Augmenting the Social Space of an Academic Conference

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ABSTRACT
Academic conferences provide a social space for people to present their work, learn about others' work, and interact informally with one another. However, opportunities for interaction are unevenly distributed among the attendees. We seek to extend these opportunities by allowing attendees to easily reveal something about their background and interests in different settings through the use of *proactive displays*: computer displays coupled with sensors that can sense and respond to the people nearby. We designed, implemented and deployed a suite of proactive display applications at a recent academic conference: *AutoSpeakerID* augmented formal conference paper sessions; *Ticket2Talk* augmented informal coffee breaks. A mixture of qualitative observation and survey response data are used to frame the impacts of these applications from both individual and group perspectives, highlighting the creation of new opportunities for both interaction and distraction. We end with a discussion of how these social space augmentations relate to the concepts of focus and nimbus as well as the problem of shared interaction models.

Categories and Subject Descriptors
H.5.3 Group and Organization Interfaces: Computer-supported Cooperative Work.

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Awareness, social spaces, proactive displays, evaluation.

1. INTRODUCTION
An academic conference provides a time and place for people with common interests to gather together for the pursuit of professional, personal and social goals. One of the appeals of a conference is that it creates a context to support *mutual revelation*: allowing attendees to learn more about others and their work, as well as being open to opportunities to tell others about themselves and their own work. Thus, many conferences offer a variety of sub-contexts for different kinds interactions, including formal presentations such as keynotes, papers and panels; informal presentations such as may occur around demonstrations or posters; and the more casual exchanges that typically take place during breaks and receptions.

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However, such opportunities for 'give and take' tend to be unevenly distributed among the conference attendees, depending on one's status in the community, level of participation in the formal conference program, and more subtle issues such as one's native language and level of extroversion. Conferences typically help facilitate interactions among attendees with simple augmentations, such as conference badges that list an attendee's name and affiliation and which may include other information or adornments, such as colored ribbons highlighting one's role in the conference or indicating a local chapter of the sponsoring organization of the conference. We believe that additional augmentations, appropriately designed, can create even greater opportunities for interactions, and spread them more broadly across the population.

One such augmentation is a *proactive display*: a large computer display outfitted with sensors that can detect people nearby and respond to them in contextually appropriate ways. We designed, developed, deployed and evaluated a suite of proactive display applications at a recent international conference. Our goals in deploying these applications, which will be described in more detail below, were to:

- Enhance the feeling that conference attendees participate in a common research community.
- Mesh with common social practices at the conference.
- Manage the privacy concerns of individuals who choose to participate and those who do not.

The primary focus of this paper is a qualitative evaluation of the proactive display applications deployed at the conference. Other research has also focused on technical augmentation of conference social spaces. Some systems seek to facilitate the one-on-one, person-finding social activities at a conference; others create visualizations based on aggregate data. Most of these efforts have been primarily technical explorations, with little in the way of systematic evaluation of the impact the technologies have had on people's experience of the conference. This work is differentiated from that prior work along two dimensions; (a) our applications address the individual to group relationship in a novel way and (b) we perform a detailed evaluation of the applications in the conference setting.

The results of our evaluation are used to reflect and extend our understanding of awareness in social settings that are not oriented toward traditional work tasks. These results are closely aligned with the first design goal of enhancing the feeling of community among the participants. However, our evaluation also resulted in some surprising findings. For example, the technology incorporates an interaction model that confuses some people, and it was used in unanticipated ways (what might be called 'gaming' behaviors) that is reflected in both positive comments about the

resulting atmosphere, and some negative attribution about the system not working correctly.

The remainder of the paper describes the deployment and evaluation of two proactive display applications at an academic conference. The overall design approach is described, including some details of each application. We highlight the physical and social setting for each application. The evaluation methods are described in detail, including data collection and analysis. We detail the results of the evaluation and discuss the results relative to some established CSCW themes. First, we describe some related work.

2. PRIOR WORK

This research blends two streams of existing research in the augmentation of physical social spaces. One stream can be characterized as wearable or handheld technologies that attempt to facilitate interactions between people, between people and computers or between people and artifacts; the other focuses on the use of large displays in shared contexts.

Researchers using wearable or handheld technologies to augment physical social spaces have relied on a mix of technologies. The wearable approach has included a range of infrared (IR) and radio frequency (RF) devices that can be worn like a conference badge. Meme Tags [3] are small badges with LED displays that are intended to facilitate one-to-one interactions by showing information relating wearer to viewer. Meme Tags collect aggregate information that participants can view, but they were not designed to facilitate small-group interaction. Intellibadge [7] is used for tracking people throughout a conference. Large displays show aggregate information about all conference attendees. While the aggregate data, based on extensive system logs, is well-reported, there is relatively little documentation of any evaluation regarding the impact of the system on participants' conference experiences.

Other researchers have used handheld computers or personal digital assistants (PDAs) as a basis for augmenting the physical social space. One common advantage of the PDA approach is that it provides a larger, personal display when compared to badge type devices. The SpotMe Conference Navigator (http://www.spotme.ch), is a conference matchmaker that runs on a PDA using RF to perform one-on-one profile matching. When another attendee with a similar profile is near, both users are notified. Unfortunately, there are no user studies yet reported on the use of these devices. PDAs were used by Sumi & Mase [18] to recommend face-to-face interactions and to recommend interesting things to see at a conference or laboratory open house. As with Intellibadge, the evaluations focused primarily on use of the system and system logs rather than the impact on users or the social space.

One notable example of an evaluation of social impacts was a system that used PDAs to encourage conversations among small groups during museum visits [20]. The evaluation of this system [10] focused on user dyads (pairs) sharing a single device. The study noted the amount and type of one-on-one interaction that was promoted by the device as well as how it changed the users' interaction with others in the same physical space.

The applications that were designed and deployed in our field trial are different from these prior systems in important ways. The prior systems all focus on either dyadic relationships (and on one-on-one interactions) or aggregate features of the conference attendees. While we also sought to facilitate one-to-one interactions, we wanted to support a broader range of interactions, such as one-to-many and many-to-many interactions, common in a conference setting.

Another way to augment social spaces, rather than using handheld or wearable devices, is to use large, interactive displays situated in public or semi-public areas. Opinionizer [5] uses a large display to which people at a party can post opinions via a nearby keyboard. Observations and interviews from two deployments revealed the importance of carefully situating the displays and making interactions as lightweight as possible in order to entice people to approach and interact with the display. PlasmaPlace [6] uses a large display to show conference-related content and to allow conference attendees to navigate through an online community site using a trackball or touch-screen. Experiments with the appearance of the display yielded several insights we have adopted, such as the attractiveness of portrait-mode orientation and the importance of selecting an appropriate pace for changing the display content. Another variation on shared displays is AgentSalon [18], which uses a display to show interactions among animated characters representing nearby users. The characters act as proxies for their users, exchanging bits of user profile to discover shared interests.

All of these other shared display applications are *interactive*: they require direct, explicit manipulation at or near the display, which may limit people's willingness to step up and participate. Our *proactive* display applications are designed to respond to people nearby, based on the detection of radio-frequency identification (RFID) tags that can be placed in people's conference badges, without any need for them to explicitly interact directly with the displays or other devices connected to the displays. We believe that this proactive model may encourage broader participation in certain contexts; for example, having a picture appear on a large display simply because one happens to be near the display may be more socially acceptable than having to explicitly post or retrieve a picture on that display (in real-time) if the people near the display don't already know each other fairly well.

Some display applications are beginning to augment the physical space in a more proactive way; by recognizing and responding to individuals who enter or leave the physical space. GroupCast [13] identifies individuals based on IR personnel badges and selects content to display based on user profiles. Villar, et al., [19] also created a system that enables displays to respond to people nearby, but using wearable *pendles*: small wireless devices that can store information and detect gestures. Both of these systems were deployed in rather restricted contexts: lab environments where people already knew each other fairly well. Furthermore, evaluation has been largely anecdotal. Our deployment involved a much larger number of people than most of the previous work, and we report on a more systematic evaluation of the deployment.

3. DESIGN: SYSTEMS AND SETTINGS

Our proactive display applications were intended to facilitate one-to-many and many-to-many interactions, in addition to one-to-one interactions, among conference attendees. Because of our goal of meshing with common social practices at a conference, the physical and social settings were carefully considered in the design of these applications.

There is an on-going discussion of *context* in CSCW and ubiquitous computing [9]. In the practical sense of deploying a technology to enhance the conference experience, we take the context to be the social interactions that happen in a specific physical location at a conference. Different physical settings of a conference create rather distinct affordances. Interactions will have a different character based on who and how many people are in the physical setting, and what sort of task is scheduled for that setting. For example, a conference paper session affords different social behaviors from that of a coffee break.

Although the applications were designed for different settings, they share a common infrastructure. The hardware infrastructure includes computer servers with network connections to client machines. The client machines manage large displays (either projection or plasma displays) and handle input from RFID tag readers. The content for the machines comes from a database of profiles that conference attendees create, which includes information such as name, email address, affiliation, photo and various representations of interests. Each profile can then be associated with an RFID tag worn by the attendee, unobtrusively inserted into his or her conference badge.

The applications deployed at the conference that we focus on in this paper are AutoSpeakerID and Ticket2Talk. In the following descriptions of the applications, the physical settings, and the kinds of interactions they may naturally and beneficially support, were the specific focus of our design.

3.1 AutoSpeakerID

AutoSpeakerID (ASID) is an application that displays the name, affiliation and photo (if provided) of a person from the audience asking a question during the question and answer (Q&A) period following a paper or panel presentation. A common practice at many conferences is for a person asking a question to state his or her name and organizational affiliation before asking a question. This helps the speaker and audience better understand the context of the question and facilitates future follow-ups by speaker or audience with the questioner.

A diligent session chair may remind a questioner to state his or her name and affiliation, but this is not always done. Even in cases where this norm is enforced, questioners' names or affiliations may not be heard clearly by the audience, or may be difficult to spell (for those taking notes). This is especially true when the questioner is hurrying to ask the question. The problem can be further exacerbated when the questioner's native language differs from that of a majority of the audience.

ASID is designed to visually augment the common practice of verbally stating name and affiliation. The microphone stand is augmented with an RFID antenna so that when a questioner approaches a microphone to ask a question, if he or she is wearing an RFID tag in their badge, a large display off to the side of the room shows the name, affiliation and a photo from that person's profile. Figure 1a shows a screenshot from the application and Figure 1b shows ASID with questioners lined up at the microphone and the ASID display behind them (one of the larger, main screens used for presentations is to the right in the photo). The questioner's information is shown on the top half of the screen in order to increase visibility from across the room.

Figure 1. AutoSpeakerID (a) screenshot (b) in a session

Without carefully considering the community norms, individual goals, and physical setting, a proactive display like ASID could be detrimental to the conduct of a conference session. ASID should not detract significantly from the session's content and intellectual exchange, the primary focus of attention in such a session. People should be allowed to present themselves as they see fit, e.g., choosing the form of their name and affiliation that they wish to use in this setting. Furthermore, a questioner should be able to opt out (i.e., a conference attendee might not want to have the proactive display show their name, affiliation or photo).

These issues were among several that were specifically considered during the design, implementation and deployment of ASID. The ASID display was specifically smaller than the main presentation screens, and was positioned to the side of the general session space. There were no technical controls over the information that users could enter into the profile database.[1] Finally, people could opt out simply by simply not wearing their RFID tag when they asked a question.

3.2 Ticket2Talk

The second proactive display application designed and deployed at the conference is *Ticket2Talk* (T2T), which displays an image and caption representing a user's interest when that user is near the display. T2T is designed for a more informal setting within the conference: a coffee break area. T2T and ASID share a common theme, they are designed to explore the one-to-many relationship building that fits in several conference settings, although T2T was typically not simultaneously viewed by as many people as ASID.

The notion of a 'ticket to talk' [16] was important to the design of this application. In these settings, the visual ticket should be a representation of a topic about which a participant would be happy to talk with anyone while at the conference. The profile database includes two fields used by this application: a URL for an image and a caption for that image. A ticket to talk could represent a professional interest (e.g., a research project or the cover of a recently published book), or a personal interest (e.g., a picture of a favorite pet, vacation spot or musical instrument).

Figure 2a shows a screenshot of T2T. The image is displayed center screen, with the picture, name and affiliation of the participant whose ticket it is at the top. An individual's ticket is only on the display for five seconds at a time. A portion of the screen near the bottom shows a collection of thumbnail pictures and names of other people whose RFID tags have been detected near the display. The thumbnails represent a queue of people who

[1] We did implement a 'kill switch' so that a person monitoring the ASID client machine could blank the screen if obscene or offensive content was shown.

will soon have their tickets to talk shown on the display. Arrows appear on either end of the queue when there are more people detected in the area than can be shown in the list of thumbnails. When an RFID tag in the queue is not seen for 60 seconds, the tag and associated profile is removed from the queue.

At the conference, T2T was deployed behind a table used to serve coffee and snacks during conference breaks. Figure 2b shows a picture taken from behind the display, highlighting one RFID antenna and the back of the display. The people in Figure 2b are queued up to get coffee. The sequencing of tickets shown on the display was designed to reflect the serial nature of how attendees move through a line to get coffee. Naturally, this is not a perfect match as people will sometimes jump in and out of line to quickly grab coffee or tea. But for a person who progresses through the line, the displayed tickets provide an opportunity to learn about others nearby.

Figure 2. Ticket2Talk (a) screenshot and (b) setting (from behind).

T2T was designed to provide opportunities to initiate conversation. However, we do not assume that every participant will always want to initiate new conversations at the moment they are near the proactive display. Thus, the application should ensure *plausible ignorability*. That is, no one should feel compelled to initiate conversation with another attendee who just happens to be nearby. Situating the display on the periphery allows a person moving through the line to simply notice the stream of tickets, without acting on any particular one. The tickets on the display can contribute to increased awareness of other attendees; both their identities and something of their interests. This information may be used at some later time to initiate an interaction (e.g., at a demonstration or poster session, or the conference reception).

4. DATA COLLECTION & ANALYSIS

We deployed the proactive display systems at The Fifth International Conference on Ubiquitous Computing (UbiComp 2003), a single-track academic conference held in Seattle in October 2003, which was attended by approximately 500 people. Pre-registered attendees were contacted in email to inform them how to participate and to allow them to create a profile. Attendees could create profiles through the web prior to the conference or on-site. Conference registrants were not automatically included in the profile database.

In order to respect the privacy and choices of individual attendees, they needed to take three explicit steps, and opt-in at each step. First, an attendee needed to create a proactive display database profile. At any point, an attendee could edit or delete information relevant to each of the proactive display applications. Second, at the conference, the attendee had to get an RFID tag and activate it (associate it with their database profile) at one of the two activation kiosks available on-site. Finally, an attendee needed to actually wear the activated RFID tag, which fit conveniently inside a conference name badge sleeve. If an attendee threw the RFID tag away or left their conference badge somewhere (say at their seat), they would not be detected by a proactive display.

The applications and activation kiosks were deployed for most of the conference, beginning with the demonstration session the first afternoon and ending with the closing session on the third day. Most profile creation and RFID tag activation took place during the first two days, with enrollment activity trailing off on the last day of the conference. During the three day period, about 40% (201) of conference attendees became active participants (i.e., they took the time to create a profile and activate a tag).

The data collection and analysis regarding the impact of the displays on the conference attendees relied on standard qualitative methods. Data was collected through systematic observation, short informal interviews, and a follow-up web-based survey of conference attendees. The survey included a mixture of objective, multiple choice and open-ended questions. The observational methods for data collection were tested during a prototype deployment of ASID and T2T at an internal open house three months prior to the conference deployment.

The qualitative data (observations, informal interviews, and free response data from the web survey) was coded using open coding methods [17]. Three coders participated in the coding activity. Naturally, different coders see different things in the data; when differences arose, they discussed the data until some agreement was reached. In some cases, this was resolved with a new code, in other cases the data was coded into more than one category. The results were then compared to the original design goals.

The majority of the following analysis is oriented around the qualitative results. But first we provide a brief discussion of the quantitative survey results. Of the 500 conference attendees, 94 responded to the web survey (a 19% response rate). A majority of the respondents (68%) reported active participation in the field trial by creating a profile and wearing an RFID tag during the conference. Thus, survey respondents were biased toward participation in the field trial relative to the level of participation by the overall conference population. A majority of respondents (63%) attended the conference for the first-time. First timers strongly indicated that the proactive displays were more likely to help them learn something new about another attendee or interact with someone they didn't already know.

For each display application, the survey specifically asked if the respondent felt the application had a positive or negative impact on the conference. Table 1 shows the response rates. In general, participants felt the applications had a positive impact.

Table 1. Number of respondents assessing the impact of each application as positive or negative.

Proactive Display Application	*Positive Impact*	*Negative Impact*
AutoSpeakerID	71 (77%)	10 (11%)
Ticket2Talk	39 (41%)	3 (3%)

The following sections present our results structured in relation to the initial design goals. We present evidence for each design goal, and assess whether each was achieved, and if so, how. In some cases, the evidence supports meeting a design goal, in other cases, the data suggests that the results were mixed.

4.1 Enhancing the Feeling of Community

One design goal for the proactive display applications was to enhance the feeling of community among the conference attendees. A greater sense of the identities, perspectives and interests of other conference attendees, gained either through direct interactions or through more peripheral means, would provide evidence that an application is meeting this design goal.

4.1.1 AutoSpeakerID

Enhancing community is more than simply knowing other people's names or affiliations. It means having a broader understanding about people's background or activities. The most obvious aspect of AutoSpeakerID is that it presents a name, affiliation and photo. ASID generated a number of comments in our web-based survey pointing out how the application fills in for what is missing.

> I liked AutoSpeakerID because I could easily know who was speaking and their affiliation.
>
> It was very nice to see people's names an[d] affiliations when they asked questions. I wrote some of them down and contacted them later.
>
> I often missed some part of a person's verbal introduction so the display was useful in helping me close the loop.

However, a larger number of comments address the broader issue of making sense of what is going on in the space of a paper session or panel session.

> It gave me a better idea of who was asking the question.
>
> I was able to know what kind of people attended the conference.
>
> It was nice to be able to see who was speaking to put their question in context if I didn't hear or forgot the person's introduction.

These three comments represent an understanding that is categorically different from simply knowing a person's name and affiliation. They show that individuals who are in the audience frame their understanding in the context of what they hear (or don't hear). The ASID application helped them see what was unheard, reestablishing the framing for questions or comments.

4.1.2 Ticket2Talk

Enhancing community can be about increasing opportunities for interaction, the overall number of interactions, or the quality of the interactions. In analyzing what occurred around T2T we first turn to our observational data. But observational data presents a dilemma.

The problem here for observational data is recognizing the difference between a simple social acknowledgment, the kind that helps people navigate in a physically crowded space, versus that which is in some way a result of the proactive display application. The key here is not simply observing the individuals' acknowledgment of each other, but that they also acknowledge what is showing (or was recently shown) on the display. Naturally, this is not perfect, but it is the closest we can get to knowing that the application may have influenced one or more of the parties in the acknowledgement. In the observations of T2T recorded by people on our deployment team, there are many occurrences of this dual acknowledgement.

> *Two people were getting food at opposite ends of the table. One of the two looked at the display, and upon recognizing the person in the display turned to the other and greeted him. ...*

In this first observation, one of the parties looks at the display and then recognizes that the person on the display is nearby. There is then an active acknowledgment through a greeting and verbal exchange. There are other observations with a similar flavor.

> *... One man looks down at tag, looks at display, and back again. No introductions, but lots of smiles.*
>
> *Three people, not together. They all notice the picture come up on the display. Everyone smiles and nods.*
>
> *... One person stops and laughs out loud when the picture comes up on the display. Everyone chuckles and smiles, even the ones in the back row. No introductions.*

These are not isolated observations. These observations demonstrate the dual acknowledgment that begins to frame the impact of the application. Individuals whose tickets were on the display were more likely to be recognized by others who were standing close by.

A number of explicit comments mention how T2T resulted in interaction or conversations. Respondents generally have difficulty recalling specific, casual, incidents like these. Thus, the comments made by some survey respondents indicate events that were quite significant to them.

> [I] managed to [meet] in person somebody who I knew by email contact but have never met before. I happened to be in front of the coffee desk when his name flashed on the screen. This was really cool.
>
> I was chatting with someone I didn't know personally (small talk) about a recent presentation when I noticed his profile on the Ticket 2 Talk display and realized he was affiliated with an organization I really admire and would like to collaborate with ... Noticing this allowed me to redirect the conversation to that topic!

As with ASID, there were some comments about the functional qualities of the application; the way it allows an observer to put a name to a face, even when there is no interaction.

> I thought that ticket2talk was a very useful display because it helped me put names to faces just by hanging around the area.

While few people felt that the applications had negative impact, there were some comments that represent the trade-offs of augmenting a social space. As might be expected with a group of

this size, what some attendees like, others do not. One respondent commented:

> [I] did not like automatic display of my information at coffee area because it was like a "loud" announcement that I was there...

The design and the physical deployment recognized the possibility that all people might not want to be "announced" in a room. So, while T2T was physically near one of the coffee and snack stations, there were two other coffee and snack stations that did not have a T2T proactive display nearby; and, as mentioned before, people could opt out via a variety of mechanisms.

4.2 Mesh with Established Practices

The problem of meshing with established practices involves deciding *which* or *whose* practices to attend to. Not every conference has the same practices and norms, and not every attendee adheres to those practices. Thus the applications we designed address a relatively narrow range of established practices both within the target conference community and within each of the specific settings in which they were deployed. Furthermore, deploying any technology in a field trial is not neutral: there will be some impact on the users in the setting. One challenge is to understand the significance of the changes; another is to differentiate how much of the impact of the applications is attributable to the novelty of the technological intervention and how much is the result of the design goals.

4.2.1 AutoSpeakerID

AutoSpeakerID was designed to provide visual information to the audience, augmenting the oral introductions given by question askers at the end of a paper session. The ASID display was smaller than the main screen and situated near the front on the left side of the general session room. We implemented a fade in/out feature to reduce the flash of a new image on the display. A kill switch could immediately blank the screen in case of an obscene or offensive image, but it was never used. In a prior section we covered some data describing community-enhancing aspects of ASID. Our data here suggests that ASID changed aspects of the general session both for people who asked questions and for the audience.

Prior studies of technologies for augmenting conferences rarely identify unanticipated uses of the technology (see boyd [4] for a description of unanticipated uses of other technologies). In our case, attendees were not prevented from creating fake identifications or otherwise subverting the system. There was a small number of people who created wholly fake identifications (e.g., a "Bill Gates" profile), provided partially false data (e.g., "University of Tigger"), and on one occasion physically switched a person's RFID tag. Surprisingly, the feedback on the impact of such gaming of the system was mostly positive, with many people indicating they enjoyed the fun of these profiles. For example:

> It was great to see people having fun with it entering comical names or affiliations. It lightened the feel of the paper sessions.

> I thought it made the q/a sessions a little more fun. The best parts were when the setup made errors. It provided for some comic relief.

While many comments point to the fun and interesting aspects of gaming, it would certainly be problematic if taken to an extreme. From the perspective of some respondents, the gaming distracted from the quality of the intellectual exchange. In the following comment the person questions the motives of the person asking a question.

> Some question askers seemed to be asking questions just to demonstrate their manipulation of the RFID system. So when "Bill Gates" asked a question I wondered whether he really cared about the answer or just wanted to make a public display.

Gaming was actually not very prevalent. Through observation, we know of only three individuals who asked questions while some amount of inaccurate information from their profiles was on display. However, each of those individuals did ask a question on more than one occasion. In several of these gaming instances, laughter erupted among the audience, which caused slight pauses in the Q&A session. Interestingly, the audience laughed less in successive instances.

Another impact we observed was the audience turning their collective heads toward the ASID display, to the left of the general session room, instead of focusing on the speakers at center stage. A few comments indicate that the ASID was distracting to audience members.

> Somewhat distracting as it required visual attention.

> As an audience member I felt that it distracted from the actual process of asking and answering questions. Each question began with a "will it or won't it" moment as everyone watched the screen to see whether the system would work.

> I tended to watch what it was doing than really listening to the question.

In some cases, questioners altered their normal question-asking behavior. Some fiddled with their badges, paused for their profile to appear on the ASID display, commented on whether or not they were wearing an RFID tag, or stopped offering an oral introduction altogether. Although there were only a small number of examples of each of these behaviors, they created a particularly strong impact on a few of the respondents.

> It seemed distracting - in the sessions I was in it seemed that virtually every person who approached the microphone began by commenting on the speaker ID (e.g. "oh it's working, yes that's me" or "it's not working for some reason").

> Honestly I found the speaker-id a distraction. Every person that walked up to the mike seemed compelled to either pause while they looked at their description or mumble something about not having gotten a tag yet.

It is problematic to assess how well ASID meshes with existing practice. In normal Q&A sessions there are no opportunities for the type of visual gaming we observed, though some oral humor on the part of a questioner is not unusual. As noted earlier, only a small number of individuals actually manipulated the system

explicitly. But the augmentation of practice generated a large number of comments related to how it changed the feeling of the session. It is also clear that the system led to some distraction which was not viewed positively.

If a system like ASID is designed to augment current practices, then a questioner should probably continue to be encouraged to orally state name and affiliation when asking a question. As some participants became more comfortable with the ASID, they stopped offering any verbal introduction, relying instead on the visual introduction afforded by ASID, transforming the role of ASID from augmenting existing practice to creating a new one.

4.2.2 Ticket2Talk

The Ticket2Talk proactive display was situated in a coffee break area, behind a table with a coffee urn and other refreshments. Casual conversations among people moving through the line are common at conferences. T2T was designed to augment this practice by providing visual content that might help initiate more conversations. We hoped to promote casual conversation without distracting participants from the refreshments available during breaks or violating social norms. In a previous section we presented data describing how T2T fostered interaction. However, as with ASID, we also observed instances of new and different practices around T2T.

A few attendees may have had difficulty understanding the interaction model of the proactive display. Some participants expected an immediate response when they approached; when their profile did not appear in the central display area or lower queue, they resorted to waving their badges or pacing back and forth to get the attention of the proactive display. Consider the following observations recorded by people on our deployment team:

> *People walk up with a big smile. Look at the person standing next to them and again at the display. Is that you?!? One is waving RFID tag in front of reader. Pick me up!*
>
> *Two people at the table, one person walks up to reader and back. They are moving back and forth trying to get picked up by the reader.*
>
> *Again with trying to get picked up by the reader. It's very important that my picture shows up. It was something that we are experiencing together and everyone's picture (from known group) should appear.*

In the T2T application, when a participant's profile did not instantly appear, some reacted with non-standard conference behavior, e.g., badge waving or pacing back and forth in front of the display. This behavior is reminiscent of reactions to other technologies, e.g., pressing the "close door" button in an elevator multiple times or shaking a computer mouse trying to urge the computer to react. In groupware applications like T2T, mediating shared interaction and shared control present a significant challenge for both users and designers.

On the other end of the spectrum, a few of the attendees were so engrossed by the display that they appeared to take no notice of the other people around them. The following three observations describe the behavior in more detail.

> *Many were transfixed and literally stopped all movement while watching. This can be more distracting than conducive to social interaction.*
>
> *People tended to watch the display like a TV.*
>
> *I saw at least 5 people taking photos of the display, with their pictures on it. They appeared excited to see themselves.*

Staring at people is usually considered socially unacceptable behavior, however staring at people's digital representations of themselves, via their tickets to talk, seemed acceptable to at least some of the attendees. While not part of established practices in this conference, and in some cases in conflict with the goal of promoting face-to-face interactions, this behavior may still have resulted in greater awareness on the part of those who were transfixed by the T2T display.

4.3 Managing Privacy Concerns

Respecting privacy, as a design goal, while still offering opportunities for revelation, is a challenging combination. On-line privacy is a complex problem that the research community is only beginning to resolve in small ways [14]. Proactive display applications need to manage privacy in three domains; the on-line, the face-to-face, and the bridge between. For example, in the on-line space the profile information needs to be controlled and managed in a way that shows respect for individual choice. In face-to-face, the system needs to support the choices individuals would make in a public setting, like avoidance. And, in the bridge between them, when a profile is displayed on a screen, individuals should be able to plausibly ignore the screen or other individuals around them. In the data, comments fall on both sides of the issue.

To respect the privacy of attendees, the system specifically required several 'opt-in' steps. One of those was that an attendee needed to explicitly create a profile. We could have automatically migrated some of the data from the ubicomp.org community website (modeled after CHIPlace and CSCWPlace [6]) or the conference registration database into our database, saving the users a few steps. The profile creation 'opt-in' did allow a user who had a community profile to populate up to five fields from their community profile, but other fields had to be entered by hand. If a user did not have a profile on the community site, then all eight fields in the form had to be filled in manually. We received several comments on this approach:

> `... Would have been nice if it could have been pulled automatically from my registration.`
>
> `... Probably would have [used it] if it were part of registration ...`
>
> `I wish that in future conferences when someone signs up they automatically have an ID tag in their badge when the register ... and then they can chose to add pictures and interest when they want otherwise the system would just show their name and affiliation.`
>
> `... it might had been nice that [the research] community directory information was downloaded automatically.`

In the face-to-face dimension other decisions were made to help manage privacy. The profile information from our database was only made available on the proactive displays, and only when the person with whom the information is associated was in the vicinity. It is certainly possible to make this information accessible in other places or at other times, e.g., through a web page. By restricting the presentation of the information in the physical space of the conference, privacy norms that are similar to those in face-to-face situations can be established. Again, comments from attendees fall on both sides of this issue. Some wanted more access to the information on the displays while others wanted the technology to support different activities.

> It would be helpful to be able find people's current locations with the help of displays.

> ... follow-up was frustrating. [T]he apps were useful in helping you identify people you might be interested in meeting BUT there was no subsequent way to make those people aware of your interest and hence no good way to rendezvous.

These respondents are looking at specific problems which they have in a conference and providing design suggestions for applications that may help solve these problems, but may not fit within the scope of what is possible with proactive displays. Finding another's location or receiving messages to make arrangements for a rendezvous both raise the specter of digital stalking made real in the face-to-face world. The challenge is finding the right balance for managing privacy across the on-line, face-to-face and bridging spaces. Similar technologies (mentioned in prior work) that have been used in conferences have not always dealt well with privacy issues. Our evaluation shows that, despite our careful attempts there are still concerns when any kind of personal information is used.

> ... At Interact I participated in a similar project which used handhelds to facilitate networking. I am a female researcher so I was a bit unnerved that [a] male conference attendee sent me a message at midnight ...

> I didn't want all this information to be available to everyone - would rather have more control over who gets to see what ... and might want to highlight interests differently to different people.

Both of these comments illustrate concerns about how information (and a technology) is used when the owner is not present and when the owner is present. The first comment is not about our application; but the second comment is. In both comments, the person is expressing a desire for control over how personal information bridges the on-line and face-to-face world.

The number and range of comments about privacy issues was remarkably small. The presentation here might seem to make privacy a bigger issue than that which was expressed in the data. The relatively low number of comments may indicate that the applications achieved a reasonably appropriate balance with respect to managing the privacy of the conference attendees.

However, it is possible that our attempts to manage privacy were overly cautious. Our three step 'opt-in' approach required more effort for people to participate than an opt-out or less conservative strategy. As a result, some participants specifically mentioned that they did not participate because of the effort threshold. But on the positive side, the policy resulted in very few complaints being registered about privacy before, during or after the conference. If absence of complaints can be used as a measure, then by that measure the design succeeded.

5. DISCUSSION

These results inform design in a collaborative space that has not been well-studied: the academic conference. The approach of technologically augmenting the social space and observing the impact is a type of 'study ourselves' approach, but only to the degree to which one believes that a conference is somewhat homogeneous. The range of responses suggests that conferences are more diverse and that individuals come to a conference with different ideas about their specific participation. Given the broad design goals (enhancing community, meshing with established practice, and managing privacy) perhaps it's not surprising that the results are somewhat mixed. But this is perhaps indicative of the diversity within even a single conference community.

The primary impacts reported here are interesting for a number of reasons. Most reports on prior work have not thoroughly considered how augmenting the social space of a conference changes the dynamics in the conference, with respect to both incentives and disincentives to participate. Our results take those issues seriously and make some of the possible design considerations clear. Additionally, these results build on the notion of 'communityware' [18] and the bridge between on-line communities and real face-to-face interaction [6]. Our findings begin to show how communityware can change the way we interact in an augmented social space. Some of those changes look to be positive, while others are not.

As we mentioned, the deployment and evaluation of technology like ASID and T2T is never neutral. The deployment will have some impact on the participants in the physical social setting, and some of the results of may be realized over a period of time extending beyond the conference. Designers hope to make positive impacts, but those impacts are negotiated between the individuals and the technology, between the group and the technology, and between the individuals who compose the group. In the case of these applications we observed modification to existing practices as well as some new practices.

Still, there are other ways to frame the results that may better help inform the intellectual development of CSCW. In particular, these results inform the on-going discussion of awareness and begin to push on our models of interaction and shared control.

5.1 Awareness in Social Settings

An academic conference represents a different type of 'work' than that which is commonly studied in CSCW. The work of an academic conference is in large part about finding, initiating, and sustaining interactions. Some would argue that conference work is about the intellectual topic of the conference, and to a degree that is true. But the topic serves to draw the participants and focus the interactions; the topic is a 'means' to the 'ends' of interesting exchanges.

This notion of work has little in common with that of a control room. But awareness is important to both situations. Rodden [15] extends the concept of nimbus and focus introduced by Benford and Fahlen [2] to general collaborative applications, presenting a model of awareness that can be used in system designs that do not carry a spatial metaphor. The more a person intersects with your *focus*, the more aware you will be of him or her; and the more a person intersects with your *nimbus*, the more he or she will be aware of you. Awareness can then be defined as a combination or overlap between one person's nimbus and another person's focus.

One way to interpret the data from this field trial is with respect to the way the applications augment or change individual and group nimbus and focus. Applications such as AutoSpeakerID and Ticket2Talk, deployed in semi-public spaces, effectively change a single participants' nimbus in a profound way. The participant is on the display briefly, but many more people are likely to catch a glimpse of who it is asking a question or standing near the coffee urn. Some people benefit from an expanded nimbus by being engaged in interesting conversation. However, others are less comfortable with the proposition; they do not want a "loud announcement" of their presence. But awareness is not just expanding one person's and then another person's nimbus.

The displays attract attention. Certainly, because of the nature of the field trial, and the novelty of the applications, our displays got more attention than if the technology was commonplace. There is always a delicate balance between peripherality and focused attention in the design of any proactive display application. If the display never attracts attention, it won't be useful and if it attracts too much attention, it won't be peripheral. In the case of the displays used in this field trial, the displays, and the participants' choices of information presented, serves to shift the focus of the audience. In a context like that of T2T, the shift in attention can be discounted much in the way individuals will scan a crowd while still involved in a small group conversation. However, in a context like ASID, the shifting focus can be a little more distracting. The combination of increasing one person's nimbus while attracting the focus of the group changes the awareness dynamics in the conference setting.

5.2 Shared Interaction

The results of our field trial relate to another groupware issue: the interaction model of a shared application. Researchers have been working on shared interaction in groupware for several years [8, 11, 12]. The solutions and design guidelines for groupware only partially apply to the problems of a proactive display. Work on sensing systems have identified similar problems [1]. But just identifying problems does not always lead to workable solutions.

Consider the problem of providing feedback to the user(s). In an application like ASID, the data reveals some confusion about how and whether the system is working. When a tag is read, and the participant has set up a profile, then their name, affiliation and photo is shown. However, in the case where there is no tag, and thus nothing for the RFID antenna to read, it is difficult to do something proactive. In this situation, the system does not know that an individual is at the microphone stand; but the audience clearly knows. Based on our data, some members of the audience made the attribution that the system is not working.

Some proposed solutions work for limited cases, but may not generalize well. In the case of ASID, one solution might be to add another type of sensor, e.g., a pressure sensor on the floor near the microphone stand, and perform sensor fusion to disambiguate the situations. The display could then at least note that the system recognizes when a person is at the microphone.

In the case of T2T, we saw badge waving behavior that suggests a need to visually acknowledge each and every badge read. Our design had a visible queue length of four people, which turned out to be too small in the setting of a coffee line in or near which more than four people linger for an extended period of time, as often occurred during breaks. Potential solutions include dedicating more screen real estate to representing thumbnail images and names of people whose badges have been detected, or using smaller images and fonts for the names. However, with limited screen real estate, and the need to show content at a resolution that is easily viewable (and ignorable) at a safe distance, a different representation of the queue may be required.

Lastly, some of the problems we observed with these applications relates to the expectations of an 'interaction society.' The usage model of a proactive display is novel and therefore unfamiliar to many. In our society we are usually faced with devices that require our explicit attention and foreground interaction; physical buttons must be pushed, icons must be clicked, door handles must be pulled. As we move to environments that sense and respond to us without our explicit attention or action, we will not always know how to react. The interaction model in applications that run on proactive displays will need to resolve the standing expectation that a display respond immediately to the user's presence. The assumption that the device responds to the individual is part of the everyday 'one user, one machine' interaction. Groupware and communityware situated in settings beyond the desktop environment break this expectation in ways that we are only beginning to appreciate.

6. CONCLUSION

We have presented the results of a recent technology deployment designed to augment the social space of a conference. The data we collected indicate some success in creating greater awareness and interaction opportunities within the conference community. However, they also show we were less successful in consistently meshing with the common practices at the conference. Indeed, we have begun to re-examine this design goal in light of our experience. Meshing with existing practices may not be a reasonable goal for a technological augmentation in a large group setting (i.e., for communityware). The variation of practices in physical social spaces within a large community or group may be too large to reasonably meet the design goal. Our conservative policies and processes to protect privacy were effective, but may have been overly cautious, as the suggestions for broadening the scope of when, where and how profile information was collected and disseminated outnumber any concerns voiced about privacy.

This field trial offers an opportunity for reflecting about how we can extend CSCW concepts originally developed for the online world into the physical world, and, perhaps most importantly, to the bridge between these worlds. As computing capabilities continue to migrate beyond the desktop and into new physical settings, it is increasingly important to consider how these capabilities can help – or hinder – activities and practices in these spaces.

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