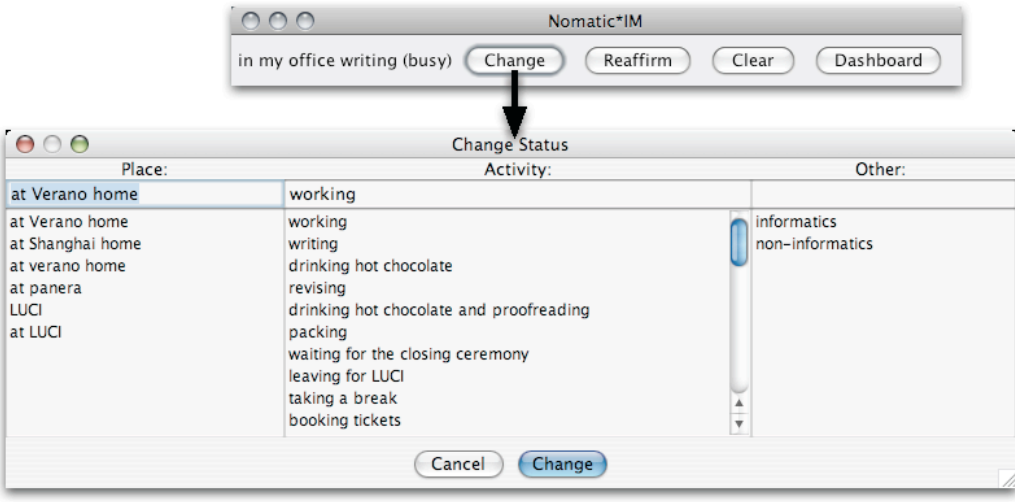

Figure 4. The primary Nomatic window shows the status that is currently being reported to IM systems and Nomatic*Viz. When a user wants to change his status, he is provided with a list of suggestions which are generated by a machine learning algorithm that matches current sensor readings to previously used status messages.

Nomatic*Viz is designed to be situated in a shared community space. Through the design of Nomatic*Viz, we sought to leverage ambiguity to address privacy concerns and more importantly to create a thought-provoking and reflective visualization of the entire community's sensor and status data. In the spirit of Gaver et al.'s work [Gaver et al. 2003], we wanted to focus Nomatic*Viz's audience on the interpretation of the overall rhythm of the community and not on the specifics of the sensor data available. However, our goal was not to engage viewers with the system but rather to engage them with the data, which in turn engages them with the community who is generating the data. By showing status information in an ambiguous way, we hoped it would encourage users to relate their contextual social background to more actively interpret the display and experience the community in new ways.

Nomatic*Viz was developed through a user-centered iterative design process. Previous iterations of the design demonstrated that the ambiguous approach was effective in addressing privacy issues, and in engaging those users who were more actively participating in the community, more. The current design includes the following features:

- The incorporation of activity status in addition to location status since people expressed interests in group activities;
- The display of activity status messages in very large words so users can quickly notice it at a glance;
- An increased use of individually color-coded historical traces to show temporal rhythms;

- The use of animation to highlight real-time information.

Figure 5. Screenshot of Nomatic*Viz display with four days of data

Figure 5 shows a screenshot of the resulting design. All participants' status data for the current week is aggregated on the display. On the top, a calendar-like bar indicates to viewers what days' data is currently being shown, the current time of the day is shown with a red arc, and a series of colored boxes represents each participant whose data is on the display.

Across the display colorful "fans" are shown. Each cluster of fans corresponds to a unique WiFi access point from which statuses are reported. The arc sweep of the fan corresponds to the time at which the user was at the location mirroring the clock at the top of the screen. Multiple days of reports from that access point are layered on top of each other. A text label with the most recently reported place name is shown next to the fan. Each user has a slightly different color. If multiple WiFi access points share the same SSID label (for example many access points administratively managed by the same organization), they are clustered together on a gray ring. The number of unique access points associated with it determines the size of the gray ring. Its position on the screen is based on the recency of the last status report. In the case of Figure 5, the central ring represents a university campus. Overlaid across the display, large lines of texts representing current

activities sampled from all participants appear and disappear. The visualization highlights current real-time status reports with pulsing circles over the relevant fan.

Thus, the information presented in Nomatic*Viz is ambiguous at several levels: instead of using a literal geographic map as its layout, it is dynamically constructed by users' collective interactions with the WiFi infrastructure; instead of using icons to represent people, it uses different colors to subtly distinguish individuals. The mapping of colors to individuals is not specified, and is therefore unknown unless viewers have knowledge of the community. The mapping of activity text to an individual is not made by the display. The fact that place descriptions are user generated allow for user control over the degree of accuracy over the location names. Finally, by layering historical traces of people's whereabouts over time, details become obscured but frequency becomes more pronounced.

To understand how people live with Nomatic*Viz in a community setting, we deployed Nomatic*Viz in a shared public space of an academic department and conducted a five month field study. Except for a few individuals with multiple affiliations, the entire academic department was located on the floor of the building where the deployment was conducted. In order to make the display more accessible and to facilitate sharing by the whole community, we placed the display at the entrance lobby to the floor, which was also the connecting point between two wings of offices and is close to many shared resources such as the kitchen, the bathrooms and the copy and mailrooms. Notably, this was not the first spot that we tried. In early iterations of this system, the display had been deployed in the elevator waiting area, where, counter intuitively, we found people didn't have time to view the display. The studied display location instead had long sight lines that enabled the display to be viewed while people were in transit to other locations.

The display of the new visualization was mounted in the lobby toward the end of the school year and remained in place for a year or so. The initial set of 7 participants consisted of researchers affiliated with the Nomatic project (one faculty member, four graduate students and two undergraduate students). Over the next 10 weeks, several other faculty members and graduate students were enrolled through personal invitations. During the summer quarter, a new round of

participants were recruited to replace participants who were no longer physically located in the building. By the end of the summer, there were 89 users of Nomatic*IM, 16 of whom had opted-in to the display of their data on Nomatic*Viz. The 16 participants consisted of 3 faculty members, 1 research scientist, 10 graduate students and 2 undergraduate students.
After the display was deployed in the field for five months (crossing two quarters and a summer), we conducted semi-structured interviews and analyzed logs of status messages. The interview protocol covered four areas: everyday schedules and mobile practices; interpretation of the visualization; encounters with the display - probing for specific instances; and disclosure practices. Most interviews were recorded and later transcribed. To jog memories and probe specific instances, most interviews were conducted by the display, also with the interviewer providing a printed sample of past status messages to the informants.

Out of the 16 participants who broadcast status to the display, 8 were interviewed, 1 pilot interview was conducted with an affiliated researcher, and the remaining 7 interviews were with participants not affiliated with the Nomatic project. Of the 8 informants, 3 were faculty members, one a research scientist and 4 were graduate students; 5 were females and 3 were males. At the time of interviews, all informants had been using the display for at least a month, with several spanning the entire 5-month deployment. In the analysis to follow, we will refer to participants by pseudonyms whose first letter indicates their role in the department: faculty names start with "F", and graduate students' and research scientists' names start with "G". In addition to the interviews, logs of status messages were analyzed to gain insight into how they were shared.

3.2. Nomatic*Viz in Use

Over the period of 170 days, a total of 10,772 updates were received from the participants, with about 63 updates per day and 4 updates per day per person. Out of all of the updates 471 were unique messages. The log results suggest that Nomatic*IM was effective in promoting status updates. This was also consistent with findings from our interviews: our informants commented that Nomatic*IM was lightweight, and didn't involve much work to use and therefore made contributing to Nomatic*Viz easy as well. Several informants reported that they definitely started updating their status much more. This was especially true for

those who didn't update at all through other social media. More specifically, the Nomatic*IM window popping up periodically was effective as a reminder for them to update their statuses.

To give a flavor of what status messages were broadcast by this group, we analyzed status message logs and identified five frequently used categories:
Meeting Events: Including talks, presentation, meetings. (e.g., "*listening to XXX's talk*", "*attending a Ph.D. defense*", "*in XXX's advancement*");
Work Related Activities: Activities consistent with daily work. (e.g., "*hacking*", "*coding*", "*working on dissertation*", "*reviewing papers*", "*storyboarding*");
Expressions of Mood: Emotions, frustrations and reactions (e.g., "*WHY DOES EMAIL HATE ME???????*", "*punching my computer in the face*", "*probably sleeping*", "*exploding*");
Non-work related activities: Activities inconsistent with work in the department (e.g., "*cooking*", "*making coffee*", "*Watching TV*", "*playing games with XXX*");
Miscellaneous: Messages such as information, invitations, and greetings (e.g., "*not in an earthquack zone*", "*Happy birthday XXX*!", "*early lunch anyone*?");

As part of the evaluation of Nomatic*Viz, we conducted semi-structured interviews with 8 participants. At the highest level, our analysis demonstrated a very sophisticated and nuanced response to the introduction of these status tools into the informants' daily practice. While a complete understanding of the details of the visual elements of the display was rarely displayed, our informants all developed deep social understandings of the implications of using the tools in various ways. In the information that follows, we will discuss some of the experiences with respect to the Nomatic*Viz display in particular.

Peripheral Awareness through Glancing

As expected, based on prior findings on large displays in shared space [Greenberg and Rounding 2001, Churchill et al. 2003], the situated context and people's practices shaped how people encounter the display. A great deal of the impact of Nomatic*Viz was related to its physical setting. Located in the lobby, which is a connecting point between two wings of offices, adjacent to some functional rooms (e.g., kitchen, copy rooms, mail rooms, meeting rooms) and on the path from the elevator to the rest of the floor, the Nomatic*Viz display is readily visible from many angles by people who enter the floor or walk by for

Figure 6. Glancing is the main form of interaction with Nomatic*Viz.

various purposes. At the same time, the lobby itself was not identified as a destination in and of itself and existed on the way to some other pursuit. As a result, people were already engaged in an activity when the opportunity for viewing the display presented itself. For example, Frances reflected that most of time when she was passing by, she was busy with other stuff, so she didn't have the energy to change her actions on the way.

Indeed, in interviews, while a few of our informants reported always "*looking*" at the display when they pass by, either when they come into the floor in the morning, or when they visit the copy room, the kitchen, and other's offices during the day, the majority of them reported that they just "*glance*" at it. Very rarely, they would stop, walk up and study it, despite the presence of seating by the display. Two informants mentioned an exception to this when on occasion they would study the display while using the adjacent kitchen to warm their lunch. However, even though most just glanced at it, our data suggests that, compared to IM, Nomatic*Viz still provides more lightweight and peripheral awareness. As Frank put it, "*I don't really look at the buddy list very often, unless it is just before when I about to make a connection with someone... but if I am walking by the display on my way to the mail room, I just kind of glance at it."* Fiona reported similar experiences, "*I used it as a lightweight...as I walk by anyway to check, then I can think in my head what I do next....* ". This is unsurprising because, as Huang and Mynatt point out that, by making information visible and persistent in a shared space, the large display makes it more easily available and eleminates the

need for members to retrieve it from other channels such as email or IM [Huang and Mynatt 2003].

A Community Display

While awareness seems to be the most obvious use of a large display of social status, Nomatic*Viz is distinctive in that it conveys a sense of what is going on within the *community* as a whole, not just a collection of individuals, as a result of juxtaposing everyone's data together and sometimes blurring it the display.

The most common element noticed while glancing was the rapid appearance of big words. Using Greg's words, these big words are helpful for "*sampling what is going on*". George reported similar experiences, "*so when I walk off the elevator, the only things that I glance at as I walk by are the big things that come up, like the task that people are doing*". To Fiona, these big words are her favorite feature, "*the number one thing I look at it, which I really like it is the big things that sort pop by...some sort of ambient knowledge about what is going on with my community of people*".

Occasionally, the words together formed patterns that characterized particular community contexts such as the end of the quarter, during a conference or a paper deadline, etc. These visible patterns enhanced the feeling of the shared experience in the community. Fiona, being one of the longest members using the system experienced the "ebbs and flow" of community activities through the display, "*Another thing that is sort of amusing me is the patterns you will see, so towards the end of the quarter, you will see 'grading' up a lot, which is often, 'me', [Frank] and [Frances] simultaneously, which sort of tickles me, because you get a sense of, OK, the end of the quarter, everyone is grading, or everyone is studying a lot, which is most of undergraduate students. Similarly, when the [grant] stuff was going on, [Frances] and I were writing like crazy, so I saw 'writing' flash up a lot."*

Frances, another long term user, also noticed the differences in the variety of activities between the quarter and the summer which was consistent with people's report that their schedules were more complex during the quarter.

In addition to the big words, the display also more subtly conveys the sense of activity level through its graphical design in features such as "fan"

density, the number and distribution of color dots, the amount of animation, etc. all of which aggregate as status messages are reported during a week. Greg reported how he perceived the visual cues in conjunction with the big words, "*Just walking by, I [notice] how many blurbs you can see ... high level status messages ... the radar dots that are animated ... how many people are online ... when they've been online*". Fiona similarly gained overall impressions based on colors and other visual cues, *"So I glance from a distance [to see] if there are lots and lots of bright colors, if there are very few colors on, I would recognize that ... that usually happens early in the morning, or during the weekends, or some other time that makes sense, it is less ... when people are off to conferences or meetings or something. [Actually] that just happened ... when the quarter ended, it was remarkable to see how much less the activity was..."*

However, whether it represents a community or more personal relationships also depends on the number of participants involved. Fiona reported a case that was revealing, "*When it was just, for a while, in the early summer, where it is like me, Frank, Frances, that seems about the only people that were there, there were a few people on sometimes, from time to time,.. but most of time...it is sort of interesting, when I go by, I would always know that is going to be one of us... then when there are times, when there are more people, it is nice, it just changes the way that I see it, it just gives me more of the gestalt view of the department, but it is less like personal small group interaction.*"

Member's Reflections

By including the display of Nomatic*Viz in addition to disclosing it to IM, we hoped to include a view of status which provoked reflections on participants roles as members of a community. Using ideas described by Sengers et al. [Sengers et al. 2005], we attempted to leverage user reflection as an important means for us to uncover unconscious values embedded in status broadcasting technologies and related practices. What we found was that the co-existence of displays did encourage reflections, particularly on the effects of the status to different audiences they represent. Fiona was aware of that the two displays communicate to different audiences, "*I use it for people's birthday stuff. I used it in my IM status message. Like in some situations, I can imagine that might be more useful for me to say 'happy birthday' to someone on the display rather than*

going through my buddy list, and the other around, there are cases, it makes sense to my buddy list, but not on the display." Similarly, Greg, who used to just put up "silly" messages for no particular reason in social media, when seeing his own presence on the Nomatic*Viz display, became more reflective of the difference between the display and the IM, "*I leave my status message and I saw it on the display, I would say, wow that is a personally identifying message, if you know me what I've been up to, you can tell...the ultimate effects, makes me consciously aware, what kind of information I disclose.*" Upon his reflections, he concluded "*the display let the group know what the group is up to, while the IM is to craft an identity for myself.*"

New Spatial Experiences

Most work on awareness has been based on an informational account. That is, what awareness technologies offer is to inform activities and availability and thus support coordination and communications. Unexpectedly, in our field trial, we found, many times, people had meaningful moments even when the display just showed information they knew already. In fact, when the display became meaningful, was when the display showed the information that they could "make sense" of or when it confirmed their sensations in and perceptions of the physical space. Our informants described how they "smirked", "cracked up", "are amused", "are tickled" and "laughed" seeing the status message on the display, and thought it was "interesting" and "funny". Grace, when recalling her experience seeing a status message, reported a particularly nice example of this, *"[her message] says, 'in a meeting with students' or something like that, I was at the office next door, so I can hear, 'oh yeah, she is meeting with students', so I thought it was interesting."* In this case, Grace was overhearing her colleague next door having a meeting with students, and at the same time seeing the status message on IM describing the meeting. Although the status message didn't provide anything new, the consistency of it with the physical world experience turned a mundane occurrence into something notable and reportable. The meaning of the status, then, is not just in its being descriptive, but rather, together with the space and setting, it participates in engaging sensation, and produces new meaningful spatial experiences.

In essence, many of the examples of community awareness we have described have similar effects. However, some of the most explicit examples of this were when seeing one's own messages. In fact, Frank and Gladys reported one motivation for them to glance at the display was to view their own messages. George also commented that it was funny to see his own status up there, or others' status that he can recognize, "*When I see my own status, I kind of smirk. It is just funny, to see. It is kind of fun. I also smirk when I see 'making coffee' because I know it was [Frank], no one else is making coffee apparently, and I guess.*"

Grace expressed similar feelings when encountering the display and seeing her own messages up there, "*Sometimes I laugh because I see my messages up there. Like one day, I had a kind of strange message. I guess it was a couple of days ago, 'at work caffeinating'. I put that message up before I went to go get coffee, and here I am at the elevator, it says in big letters 'at work caffeinating' while I had a cup of coffee in my hand. I thought it was really funny. I was like, 'hey, that is mine'*"

Whatever these occasions were, the status message did not provide new information, but our informants still seemed to be surprised seeing messages of their own. As a display not owned by anyone in particular, it appears to have obtained some staging and performative effects, and having one's own presence shown there becomes something special. What we see here is that the display introduces a gap and a suspense between authoring and seeing, owned and unowned, consistency and inconsistency within the physical space. The gap and suspense open new opportunities to engage sensations, to be surprised, and invoke experience within space. The meaning and value of the display, then, does not lie in it providing something *new*, but rather, in its participating in and creating new dramatic and spatial experiences.

Performance

So far, we have noted important ways in how people encounter, perceive and interpret the Nomatic*Viz display, and how it participates in creating performative spatial experiences. We also found our informants thinking about how they were represented on the display through status message broadcasting. We draw on Goffman's performance framework in forming an understanding of these sophisticated controls of their self-representation.

Goffman uses the metaphor of theatric performance to examine mundane face-to-face social interactions [Goffman 59]. In his framework, he used the notion of front, to refer to "*that part of the individual's performance which regularly functions in a general and fixed fashion to define the situation for those who observe the performance*" (p.22). He further distinguished it into different parts - setting, appearance and manner, and offered the insight that we often expect consistency and coherency among these front parts, and will attune to exceptions to expected consistency among them. In our field trial, we observed similar concerns in maintaining the consistency among different front parts. However, with the presence of digital elements, the front becomes more complex: not just consistency among appearance, manner and setting, but also consistency among digital and physical presence, and consistency among various digital presences.

Maintaining a Coherent Front

Like in face-to-face interactions, maintaining a coherent front is part of our informants' considerations when putting up their messages through Nomatic*IM, in the sense that they must conform with the expectations of the potential audience to avoid unnecessary misunderstanding or wrong impressions. Various strategies were reported by our informants to maintain this consistency. One strategy is to make sure the message is correct, but not exactly. Frank, for example, is explicit about this strategy, "*I don't want people to know specifically where I am, but I let people know I am on campus. If I am running personal errands on campus...I don't want people to think because I am going down, getting dinner for tonight or something, that I am not interested in their project...*" A second also commonly adopted strategy is to shutdown the whole system, and to remove the digital presence. Grace reported an occasion, "*There was one week I was sick. I was at home all the time. I kind of didn't want everyone to know that I am at home all the time, so I didn't put things into Nomatic.*"

While being at home is not something that is necessarily blameworthy, its inconsistency with the usual situations may draw attention and lead to misinterpretations without further explanations. By shutting down the system, it saves the trouble of explaining it.

One common reason for inconsistency is due to lack of updates or inattention to it. For instance, when Frances went on vacation she was more concerned about reporting inconsistent information between the digital and real presence due to inattention than she was about communicating the fact that she was on vacation through the system. As a result, she shut down the system too.

Same Message, Different Audiences

What adds to the complexity of maintaining a coherent front is when multiple audiences are present. It is certainly true with the Nomatic system, where the same status information is published to both the Nomatic*Viz display and IM and others. Fiona is a typical example, as a faculty member, her audience is very mixed, including peers, colleagues, friends, students, people at a distance as well as people that are local. As a response to this very mixed audience, statuses become less funny, and more vague, or innocuous. As Fiona put it, "*The only attention is... I make things neutral for the most part. If I want to be funny, I try to make sure it is funny in a way that it is not going to be a problem for the mixed audience that I have.*"

To address the multiple audiences, status messages are, to some extent, "washed out". While managing different audiences separately may relieve some concerns, however, it may not be practical, as Greg points out, "*By dodging the problem, it may introduce new problems.*"

Striking, here, are the sophisticated ways people have crafted their messages for different audiences at the same time. One technique is to create high context and low context messages to communicate different things and suggest different availability to multiple audiences. High context and low context are used by Edward Hall [Hall 1976] to distinguish different cultures. While the former says things that heavily rely on shared context to understand what the speaker says, the latter incorporates more contextual information. Our data shows a common use of both high context messages and low context messages to say different things to different audiences.

Fiona's example was a case in point. During the period of study, she was actively collaborating with a local hospital in another city. Originally, she put "hospital" as her location status. However, this message often invited some query messages from her buddies to check whom, worried, checked in with her. This

interaction made her change her location to the city's name where the hospital is instead. That way, the local people would be informed where and what she was up to, while, at the same time, it wouldn't create much concern from the remote audience, because the city name didn't make much sense to them without the relevant background information.

In reverse, while high context messages are used to inform different things depending on people's background knowledge, low context messages are commonly employed to suggest different availability to different people. Grace's example was representative, "*Sometimes, I am working pretty intensively on something. Like, this week, I was working on a NSF grant, and I put it as 'I was busy with NSF grant', then anyone who is working with me with the NSF grant knows that they can disturb me because they were also working on the same thing. Sometimes that is helpful as a gate keeper.*"

Indeed, data shows that people respond to these messages accordingly. For example, people will decide whether it is appropriate to disturb one another by seeing whether the messages put up there are relevant to their work.

We found, sometimes, people customized the status with certain audiences in mind. Fiona provided one extreme example. During a stressful time, Nomatic*Viz was appropriated by Fiona to create a little levity, "*It must be around some paper deadlines, that I can't remember, and we were joking around and put. I was listening to some silly music or something, Justin Timberlake's 'bring the sexy back', so I switched it to my IM message, just to see whether it will show up on the display, just to mess around and then [Frank] and [Frances] kept running back and forth. They were going between offices. They often coming in here, and they were writing together, and so I was amused to see whether they would like run past the display and happen to notice that that was on there."*

Frances also mentioned that she liked to make her messages to communicate, and make sense to the audience. For example, when she traveled, she used the hotel name, instead of the city name as her location status, because to her, that was more indicative of her being in a conference than using the city name.

3.3 Case Study Summary

In the preceding sections we presented Nomatic*Viz - a large display that shows status and other contextual information and in a shared community space. Unlike the conference call proxy, which was designed to support a specific task such a meeting or project proposal management, the ends Nomatic*Viz was designed to achieve are much more open ended. At the same time, the user group studied is also much more loosely connected and less dependent on each other. Except for sharing the same space, either on the same floor or in the same building, there are no long-term shared tasks to connect these participants, so the social relationships among them are more informal, spontaneous, voluntary and relaxed. It is a bit like prior media space projects, which were not intended to support some pre-established collaborations, but which were created more in the hopes of fostering more informal interactions and potential collaborative opportunities in the future.

Rather than seeking information of strangers, participants are more attuned to information that they can recognize, associate and interpret. Members of the community pay more attention to those statuses that they know and recognize. While the display is designed to be anonymous, members usually can recognize the author of the status based on the content and the form of the status message as well as their shared background knowledge of the community. For instance, people are more attuned to status information when they find what they see from the display is consistent to their perception of the real space. One extreme example is people pay particular attention to the appearance of their own status.

In these more relaxing and spontaneous situations, participants have a more relaxed attitude towards the two displays. Engaging with the display is more or less a downtime activity. They glance at the display while on the way, and only closely study it when they are waiting for something in the kitchen.

Unlike the conference call proxy which is based on social traces passively left behind while users engage in other activities, status messages in Nomatic*Viz are users' direct products. In the former, while users have to change corresponding behaviors to maintain their front; in the latter, they could directly manipulate the data to manage their presentation with great latitude in determining what statuses to share, how to form them and when to update. Even with just very simple text editing, our study shows that users put great thought

into the format and content of the messages. In other words, the information shown on the visualization is more like a carefully crafted expression than an automatic and passive notification. This is similar to the Goffman's distinction between expression given vs. expression given-off. Using users' active involvement is a double-edge sword. On the one hand, the fact that users take an extra step to submit statuses suggests that the data submitted is meaningful, at least to the submitter. On the other hand, users have more freedom to manipulate the data content and form, which may not reflect the real situations.

4. Discussions

As expected from previous literature, the two social context displays - the conference call proxy, and Nomatic*Viz, although based on different technical features and examined in different settings, demonstrate effectiveness as a social context to inform members of what is going on with the group. Whether it is to indicate an appropriate time for joining a call, or to display aggregate status to give a sense of what is going on within the community, they all help their members to glean contextual information around them and help them to align their behavior accordingly. This is the familiar informational view of social context displays. Or put another way, it is an audience perspective - about how people observe and gain information from them.

What has been less discussed and relatively little explored is that these social context displays do not just provide a context to inform actions, but also act as stages through which members perform and communicate to their audiences. Whether it is to automatically withdraw from a meeting during sensitive topics, or to make sure one's statuses are consistent across different media, and so on, members all considered what to present, when to present and how to present themselves on the display. The existence of a social context display, then, by rendering aspects of presence and activities visible, dramatizes the computer-mediated activities, provides resources and engages people to perform and behave in accordance to certain moral and instrumental standards. This includes behaving according to the accepted rules of the setting, and projecting a desired image before others, either through changing their behavior or by manipulating their visual cues directly.

To use the idea of "performance" for the analysis of computer-mediated interactions is not our own unique insight. Goffman's notion of performance and its relevant concepts such as self-presentation, impression management, "face" or identity management have been familiar topics in HCI, CSCW and Ubicomp [boyd 2002, Voida et al. 2005, Mark and Semaan 2009, Lederer et al. 2003]. This is unsurprising because, as suggested by Bentley and Goffman, there is always a performative aspect when one's activities and actions become possible for others to observe [Bentley 1965, Goffman 1959]. While performance is not a new idea, our studies did uncover some subtle and nuanced aspects of performance in computer mediated interactions and related topics.

In this section, we reflect on design insights that can be drawn from our case studies when seen as performances through mediated interactions. We ground our examples largely on the two projects and related work of making social information visible; however, some of the perspectives may also be related to the design of HCI, CSCW and Ubicomp systems in general.

4.1 From Privacy to Performance

One of the starting points for this work was to find out whether and how social context displays may cause privacy concerns that can compromise their value. Privacy has long been a concern when digitally mediated interactions are present. In particular, two classes of privacy concerns are identified in ubiquitous computing settings [Bellotti and Sellen 1993]. One is associated with the fact that computer technology and information collected may be put to insidious or unethical uses; the second concern is with user interface design features that interfere and/or harm user interactions. Our primary concern here is with the latter. The related work on making social information visible is devotes much time to discussion of this. For example, privacy has been a major concern for critics of media spaces [Bellotti and Sellen 1993, Clement 1996]. A change in focus to "social translucence", instead of "social transparency", acknowledges the vital tension between visibility and privacy and the power of constraints in supporting social processes [Erickson and Kellogg 2000]. Privacy concerns have also arisen in some of the studies of social visualizations [Viégas and Smith 2004]. So when we started to explore social context displays to enhance interactions and collaborations, privacy naturally became part of our concerns.

However, although widely discussed, it is still hard to define what is really meant by privacy. It can arise in a variety of social, cultural and organizational environments, and its nature and solutions can vary widely. Therefore, there is still quite a debate of how to conceptualize and address privacy appropriately. One perspective is to see it as a matter of trading value, meaning that people are more prepared to accept potentially invasive technology if they consider that its benefits outweigh potential risk [Patil and Lai 2005, Ladd 1991]. Others criticize this perspective for failing to taking other symbolic and social values into account, and suggest that we should look beyond narrow views of privacy or security, but look more broadly at collective informational practices that incorporate the social and cultural context into consideration [Dourish and Anderson 2006]. However, although moving away from privacy to collective information practices as a unit for analysis suggests new implications for understanding privacy and security in everyday technological settings, there is no concrete conceptual tool provided to articulate and account for users' experiences and feelings in relation to privacy.

Based on our experiences, "performance" turns out to be a valuable way to think about issues that have been glossed over as privacy. In particular, the notion of audience in the performance framework seems especially relevant. It makes intuitive sense that audience plays important roles in performance, and awareness of who the audience is is critical for people to feel comfortable in expressing themselves. This is clearly demonstrated in the conference call proxy where we found people made specific effort to identify their audiences. For example, one of the most heavily used features is bringing up others' corporate directory information to gain an understanding of others' background, where they are from or to whom they report. Some explicitly stated that it was important for them to learn about their audience so they can determine what and how to speak. We also found people customarily set identities for unregistered users who showed up as guests at the start of the meeting. Further, when the meeting started off, people tended to monitor the display to ensure only the correct representatives would be there ("no sneaking in the call"), as a way to protect the confidentiality of the call. All these practices illustrate how important it is for people to gain awareness and understanding of their audience for appropriate performance.

Even in complex situations when there are multiple or mixed audiences such as Nomatic*Viz, as long as people are aware of who their audiences are, they

can still very skillfully manage their expressions. In Nomatic*Viz, our participants' status messages are simultaneously broadcast to multiple social media platforms, which indicates that people have to deal with multiple audiences simultaneously when they update their status messages. The first platform is Nomatic*Viz; its situated nature implies that the corresponding audience will be those who come to the building, which largely means faculty, students, researchers and staff of the same academic community. The second platform is IM; there is no situated (or even shared) audience for IM status. The user's status will likely appear in multiple, disjoint buddy lists scattered throughout a wide variety of contexts.

Our study shows how skillfully people can manage their performance with these multiple audiences by simply editing their textual messages strategically. They made their messages more specific or more general, used high- or low-context messages to say different things to different audiences at the same time. Or they just impersonalized or made their messages washed out as a safe way to deal with the mixed audience or just shut down the system during unusual situations, such as when being at home sick for a whole week.

It appears that what causes concern is not how complex the audience is, but when the audience is uncertain. Another example of this comes from the report of the media space Rave at EuroPARC [Bellotti and Sellen 1993]. Rave connects each office of the building with cameras, monitors, microphones and speakers, to allow members to communicate and work with each other and be aware what is going on in the community. While in general, members in the building were comfortable with the media space, and did not worry much about privacy, it posed privacy concerns for newcomers and visitors to this space, simply because as newcomers, they don't know to whom and when their images were being sent. This made them uneasy about their ability to control and present themselves. Sometimes, it even posed issues for seasoned members. For instance, if a colleague with whom one has an office-share switches off their camera or moves out of view, people tend to forget that the colleague can still see him, or forget the presence of that particular audience in his show. These examples illustrate that it is lack of awareness or uncertainty about who it audience is that make people uncomfortable in their presentations of themselves.

One typical design reaction to deal with the complex audience is to provide means for people to categorize their audiences (e.g., friends, family, colleagues, and etc.), and allow them to set different preferences to these different groups [e.g., Lederer et al. 2003, www.facebook.com]. However, analysis from social science points out that actual information privacy practices are highly fluid and dynamic and subsequently call this static configuration and enforcement approach into question. We argue that, instead of providing means for setting and enforcing, it is more important to make users aware of who their audiences are.

4.2 Individual or Collective Performance

What has been brought to the forefront by looking at the social context display with its emphasis on the group in design and sharing is that performance is not just by individuals, but many times also by teams. This aspect of performance has been largely ignored in previous discussions of performance in computer-mediated interactions but appears to be salient in our studies. Discussions of performance in previous literature almost exclusively focus on individual performance. Either it is about videos selectively shared to express one's national identities [Mark and Semaan 2009], a music collection managed to match one's identity [Voida et al. 2005], or a personal profile edited to foster a desirable impression [Hancock et al. 2007], the primary focus is on how individuals manage their faces and identities in the digital space. The same critique also applies to the related work discussed earlier, except for the idea of social proxies, which do place an emphasis on "group" interactions [Erickson and Kellogg 2004].

Our studies helped to reveal that performance is not merely by individuals but also by teams. Team members coordinate and collaborate with each other to create a collective front and a coherent team performance. In the conference call proxy, the call leader ensured team performance through appropriate monitoring and coordination. The coherence of the call was also ensured by individuals who did not just manage their own behaviors accountable but also monitored the proxy and assigned identities to the guests. Our informants pointed out themselves that Nomatic*Viz, in contrast to Facebook, or IM, supported crafting an identity for the *group*, and not as much for individual dyadic relationships.

A couple of design decisions contributed to the prominence of collective performance in these projects. First, both social context displays were designed to have a third-person perspective that included the viewer in the display; this helped foreground the group. Second, information was aggregated or anonymized such as in Nomatic*Viz, which further mitigated the sense of individuality.

4.3 Hybrid Regions for Performance

There are some common concerns associated with the involvement of information technologies in mediating people's interactions in general; two were most prominent in our studies.

The first is that technologies will destroy the context for interactions. In Goffman's framework, context plays important roles in performance. People will monitor and assess the conditions of the environment where they are presenting themselves, usually with little conscious effort, and determine what is appropriate in the particular setting. When technologies are involved, however, it is commonly viewed as making performance problematic since they can lead to the "erosion of situated action" [Grudin 2001]. However, the success of our prototypes working as providing relevant social context shows that technologies do not just undermine and disrupt the context, but many times, they are also able to bring in new and richer contextual information that might be unavailable in face-to-face settings. The conference call proxy is a very representative case. We found our participants had developed routines to gain contextual information from the display: they monitor the display to find an appropriate time to join, bring up others' directory information to obtain an appropriate perspective of each other, adopt backchannels to keep team members on the same page and use others' pictures and names as visual aids for recalling and remembering strangers. In all of these cases, people were able to obtain enhanced contextually relevant information about the meeting and about each other.

The second is that some rich expressive channels will be lost when interactions become computer mediated. In face-to-face meetings, people utilize a range of non-verbal cues to communicate with each other. Our bodies, facial expressions, and tones all convey subtle yet vital cues to complement verbal words. At the same time, through experience and our mental model, we all know

how to read those nuanced cues to help us to understand each other. However, when communications are mediated by technologies, it seems that much of the expressive signals that are vital in face-to-face meetings are lost and it becomes difficult for people to effectively communicate with each other through technologies. Yet, as revealed by this, and many other works, technologies do not just take away expressive channels, but can also in many ways enhance and provide new means for expressions and interpretations. In the case of the conference call proxy, people are able to engage in both front and back channel communications simultaneously; in Nomatic*Viz, people can see what is going on within the community as a whole, not just individuals. Similarly, much empirical research of digital media also reveals how people leverage and control the digital media as new artifacts and means for self-presentations, and impression management become available [Hancock et al. 2007, Mark and Semaan 2009, Voida et al. 2005].

By reviewing the two popular views of how technologies are affecting performance in the digitally mediated world, and how our studies seem to suggest the opposite, we are not arguing for one way or the other to account for the effects of information technologies. Obviously, it is more complex, and any articulation of its role as one way or another would be too limited. The role of information technologies can be multifaceted - while it may destroy one aspect of contextual information, it may be able to enhance some other aspects; while it takes away some of the communication resources, it can also provide new communication resources.

It appears to us that, the above two concerns of the role of information technologies in performance, although different, seem to be rooted on the same assumption - that is that the digital world is detached and separate from the physical world. Based on this assumption, the physical world is often taken as a gold standard which the digital world is compared to, properties of how the digital is different from the real are derived, and attempts are made to simulate and copy properties from the physical world to make the digital world as close as possible to the physical world [Coldefy and Louis-dit Picard 2007, Tang and Minneman 1991]. However, in a sense, with our projects, it wouldn't be sensible to talk about user experiences if the two social displays as seen as being detached from the *physical world*. For example, in the conference call proxy, without considering the

distributed and mobile nature of the organization as well as its organizational structures and cultures, it would be hard to understand why some of its features such as corporate directory information, people's pictures and names, and mute functions will become so important and why certain practices had merged. Without considering that the situated physical and social environment of Nomatic*Viz, it wouldn't be straightforward to understand why people choose to reveal some and obscure other status messages.

Resonant with Harrison and Dourish's notion of "a hybrid space" as a model of media space [Harrison and Dourish 1996], we call what a social context display helps to create as a "hybrid region" composed of both digital and physical elements. Dourish and Harrison observe that since in a media space, unlike those virtual environments that use virtual avatars, what is projected in the media space is a view of physical subjects and settings. In this sense, they term "hybrid space" is applied. It is a space that is comprised of both physical and virtual space. In our two projects, even though no video or audio is employed, and only graphical icons or at most photos are used, they still demonstrate the hybrid nature of a space, in that people's real identities, photos, organizational roles, location and status in the physical world are submitted and projected on the digital media. As a result, people's behavior is framed both by the associated technical features as well as the situated physical and social settings. People's scrutiny of their self-representations in the digital space is driven by by their physical world identities, and they adjust their performances so that their behavior appears appropriate and sensible with respect to the social and cultural environment. Just as revealed in previous studies, deception is much less common on social networking sites than on dating sites simply because social networking sites are usually associated with people that are already known from the non-digital world, so users tend to be more careful about not to presenting themselves falsely [Hancock et al. 2007]. In other words, the functions of the social context display such as encouraging more accountable and appropriate behavior are highly reliant on its connection with the physical environment.

Talking about whether digital space is separate or integrated, is not as important as the degree of how integrated these two realms are. This issue is relevant because one of the concerns with digital performance is how authentic or trustable the information is [Turkle 2011]. One line of research is using signaling

theory to assess the trust-ability of the digital self-presentation [Shami et al. 2009]. Based on our experiences, it suggests that how integrated the digital system is with the rest of the world influences how trustable the digital performance is. In particular, the more integrated, the more likely people will use the same representation of themselves that they do in the physical world. This doesn't imply that more authentic or more integrated is better, since overemphasis on authenticity might compromise the richness and the power of the digital world as an additional channel to express one's self - it might be different from the physical one, but nonetheless an integral part of self-making. It does point to the connection between integration and authenticity, and implication for design intervention to influence the trustability of the mediated world.

5. Claims and Conclusions

Through examining the use of two social context displays deployed in different settings, we have shown that they both provide a social context to inform actions and interactions, and that the people using them actively perform, manage and construct their presentations through them. While resonating with Goffman's performance perspective in face-to-face settings, performance through social context displays has its own characteristics. The situated social and physical settings are important in shaping the perception and use of the corresponding social context displays. More specifically, we wish to emphasize the consequences derived from our work.

First, social context displays are effective in providing social context to inform individual or group actions. It is most obviously demonstrated in the conference call proxy project, where people monitor the display to be aware of social circumstances to find an appropriate time to join, to take appropriate actions to manage the start of the meeting or to learn more about their audience to determine what to say as well as to ensure confidentiality of the call. Our data shows that the presence of a conference call proxy effectively provides contextually relevant information to ensure the coherence of audio conferencing.

Second, we suggest using a performance perspective to analyze and understand social context displays in use. The original motivation behind the social context display was to provide a means for members to be aware and learn

about what is going on in the social group life around them, which can inform their decisions and behavior. However, as uncovered by our studies, this is only part of story. Many of our observations were about how people manage and craft their presentations when their presence and activities are made visible *through* the display. By performance, we want to draw attention to these aspects of practice when people encounter the display. That is, people do not just observe the display but also perform through them.

Third, based on our studies, we found "performance" to be a valuable way to think about issues that have been casually given the gloss of "privacy". In particular, the distinction between "expression given" vs. "expression given-off" and the notion of "audience" in the Goffman's framework seem especially relevant. Examples from these cases suggest that, at least from a design perspective, we should be more careful when we are dealing with the information that is given-off (e.g., such as people's online posting or visiting behavioral patterns), not given (e.g., people's posts or messages). Also, from our own and others' experience, it appears that what causes concerns is not how complex the audience is, but when the audience is uncertain. This suggests that, for design, it is more important to make users aware of whom their audiences are, than to ask them to categorize their audience with different privacy preferences beforehand.

Fourth, what has been brought to the forefront by this work is that performance is not just done by individuals, but many times also by teams. This aspect of performance has been largely ignored in previous discussions but appears to be salient in our studies. We found the social context displays can foster more coherent group activities, or team performance. On the one hand, it enables directors or moderators of the group to monitor the social process of the collective activities and take effective actions to keep things on track. On the other hand, with the increased visibility of their presence and activities, it fosters more accountable behavior from individual members, who would self-suppress inappropriate behaviors and will tend to stay in line.

We also believe a couple of design decisions have contributed to the prominence of collective performance in these projects. First, the two social context displays were designed with a third-party view, not a self-centered view, which enhances the sense of groupness. Second, information on the social context

display, particularly the Nomatic*Viz display, is aggregated or anonymized, which further mitigates the sense of individuality.

Fifth, we stress that what the social context play helps to create is a hybrid region with both digital and physical components, rather than a new separate digital realm. Our two projects, even though no video or audio is employed, and only graphical icons or at most photos are used, demonstrate the hybrid nature of the space, in that people's real identities, photos, organizational roles, location and status in the physical world are submitted and projected on the digital media. As a result, people's behavior is framed both by the associated technical features as well as the situated physical and social settings. Furthermore, we think talking about whether digital space is separate or integrated is not as important as the degree of how integrated these two realms are, particularly as it is relevant to the issues of authenticity or trustability of online information. Our study suggests that how integrated the digital system is with the rest of the world influences how trustable the digital performance is. In particular, the more integrated, the more likely people will use the same representation of themselves that they do in the physical world. This points to possible design interventions for influencing the trustability of the digitally mediated world.

Finally, we propose that we need to verify and develop social context displays for collective practices in more varied settings for various purposes. As shown in our studies, although informing and performing are shared by both social context displays in our studies, obviously the value and the lessons of the two social context displays are very different and highly situated. For the conference call system, without understanding the distributed nature of the group and the high chance to meeting with "strangers", it would be hard to understand how the seemingly mundane information like pictures, names, and speaking are so valued by our informants. For Nomatic*Viz, if it were not a collocated group, it would be less likely that people would take bits and pieces of everyday routines such as being in office, calling for lunch, and attending a talk as informative. In the first case, the value of the contextual information lies in its compensation for the lack of physical context, and in the second case, the value lies exactly in that they can be associated with one's physical settings for interpretations and actions. So the specific value and role of social context displays can only be considered in relation to the setting where it is presented. Further, many studies of social

context displays, as with studies of other technologies, have been focused on western cultures, with relatively little attention placed on other cultures. Cross-cultural examination provides both opportunities and challenges to explore the issue of social context displays further.

Social context displays and their related work (including awareness, social navigation, social visualization, and social translucence) have occupied much discussion in HCI and CSCW, and Ubicomp. As sensors, displays and mobile technologies become increasingly pervasive, we believe more technologies making social traces visible will occupy the space we inhabit, and continually play important roles in enhancing collaboration and connections for distributed as well as collocated groups. Our traditional focus has been on how to automatically sense, reason about and display activity and other contextual information, and how to contextually enhance people's behavior, while at the same time providing enough controls for users to address privacy issues. However, as we can see from our data with the two social context displays, this perspective does not address the complexity of how these displays function in a social environment. Instead, we have seen that people engage with social context displays with contextual knowledge of the community and the space, and how people actively negotiate self- and group-presentations and maintain coherent fronts to multiple audiences simultaneously. Rather than considering a tradeoff between visibility and privacy, we argue that we should consider the regions that our social context displays help to create and how people perform to different audiences in the presence of the display.

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