Semi-Public Displays for Small, Co-located Groups

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ABSTRACT
The majority of systems using public displays to foster awareness have focused on providing information across remote locations or among people who are loosely connected and lack awareness of each other's activities or interests. We have, however, identified many potential benefits for an awareness system that displays information within a small, co-located group in which the members already possess some awareness of each other's activities. By using "Semi-Public Displays," public displays scoped for small groups, we can make certain types of information visible in the environment, promoting collaboration and providing lightweight information about group activity. Compared to designing for large, loosely connected groups, designing for Semi-Public Displays mitigates typically problematic issues in sustaining relevant content for the display and minimizing privacy concerns. We are using these applications to support and enhance the interactions and information that group members utilize to maintain awareness and collaborate.

Keywords
Peripheral displays, awareness, CSCW, community, information visualization, ubiquitous computing.

INTRODUCTION
Large-scale display technologies are becoming increasingly ubiquitous in work environments, but determining what content and interactions are most effective for them still remains a challenge. We are focusing on the application of public displays to small co-located group environments, specifically the academic lab setting. The members of a co-located lab are likely to be highly aware of each other's activities; even so, we have identified several benefits that public interactive displays can offer in a small group setting. By making certain types of relevant information persistent in the environment, these displays can provide information about group members, and foster coordination and collaboration. We have found them to be a potentially effective medium for making information from other channels persistent in the environment, thus making information easily available and reducing the need for group members to remember or retrieve it from overloaded channels, such as email.

Small group settings are often already equipped with the means to display information, such as projection displays, electronic whiteboards, or large monitors, but these tend to be used only in certain circumstances, such as during a meeting or a presentation. Our aim is to take advantage of these resources by using them as persistent sources of group information and shared workspace.

Several recent and current projects, including MessyBoard [5], The Notification Collage [7], and GroupCast [13] use large shared displays as a means of promoting awareness and facilitating information exchange in different types of groups and spaces. Public displays have typically been utilized to promote awareness among larger groups, but the information they convey, such as live video and presence information, tends to trigger known problems of privacy, information relevance, audience targeting, and information scoping because of group size [12]. Additionally, previous work has shown that it is difficult to identify types of content for public display applications that are useful to general audiences. We have observed that small workgroups, however, are likely to have common interests, and therefore lend themselves better to peripheral group displays for awareness. Information that is of interest and relevance to many or all members of the group is more readily identifiable, and the individual members are more likely to seek information about others in the group.

DESIGN SPACE
We have analyzed many of the existing and past projects that address awareness between people and have found that they can be meaningfully subdivided along two dimensions (fig. 1). First, awareness applications can be categorized by the type of audience they are intended to support. Applications have been built to facilitate awareness between pairs of people, as well as among groups of people. Applications that support groups typically target different types of groups such

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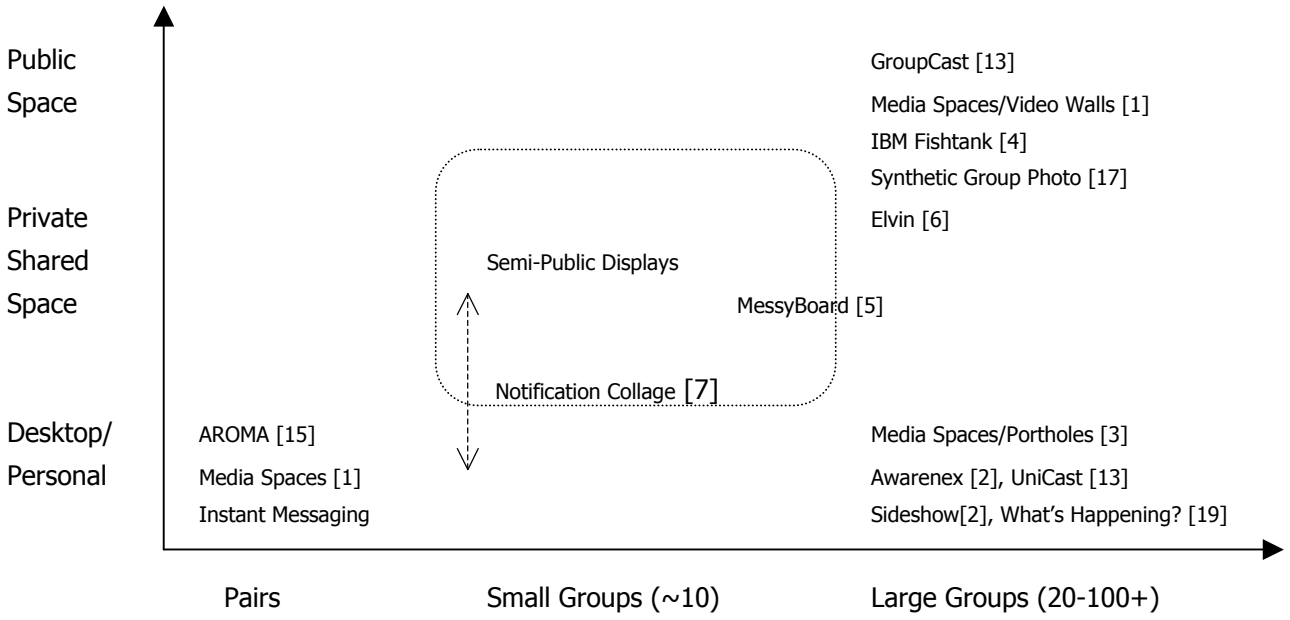

Fig. 1 An illustration of the current design space of awareness applications categorized by the group size they are designed to support and the type of space in which they are meant to be viewed. Our design addresses the largely unexplored space of shared public displays to support small, co-located groups, delineated by the box in the central.

as a workgroup of five people, or a company of a hundred. Applications typically are intended to support only one of these audiences—pairs, small groups, or large groups.

Additionally, we have examined the environments in which the applications are intended to be viewed and used. Applications typically reside on the desktop or other individually viewed display such as a PDA, within a shared private space such as an office or lab, or within a public space, such as the kitchen or lounge area of a building.

Looking at the space, we can see that much of the work on awareness applications falls into three areas: applications for pairs on desktop or individual displays, applications for large groups on desktop or individual displays, and applications for large groups in public spaces.

The success of these applications is primarily dependent on two issues: the ability of the application to provide *relevant content*, and the extent to which the application addresses *privacy* concerns.

Applications deployed in public spaces intended for supporting large groups that provide low levels of general awareness have been most effective. Displays that indicate the presence or absence of group members [4] or video walls that allow for opportunistic conversations [12] have been fairly successful in facilitating low-level awareness.

Applications intended for large groups that attempt to provide higher levels of awareness by providing more detailed information about individuals often face difficulties because of privacy concerns. It is difficult to make personal details available to large groups without impinging upon individuals' privacy. Because of the tradeoff between privacy and depth of awareness, the applications that have been most successful and useful for large groups have been those that provide less information. Another challenge for presenting detailed awareness information to large groups lies in the relevance of the information to its audience. Because it is unlikely that detailed information will be of general interest and relevance to all members of a large group, rather than a subset of that group, it is difficult to provide appropriate content for these systems. A further challenge is presented when such systems rely on the users to supply content explicitly. Because information an individual can provide about herself and her activities and interests is unlikely to be of interest to the large group in general, individuals tend not to be motivated to supply content, or else have difficulty identifying appropriate content. As a result, systems for promoting awareness in large groups that rely on user-submitted content tend to be uninformative because of a paucity of content, or because content is not of interest to much of its audience [13, 18].

Desktop displays of applications for large group awareness exacerbate privacy concerns because it is difficult to assess who is looking at what information and how often. In contrast, public displays that exist in a shared social space that bring with them shared social mores and mechanisms for preventing abuse. Moreover, desktop interfaces for pairwise connections have the opposite effect. The privacy garnered by the personal display supports the depth and details appropriate for disclosure by a pair of users.

Clearly, some unexplored areas of the space defined by these dimensions make less sense for design. For example, if the

intention of a system is to increase pairwise awareness between people, using a display in a public space is unlikely to be a good choice to support that goal. However, not all areas with potential for design have been explored in depth. We posit that the space of applications for small groups supported by displays in shared group space has been largely unexplored. Designing applications for this space is an important area of research for several reasons. First, detailed information about individuals is more likely to be of relevance to the group as a whole. It is easier to identify and present content that is going to be both informative and appropriate to its audience. Additionally, whereas the presentation of personal information to a large group may intrude upon an individual's privacy, such information may be more appropriate among a group of co-located co-workers, who are likely to share context and have more personal knowledge of each other. Finally, because the need for communication and collaboration within small groups is often greater than that of large, distributed groups, it may be more important for individuals in a small group to have access to information about their co-workers. The small group audience may benefit more from having access to awareness applications and their content than the larger groups for which most applications have been designed.

The shared public display setting also matches the privacy and collaboration needs of small groups. The use of the display can be integrated into the practices and social customs of the group. The shared space encourages collaboration, especially semi-ansychronous collaboration, without competing for valuable desktop real estate.

A few recent applications have addressed a design space similar to our area of focus. The Notification Collage is a shared collaborative display that uses a variety of media such as user-submitted images and sticky notes, and live video to create a digital bulletin board [7]. MessyBoard is an application that runs on a shared display to which users can engage in discussions and post information to help users remember context [5]. While both applications use large, shared displays within groups of co-located colleagues, they are also emphasize remote communication. Notification Collage provides live video to allow users to 'telecommute'; MessyBoard has been used to connect multiple small groups that are remotely located. This emphasis adds useful content and awareness information to the applications, and increases the spatial range of usage, but as a result gives these applications a different audience than the one that we are targeting with our work. Using the Semi-Public Displays, we aim to create a shared display awareness application that is not only an interface through which people can receive and share information, but one that takes advantage of group viewing and promotes interaction away from the display between co-located colleagues as well.

DESIGN MOTIVATIONS AND ISSUES

To explore the design of Semi-Public Displays, we designed a set of interactive applications for our lab, the Everyday Computing Lab (ECL). We use public peripheral displays in our academic lab environment because we believe they provide many benefits to our group by supporting asynchronous collaboration, opportunities for sharing targeted information, and visual representations of lab activity. Because the information in these displays is intended to support members of a small, co-located group within a confined physical space, and not general passersby, we call our system a "Semi-Public Display."

Based on observations of practices for maintaining awareness and collaborating, we identified potential content for the system, limitations of current methods for sharing this information, and then sought to adapt this content to be effective and appropriate on a large shared display. In exploring the current methods the lab members used to maintain awareness of each other, we found they used information distributed across several methods and tools. In designing the system, we also aimed to provide users with a display on which they could have easy access to this type of information all at once.

One tool we examined was emailed status reports, which lab members compose and send to the members of the group on a weekly basis. These reports contain information about people's current work status, their work plans for the coming week, and requests for assistance with specific tasks. We found this information to be useful and effective in helping members maintain awareness of each others' work, but also found that the group members would forget about the help requests after reading the emails. We therefore believed that this content would be made more useful if it were more easily accessible and visually persistent.

Additionally we found that people made use of information such as instant messenger status cues, and colleagues shared calendars to maintain awareness of each other's schedules and presence in the space. While the calendars are useful sources of high-fidelity information, they require effort on the part of others to check them, and many of the group members do not maintain a shared calendar. We also found that one of the major reasons group members were interested in their colleagues' schedules was because they used that information as a way of helping them determine what upcoming events might be of interest to them. While using an individual's calendar may be an effective way of assessing which events are of interest to that individual, gauging which events are of interest *to the group* using individual calendars is time-consuming and less effective. Similarly, instant messenger status information provides users with a way of gauging whether group members have recently been active at their machines, but again is not as effective for reflecting *group* activity, or group presence over time.

After we identified the benefits and limitations of the various tools and methods used by group members, we designed applications to provide needed information, adapted for a shared group display.

We use a touch-enabled SMART Board™ to display the applications. Each application occupies roughly a quadrant of the space, forming a montage of persistently visible

information (fig. 2). In the following sections of this paper, we describe the information and interactions that we have found to be of importance to group awareness as the motivations for our system components, and the following four applications that we built to support the display and access of this information:

- *Reminders* – brief requests or facts displayed to foster discussion and enhance awareness of group members;
- *Collaboration Space* – designated shared interactive spaces for asynchronous group work;
- *Active Portrait* – a graphical representation of the group that provides an overview of group activity over time;
- *Attendance Panel* – an abstract visualization of planned attendance at upcoming events to reflect group interests.

REMINDERS AND COLLABORATION SPACE

The Everyday Computing Lab currently makes use of weekly status reports that are sent via email to all of the group members. While these reports are a rich source of information and valuable for promoting awareness of group members' activities, the email medium does not maximize their utility. We have identified information contained in these reports that would be most useful if they were kept persistently visible in the environment. For example, when one member of the lab sends out a report to her labmates containing the request, "If anyone has some time, I'd like some help revising my Ubicomp submission," lab members may be willing to help, but without regular email reminders, they may forget, necessitating another mass email. Lab members often write these sorts of help requests once in the weekly report, but find that they need to repeat themselves to get the help they need. Because the information already exists, we sought to find a way to obviate repeated requests.

Our system uses a slideshow-style application to display these help requests and reminders on the Semi-Public Display (fig. 2d). The text of these requests then becomes part of the environment and serves as reminders to colleagues. We use a simple Perl parser on the text of the status reports to extract help requests; we then cycle through the requests, displaying each one for a few minutes at a time for the duration of the week. Though simple, it provides constant access to this information in the environment, and, unlike repeated emails, is non-intrusive in people's personal workspaces. Because the volume of help requests is generally low (fewer than a dozen per week), each request is displayed frequently enough that it is unlikely to be missed by people working in the space.

In addition to reminders, we found that the status reports also contained requests for more immediate feedback and collaboration. We wished to support this by facilitating asynchronous brainstorming, creating a forum in which collaboration could occur outside of discrete meetings and sessions. Although group spaces are often equipped with whiteboards for collaboration, an examination of our group's

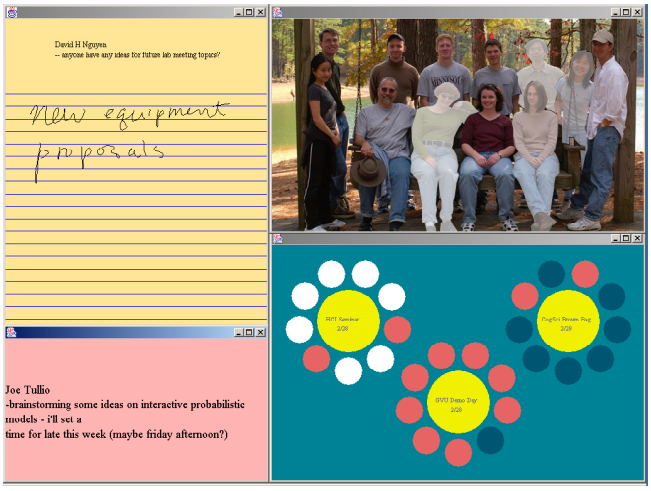

Fig. 2 The Semi-Public Display prototype. Clockwise from top left: a) Collaboration Space; b) Active Portrait; c) Attendance Panel; d) Reminders

usage of whiteboards showed that they were best suited for synchronous collaboration because of the static nature of their content. After a group work session, the content of the whiteboard was not later edited or worked on by group members. The content ceased to be dynamic afterwards because it was unclear if group members would notice new changes, and content ownership was ambiguous.

By creating a collaboration space for the Semi-Public Displays, our aim was to provide a dynamic, captured space that was clearly designated as editable and viewable by anyone at anytime. Again, using help requests extracted from the weekly status reports, we cycle through the items, displaying each one for several minutes at a time, and provide a space in which users can create and edit ideas. People interacting with the display can add content using freeform ink and gestures provided by the SATIN toolkit [9], and the content affiliated with each item is captured and redisplayed every time the item is shown (fig. 2a). Unlike conventional whiteboards, whose content group members are often wary of erasing, editing, or adding to outside of brainstorming sessions, our design keeps the request visible and provides an explicit space for brainstorming and scribbling at all times.

A number of other applications address offloading knowledge and retrieval by putting awareness information in the environment. Related work includes the Notification Collage, upon which users can post items of potential interest to the group [7]. The What's Happening screen saver also displays information about individuals for group awareness, but targets a much larger audience for the purposes of making large, loosely connected groups of individuals aware of each other's activities [19]. Our application differs from these in that it is intended as a reminder system and collaboration space to support and enhance existing channels of information exchange and collaboration. Additionally, it is designed specifically for the interaction dynamics of a co-located group.

ACTIVE PORTRAIT

We observed that lab members also make use of instant messenger status cues to obtain context about the other members of the lab. These cues provide information about whether someone has been recently active at his computer. Understanding the context of the physical lab space, including who has been present recently, is important for fostering collaboration and group work. We aim to provide easy access to information about presence and recent activity in the lab space. While instant messenger status cues are a good way of providing specific information about individuals, we wanted to provide a broader picture of recent activity in the space, not specific whereabouts or accurate counts of idle time. We sought to provide an at-a-glance visualization to provide context about group presence in the space, but abstracted to maintain individual privacy.

The application that we use to display an abstract representation of group activity consists of a group photograph of the lab members (fig. 2b). In this "active portrait," each person's image is displayed in full color if he or she is present in the lab. A person's image fades slowly over time when he or she leaves the lab. If a group member has not been in the space for several days or more, his image fades nearly to white by increasing lightness and decreasing color saturation, but retains some color value for recognizability. The resulting composite image provides viewers with a quick, at-a-glance picture of colleagues' recent presence in the lab. It allows the viewer to have some context about lab activity, especially when she has just entered the space. Unlike tools such as shared calendars or in-out boards, however, the image does not provide specific information about the exact times when a person left or entered the space, or a person's current whereabouts.

Our design provides low-fidelity presence information to give an overall picture of group presence, unlike instant messenger status, which gives high-fidelity information about presence, usually accurate to within minutes. Like instant messenger status cues, our design also monitors keyboard activity on desktop machines to measure idle time. The design does not, however, provide near-immediate information about whether a user is idle. Instead, individuals in the photograph fade slowly over a period of days to provide broader context about activity. Therefore, rather than conveying information such as "Beth has been away from her computer for 7 minutes," the Active Portrait allows users to make inferences such as "The lab has been mostly empty for the weekend" or "Most people seem to be around this morning."

Several other projects have addressed the question of how to visualize presence. IMVis uses a three-dimensional layout of an instant messenger contact list with graphical or photo representations of contacts with space as a metaphor for availability [14]. The Synthetic Group Photo allows users to create a custom layout of colleagues' images to track presence, like a graphical in-out board [17]. Piazza uses a similar graphical representation of users to display information about who is working on related tasks, though not necessarily in close physical proximity [11]. Unlike these projects, our application is viewed collectively in a shared space, rather than on an individual's desktop. Farrell in [4] describes a system that uses a fishtank visualization on a large display to indicate presence and activity within a large group. Our work differs from all of these projects in that it is intended to display an overview of group activity *over time*, and is designed for group display and access.

ATTENDANCE PANEL

We have also found that group context is valuable in planning attendance at upcoming events; group members are likely to take an interest in an event if they know that their colleagues are planning on attending it [8]. Group calendars provide an individual with an overall picture of who is planning on attending an event, provided that other group members expend the effort to browse their colleagues' calendars. This interface, while useful, requires effort to use and check, and may disclose detailed information about people's personal calendars and schedules. We wanted instead to offer more abstract representations of planned activities, thus allowing group members to see a general picture of the popularity of upcoming events to infer group interest. Additionally, we wanted to adapt the information to make it appropriate for a persistently visible public display application, eliminating personal details to provide an easily understandable overview.

The application that we use to provide lightweight group awareness is the "attendance flowers" panel (fig. 2c) on the Semi-Public Display. The panel displays several "flowers," which consist of a large circle with an event title as a label, surrounded by a ring of smaller circles. Each flower is a representation of an upcoming event, such as a seminar or a talk. When a user interacting with the Semi-Public Display touches the center circle of a flower, the event description appears. The smaller circles, or "petals," represent users. Each petal has three states: blue for "not planning on attending," bright pink for "planning on attending," and white for "haven't decided yet." When a new event is added to the panel, it creates a flower whose petals are all white on a blue background, signifying that no one has yet updated his or her status. If a user elects not to attend the event, he toggles one of the petals to the "not attending" state, which is a slightly darker blue than the background, therefore blending with it. If a user chooses to attend the event, she toggles a petal to the "attending" state, which is a bright pink, contrasting significantly with the background. Users are free to select any petal that has not already been taken; they are not bound to any particular position on the flower. Their identities, therefore, cannot be discerned by the position of the petal on the flower, thus protecting their privacy.

The colors of the states create a visual image that brings the petals in the attending state to the foreground, while camouflaging the petals in the not attending state. A viewer can easily discern what events are of importance or interest to the group, or of potential relevance to her, by noticing how "complete" the flowers are. This simple interaction and

visualization allows users to view planned attendance at near future activities, without compromising group members' privacy.

The practice of using information about colleagues' schedule to inform one's own event attendance has been observed in labs outside of our own [8]. Related work includes the AWE system which investigated the effectiveness of providing information about colleagues' planned attendance as metrics to help users determine the potential relevance of upcoming events to their own interests [10].

EVALUATION AND RESULTS

Pre-Deployment Study

We have designed an ongoing series of questionnaires to evaluate the effects of and response to the Semi-Public Display over time. At this point in our research, we have administered a pre-deployment questionnaire to our user population as well a post-deployment questionnaire.

We administered the pre-deployment questionnaire one day before the initial deployment of the Semi-Public Display to eight members of the group. The questionnaire consisted of open-ended questions intended to help us understand the methods people use for the following six procedures:

- Maintaining awareness of group members' day-to-day work status
- Maintaining awareness of group members' 'milestone' work status such as publications, design phase, evaluation, paper writing, etc.
- Maintain social awareness of group members' non-work activities
- Maintaining awareness of group members' attendance plans for upcoming events
- Obtaining assistance with short-term tasks or immediate tasks
- Initiating collaboration or obtaining help with longer-term tasks

In addition, the questionnaire included 5-point Likert scale questions to help assess the extent to which users found these procedures important and how well they believed their methods worked.

Our pre-deployment study served to provide us with an assessment of the methods people were currently using to maintain the type of awareness that we hoped to foster using Semi-Public Displays. We found that people utilized a wide range of methods for accomplishing the six tasks and met with varying degrees of success in doing so.

One of the areas in which we found people's awareness was most impoverished was in their knowledge of colleagues' attendance at future events. Nearly all group members had a hard time keeping track of what events others are attending but felt that it was important information, influential to their own plans. Most users found their own methods to be insufficient for obtaining this information.

Lab members also expressed a difficulty with getting help with tasks, both short term and long term. Obtaining assistance with projects, papers and technical question was something that most people deemed very important, but many find that their methods were not effective, especially for longer term tasks. For short term tasks or quick help, most people relied on immediate information channels such as face-to-face conversation or instant messaging. These methods were largely successful when people could be reached. Solicitation for longer-term help, usually requested via email or face-to-face conversation often yielded less response. Group members felt that this failure was largely because people tend forget the requests when not reminded of them.

We found that most group members felt fairly comfortable about knowing colleagues' work status at a large granularity, such as whether people were in the process of designing a system, doing studies, or writing papers. They felt that lab meetings and opportunistic conversation was mostly sufficient for maintaining this awareness. They felt less aware of group members' day-to-day project status, which they deemed to be somewhat important. Most felt that they were up-to-date on the project status of a few other lab members, but not on the group as a whole.

Finally we found that most group members relied primarily on opportunistic conversation to maintain social awareness of group members. Again, group members felt that they were highly aware of a few of their colleagues activities. Maintaining social awareness however was not a task that many lab members felt to be important.

Post-Deployment Study

After the group had been using the Semi-Public Display for two weeks, we administered the first in a series of post-deployment questionnaires, which again consisted of both open-ended questions and 5-point Likert scales to help assess the extent to which the Semi-Public Display applications supported the six procedures. The study is currently in its very early stages and we have thus far gathered only people's initial reactions to the introduction of the system. We intend to produce further results that more thoroughly represent usage after the technology has become more integrated into daily life through the continued series of questionnaires and interviews over time.

As our pre-deployment study implied, people were highly responsive to the Attendance Panel. The application was viewed very positively, and users found the visualizations useful for maintaining awareness of others' plans as well as determining whether events were of interest to them. While users stated that the visualization itself was not a major determining factor for their attendance plans, some stated that they referred to it when an event seemed like it might be "marginally interesting." Although the application was often not a deciding factor for users' plans, most users said they found it "interesting" to have easy access to the information and thought that "the wall is a great place to display this kind of attendance information." The anonymity of the application proved to be unnecessary as well as undesirable;

several users said they would find the application more useful because they could then use it to understand the attendance plans of specific people. This result leads us to believe that maintaining privacy for this application in this type of group may be unnecessary; people seem to be willing to share this type of info within this group.

The Reminder Panel also received a great deal of usage and was well received by users. They responded positively to the fact that the information was persistently viewable and afforded opportunistic glancing that assisted their memory. The application provided benefit both to the requester of the help and the viewer of the request, with users stating that the panel helped "remind me of … outstanding issues that others have mentioned in their emails." Users found this application most useful in helping them maintain awareness of group members' day-to-day work status as well as for getting help with both short-term and long-term tasks because the requests were constantly viewable in the environment.

The Collaboration Panel proved to be somewhat more problematic. Users deemed it to be "more fun than extremely useful" and that the things people wrote on it were "interesting but not useful." The application seems to provide a different kind of awareness than we intended in that users are looking at what others are writing, but it does not seem to provide as valuable a forum for collaboration in its current state as does face-to-face collaboration. In addition, many people complained of the fact that they found it difficult to use the inking on the display; they found it difficult to write and draw and were therefore not eager to contribute to it. This result leads us to believe that we will need to provide alternative methods of input to encourage further collaboration.

The Active Portrait also suffered as a result of technical problems. People found it difficult to distinguish and interpret levels of fading on the image, that it was "difficult to tell if someone is faded or just in shadow"; this problem was exacerbated by the fact that the projector washed the image out, making it considerably less bright than a traditional display. Users also found that it did not live up to its potential because of the inaccuracies yielded by keyboard monitoring data. Because group members often worked in the space but not at their machines, the presence information often did not reflect the recent group presence accurately. Some members, however, expressed the belief that the application had potential utility if it could be made more accurate. One user mentioned that he would like to use it as the equivalent of "checking if [someone's] seat is still warm." Despite the difficulties that users had interpreting the data, it seems that greater accuracy, perhaps through the use of RFID tracking rather than keyboard monitoring, and better image contrast may make the application useful for some of the lab members.

In addition to gathering data via questionnaires, we have also been evaluating the effects of the display through observations of its use as well as informal conversations with our users and have found it to be quite successful in generating interaction and disseminating awareness information among group members. Since the deployment of the display, we have observed a significant increase in the average number of help requests in the weekly status reports. Additionally, we have noted much conversation generated within the lab regarding the information items in the Reminder Panel as well as the user contributions on the Collaboration Panel. Finally, several users have mentioned the benefits of having the reminders persistent in the environment; opportunistic glancing has prompted them to offer assistance and information to group members who posted the information.

FUTURE WORK

The results of our evaluation of the deployment of the Semi-Public Display support our hypothesis that making this content persistent and publicly viewable is valuable to group members. Especially encouraging was the amount of group discussion generated as a result of the Reminders and the perceived utility of the Attendance Panel.

We are currently using a series of post-deployment questionnaires to evaluate the effects of the applications, and our future evaluation plans include the continuing administration of questionnaires to understand its effects on awareness and collaboration over time. Additionally, we plan to use open-ended interviews and observations for more in-depth understanding of the usage that emerges. We are also planning a long-term deployment in a lab outside of our own to understand how differing group dynamics affect the content and usage of the Semi-Public Display.

A related topic of study that we intend to pursue is an exploration of the perception of social responsibility that members of small groups hold, and how this affects their use and interaction with awareness applications such as the Semi-Public Display. Through in-depth interviewing as well as observations of the deployment of Semi-Public Displays in multiple groups, we hope to understand how small group members' social responsibility influences the extent to which they share and use awareness information. This information will help inform future iterations of design by allowing us to leverage social responsibility to make the displays optimally useful in supporting the awareness and collaboration needs of small groups.

In our examination of the design space for awareness applications we do not distinguish between small groups that are co-located and small groups that are physically distributed, perhaps due to telecommuting. By moving the awareness and collaboration applications to the desktop display, in lieu of a shared, semi-public display, the group could lose a shared sense of communal sharing especially as the desktop interface competes for screen space with other work applications. It would be interesting to develop techniques to foster the illusion of a persistent communal space that would have similar levels of social responsibility in using private displays.

CONCLUSIONS

In this paper we have presented Semi-Public Displays, a suite of applications to support and enhance awareness and

collaboration in co-located groups. We believe that because of the shared interests and context of small, co-located workgroups, public display applications can be greatly beneficial, without incurring many of the difficulties of such applications when deployed within larger, less-connected groups. Shared displays intended to support awareness within small, co-located groups offer the opportunity to optimize the relevance and interest of the information to its audience while decreasing the privacy concerns that pose a challenge for awareness applications targeted a larger groups.

Because of the characteristics of small workgroups, we were able to identify relevant types of information. We selected the content for the applications and designed the system by looking at the methods that group members currently use for maintaining awareness, identifying possible limitations, and then adapting the content for a publicly viewable display. In the process, we identified several types of information that are highly relevant to co-located group members, and that are made more useful by being persistently visible in the environment. The display allows group members to have easy, at-a-glance access to information about group activities and interests with little effort to find and understand the information. By abstracting the information, we make it more appropriate for public display, thus allowing users more privacy about their personal activities. Semi-Public Displays centralize relevant information on a single display using multiple applications, and reduce the effort necessary for gathering this information through the current channels of email, instant messaging, calendars, and word-of-mouth. Results of our evaluation have thus far supported our hypotheses about the potential for effective, informative awareness applications designed to support the needs of small, co-located groups.

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