

The Context, Content & Community Collage: Sharing Personal Digital Media in the Physical Workplace

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ABSTRACT

Online social media services enable people to share many aspects of their personal interests and passions with friends, acquaintances and strangers. We are investigating how the display of social media in a workplace context can improve relationships among collocated colleagues. We have designed, developed and deployed the Context, Content and Community Collage, which runs on large LCD touchscreen computers installed in eight locations throughout a research laboratory. This proactive display application senses nearby people via Bluetooth phones, and responds by incrementally adding photos associated with those people to an ambient collage shown on the screen. This paper describes the motivations, goals, design and impact of the system, highlighting the ways the system has increased interactions and improved personal relationships among coworkers at the deployment site. We also look at how the creation of a shared physical window into online media has affected the use of that media.

Author Keywords

Online social networking services, social media, physical spaces, proactive displays, mobile phones, ubiquitous computing.

ACM Classification Keywords

H.5.3 [Information Interfaces and Presentation]: Group and Organization Interfaces – *collaborative computing, computer supported cooperative work, synchronous interaction*.

INTRODUCTION

Online social media services enable people to share many aspects of their personal interests and passions with family, friends and strangers. Much of the attention on such

services – in the traditional media as well as scientific literature – has focused on the use and impact of such services on interpersonal awareness, connections and relationships. Although there is a growing appreciation for the role of friendships and other informal relationships in work settings [3, 4, 16], and some research on the use of social media within the enterprise [12], relatively little attention has been devoted to how sharing personal media through online social networking services can help foster stronger relationships in the workplace.

We are investigating the use and impact of *proactive displays* – public, or semi-public computer displays that can sense and respond to nearby people in contextually appropriate ways. We have composed a sociotechnical ecosystem consisting of people, places, mobile phones and situated computer displays to promote greater awareness, interaction opportunities and relationships among collocated collaborators in a work setting. Social media – primarily in the form of photos – flow among these elements of the ecosystem, providing the objects around which people can better socialize [8].

While our primary goal is to evaluate interactions and relationships, our secondary goal is to investigate how opening shared physical windows into personal online media streams in a workplace setting affects the use of those media streams. Creating a new venue for a social media audience – for presenting oneself [5] – is likely to have measurable impact on use of that social media.

In this paper, we describe the motivations, goals and design of a proactive display application, called the Context, Content and Community Collage (C3C). The C3C system consists of a client application running on eight 46” LCD touchscreen computers equipped with Bluetooth scanners deployed across our lab, a backend server to support the clients, and a collection of administrative tools to manage the system. Figure 1 shows the client application running on one of the displays near an open area in the lab.

Lab residents who register for the system specify one or more accounts and/or search terms on the Flickr photo sharing web service (<http://www.flickr.com>), and one or more Bluetooth phone names. Whenever those people are detected near one of the displays, photos associated with

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their Flickr accounts or search terms are arrayed in an ambient collage on the display. The C3C system is deployed in a 25,000 square foot industry research lab with 72 residents.



Figure 1: C3C display in an open area at the lab

This work is motivated by three primary research hypotheses:

1. Opening up windows (via proactive displays) into social media in different areas of the physical workplace will increase interpersonal awareness and interactions among co-workers.
2. These windows will improve both personal and professional relationships among co-workers.
3. These windows will increase the use of social media by the co-workers.

The general organizational benefits from increased awareness and interactions, and personal and professional relationships, among co-workers include higher job satisfaction and higher productivity [16]. This particular lab, which is engaged in research and development of new technologies to support the creation and sharing of social media (among other topics), would also realize benefits from increased use of social media by the researchers and developers working there.

We report quantitative data collected about early usage and experiences people have had with the C3C system and Flickr, based on responses to multiple-choice questions in an online survey conducted after the system had been deployed for 4 weeks, and statistics gathered directly from Flickr. We also incorporate qualitative data gained from observations of use, open text questions in the survey and subsequent semi-structured interviews conducted to shed more light on how the deployment of these proactive displays has created a new dimension of audience for people and social media.

Before delving into the details of our system, and the impact it has had on people using it, we will begin by framing this system in the context of related work

RELATED WORK

Decreasing costs have lead to an increasing proliferation of large, interactive displays. These displays provide an ever-broadening array of physical contexts in which applications running on these displays can offer value to the people in, or passing through, such contexts [13]. The research prototypes developed and reported in the literature thus far differ primarily in the types of contexts, content and interaction models they have offered.

The Notification Collage [6] is an application running both on personal computers and a public display that enables members of a small work group to share a variety of content – e.g., photos, slideshows, video, web pages, notes – with both collocated and remote members of the group. Although we have adopted the collage metaphor in our C3C application, we have restricted the range content sources – to simplify the use for as broad a population as possible – and focused solely on public displays, as one of our goals is to increase interactions among collocated people in the physical workplace.

The Plasma Poster Network [2] consists of three large, interactive displays deployed in a kitchen, hallway and foyer of an industry research lab. Content producers could post text, web pages, images and short video clips; content consumers could read content, navigate different content frames and send messages to content producers. We have drawn heavily upon the insights and design principles articulated in this work, and differentiate it in a few important respects. Rather than require people to explicitly post individual content items to the displays, we tap into and repurpose existing social media streams (photos on Flickr). The content shared on Plasma Posters tended to be mostly professionally oriented, whereas the content shared on C3C displays was largely of a more personal nature. Finally, the content shown on the Plasma Posters, like that in the Notification Collage, was not related in any specific way to the people who happened to be in front of the displays at any given time.

There are relatively fewer examples of large displays that show content relating to the people who are in their vicinity. IBM's BlueBoard [17] was an example of a large display whose content and applications were affected by people nearby. Users could swipe their employee badges at the badge reader in order to bring up a whiteboard, presentation, calendar or other tools to engage with others on focused collaboration tasks. The C3C system, by contrast, is intended for less focused, more ambient types of awareness and interactions, and so identifies people nearby automatically via their Bluetooth phone names, without requiring a badge swipe.

Another related example of large, situated displays that respond to people nearby is the proactive display applications deployed at UbiComp 2003 [11]. This suite of three applications – AutoSpeakerID, Ticket2Talk and Neighborhood Window – required conference attendees to create an explicit web-based profile and associate the profile with a radio frequency identification (RFID) tag. The applications showed elements of those profiles when the associated tags – usually inserted into conference name badge sleeves – were detected nearby. Although our primary goal is similar – increasing the sense of community among collocated people – the C3C system differs in at least four key aspects: we use a Bluetooth phone rather than an RFID tag to identify people; our profiles do not contain the content to be displayed so much as they are simply pointers to [potentially] continuously updatable streams of content; our deployment is in an everyday workplace setting rather than at a special event like an academic conference; and the displays have been in use for a longer duration than a 3-day event.

CityWall [15] is a large, multi-touch interactive public display deployed in Helsinki city center. The display shows a zoomable timeline of photos of the city (public Flickr images with the tag “helsinki”) that can be resized, rotated and moved with one- or two-handed gestures. The initial analysis of CityWall’s use – which has been extensively recorded via a hidden video camera and microphone (recording mechanisms that would not have been acceptable in the laboratory environment in which C3C was deployed) - provides many details of the interactions people had with the display over the course of a week. CityWall provides a greater range of interactions than C3C (e.g., rotate and resizing images). The C3C system differs from CityWall in a few significant ways. CityWall photos are broadly related to the place (the city of Helsinki), but not in any more specific way to the people near the display. The study revealed interesting facts about the interactions people had with the display (e.g., the relative numbers of individual vs. multi-person interactions, and the variations of multi-person interaction they label *parallel* vs. *teamwork*), but yields few insights on the interactions people had with each other – except the shared interactions on the displays themselves – or the impact those interactions had on people’s relationships.

SYSTEM DESCRIPTION

The C3C system consists of a touchscreen interface that runs in Firefox (using kiosk mode) on the displays, a web-based registration system, and a set of Ruby application servers that detect users near C3C displays, and determine the content to be shown on the displays.

Registration

Users register for the C3C system by completing a three-step process at a web site on the lab’s intranet:

1. Create a *username* and *password* (the username is used both for login and as the identifier shown on a C3C display when the user is detected nearby).
2. Select one or more *Bluetooth phone names* from a list of detected Bluetooth devices (some people have more than one Bluetooth phone).
3. Specify and configure *content modules* that provide information to show on C3C displays.

For this paper, we restrict our attention to a content module that enables users to build content feeds using a series of searches on Flickr, a popular photo sharing website.

Content Module: Flickr

The Flickr content module allows users to create a content pool of publicly shared Flickr photos by specifying one or more Flickr *account names* from which to select photos. To make participation as broadly accessible as possible, people without their own Flickr accounts – or with Flickr accounts they did not want to share on our C3C displays - could either specify others’ Flickr account names, or simply leave the account name field blank (a null account name), and specify more general Flickr search terms.

To accommodate general Flickr searches, as well as Flickr users who may have photos in their collections that they would not consider “safe for work” (at least not to be shown on a public display in the workplace), we offered C3C users two ways of restricting the photos that might appear on the displays. For each Flickr account specified (including the null account), C3C users can specify *include terms* that must appear in a photo’s metadata (title, caption or tags) in order to be displayed, and/or *exclude terms* that must not appear in a photo’s metadata in order to be displayed.

This content module can be configured to have any number of individual Flickr photo streams – where each stream has a Flickr account and/or include terms and/or exclude terms - associated with a particular user.

Proximity Sensing

The C3C system uses Bluetooth to detect users who are in close proximity to the C3C displays. Each proactive display is equipped with two Linksys DBT-120 USB Bluetooth adapters that continuously scan for nearby Bluetooth devices. Each time a Bluetooth device is detected, the received signal strength indicator (RSSI) and Media Address Control (MAC) address for the detected device are relayed to a central Location Server. The Location Server interpolates the RSSI values for each Bluetooth device and determines whether a user is *near* the display (within 1 meter) or *far* from the display (within 10 meters). The Bluetooth MAC address is then checked against the list of registered Bluetooth devices to generate a list of users who are near or far from the display.

The C3C positions each new photograph in a semi-random collage pattern (Figure 2 shows a screenshot of the C3C display). To preserve a sense of randomness while maximizing the display time of each photo, the display is virtually partitioned into nine overlapping regions. The displays iterate over the virtual partitions in a pre-specified order, but position the photo randomly within the partition. All users interviewed believed the positioning of photos was completely random.



Interacting with Social Media

The photos themselves are framed within panels that show metadata about each photo (i.e. “requested by”, “taken by” “date taken”, “search query used to find”) and can be easily moved around the display by touching and dragging the image panels. On each photo panel we added an iconic close window button (an “X” in the upper right corner) and a “report as inappropriate” button (iconified as a caution symbol next to the close window button) – which, when pressed, would then ask for confirmation of inappropriateness from the user. Figure 3 shows an example

The image is a screenshot of a mobile application interface. At the top, there is a navigation bar with a thumbs up icon labeled '1' and a thumbs down icon labeled '0'. To the right of these are a red warning triangle icon and a red square button with a white 'X'. Below the navigation bar is a large photo of a man in a plaid shirt standing next to a large screen displaying a presentation slide. An audience is seated in front of the screen. Below the photo, the text reads: "Title: Monday 7:24 pm 5/7/07 Palo Alto, California", "Search for nokiaresearchcenterpaloalto", and "Photo requested by dean.eckles". At the bottom of the screen, there is a question: "Are you sure you wish to filter this content? This action will remove the content from the displays, pending review by a moderator." Below this question are two buttons: a red button labeled "Yes" and a yellow button labeled "No".

Administrative Tools

EARLY USE OF THE DISPLAYS

Installation Sites within the Lab

These installation sites were chosen with two primary criteria in mind: one was to experiment with several

different types of settings (Churchill, *et al.*, [2] had noted significant differences in use patterns among different installation sites for their Plasma Posters); the other was to maximize the likelihood that someone walking around the lab would be able to see at least one proactive display at any given time.

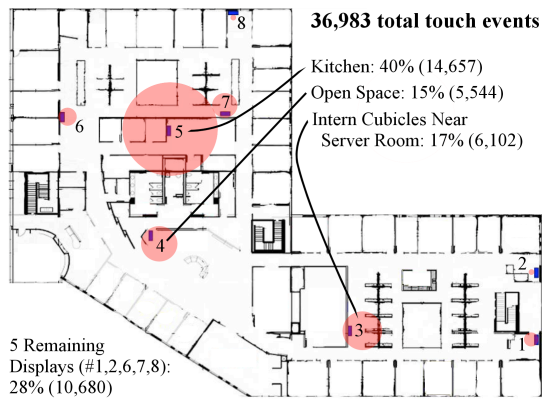


Figure 4: Deployment sites for C3C displays

Users and User Accounts

The lab in which the system was deployed has a total population of 72 people that includes permanent and temporary (intern) employees as well as external contractors. The residents have a diverse set of roles, including leadership (at various levels), researchers, interns, administrative staff and security personnel.

At the end of the first four weeks of use, among a total lab population of 72 people – including permanent and temporary (intern) employees as well as external contractors – a total of 45 people had created C3C accounts. Of these, 18 did not specify a Bluetooth name and/or a Flickr account, and so the system was unable to effectively sense and respond to them. Of the 27 who did specify both a Bluetooth name and one or more Flickr accounts, 16 specified only their own Flickr accounts, 7 specified null accounts with generic Flickr search terms and 7 specified both.

Use of the Displays

During the initial 4-week period, we logged 36,983 touch interactions on the C3C displays, of which 34,621 were select or move events, 2,101 were close window events, and 261 touch events were associated with the “report as inappropriate” feature (180 events were the initial touches of the caution icon, 49 events were cancellations via a “no” touch, and 32 were confirmations via a “yes” touch). The largest proportion of interactions took place on the displays deployed in three locations –the kitchen, the main open area, and next to one of the rows of cubicles occupied primarily by interns (sites 5, 4 and 3 in Figure 4).

During this same period, we logged 37,761 “near” events (i.e., a registered C3C user’s Bluetooth phone was within approximately 1 meter of one of the displays) and

3,106,991 “far” events (i.e., a registered C3C user’s Bluetooth phone was within approximately 10 meters of one of the displays). Corresponding to the distribution of interaction events, more “near” traffic was detected near the kitchen, main open area and main intern area; “far” traffic followed a similar pattern, but was more evenly distributed.

IMPACT OF THE DISPLAYS

Our primary goals in designing, developing and deploying the C3C system were to promote more interactions and stronger relationships in the workplace. However, a third goal was to investigate how the opening of a shared physical window into online media would affect the use of that media.

In this section, we present data we collected from three sources: an online survey we conducted, statistics we collected from the Flickr web-based application programming interface (API), and subsequent interviews we conducted to learn more about the use and impact of the displays on social media.

Four weeks after our initial deployment, we sent around an email link to a web-based survey to 72 people, including permanent and temporary members of the lab, and external contractors. The survey was open for one week, during which time 31 people responded to at least some of the questions. 15 of the respondents (48%) reported that they had created a C3C account with one or more Flickr streams and associated it with their Bluetooth phones.¹

The survey responses and statistics gathered via the Flickr API suggested a broad range of use – and non-use – that we wanted to explore in more depth. Thus, during the week following the close of the online survey, we conducted semi-structured interviews with five subjects. Two of the interviews took place in front of one of the proactive displays; one took place in the subject’s office; one took place in one of the authors’ offices; and one took place over the telephone (after the subject had finished his internship).

In the following sections, we describe how these data provide evidence for or against our research hypotheses.

Impact on Interactions and Relationships

In our survey, we asked people about the types of interactions they had around the displays, to investigate the variations of *object-centered sociality* [8] the displays engendered. We used a multiple-choice question to differentiate between the initiator of an interaction and the owner of the content object about which the interaction was initiated. Table 1 summarizes the responses.

We had initially hypothesized that most interactions around the displays would be follow a basic pattern in which a person (me) sees a photo taken or requested by another

¹ Since only 27 of 72 lab residents (38%) had such C3C accounts, this group is overrepresented in the sample.

person (you) show up on a display, at which point I would initiate a conversation with you about your photo. Rows 2 and 4 above correspond to that pattern (and its converse), which turns out to be the least common pattern. Rows 3 and 6 represent the most common pattern, in which I initiate a conversation with you (or vice versa) about a photo taken or requested by someone else, who may or may not be physically present.²

Row #	Initiator	Content Owner	# of Respondents
1	Me	Me	16
2	Me	You	13
3	Me	Someone else	20
4	You	Me	10
5	You	You	19
6	You	Someone else	19

Table 1: Types of Interactions around C3C Displays

The most surprising result was the high numbers of interactions initiated by the people who had taken or requested the photo being shown (rows 1 and 5). We initially thought that this reflected what might be called a “grandmother” pattern (“let me show you some photos of my grandchildren”), but it may include patterns in which the person other than the initiator appears in a photo, and/or mixed initiative dialogues. Another factor may be the way the question blurred the distinction between dyadic and multiparty conversations. This is an area that bears further investigation.

One of the most important questions we asked was “On balance, how would you rate the overall impact of the proactive displays on your *personal* and *professional* relationships with others at the lab?” The results are summarized in Figure 5.

On a 7-point scale, where 4 is a neutral rating, the average rating of the impact of proactive displays on personal relationships among people in the lab was 5.63. While one respondent indicated a “mixed impact”, all the other respondents indicated at least a slight positive impact. It is worth noting that 52% of the survey respondents did not have C3C accounts, and yet nearly all of them were impacted in positive ways by the displays.

² The other person may have left the area near the display or may just be approaching the area; another possible scenario is that none of the people near the display have C3C accounts, and so or the display is randomly selecting photos from the pool of all C3C users, if none of the people near the display have C3C accounts.

Unfortunately, the impact on professional relationships was not as strong, with 11 respondents reporting “no impact”, two reporting “mixed impact” and 13 reporting at least a slight positive impact. So, while we see strong support for the personal relationship dimension of our second research hypothesis, we do not see strong evidence to support the professional relationship dimension of our hypothesis.

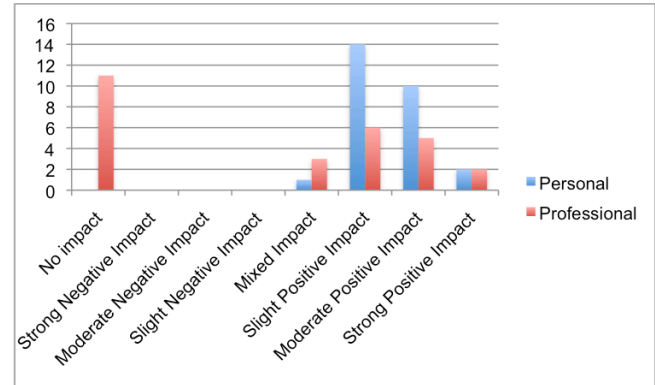


Figure 5: Impact of C3C displays on relationships

This discrepancy between the impact on personal and professional relationships is not surprising, given that the photos shown on the displays were nearly all of a personal nature. However, given the recent research demonstrating the importance – and productivity gains – from personal friendships in workplaces, even increases in personal relationships can have an indirect impact on professional aspects of work [16].

We also asked people to report any interesting experiences they had around the displays in an open text question. The quotes below are two of the 16 responses to this question, many of which explicitly noted initiations of conversations, learning about previously unknown aspects of people, and the enjoyment of travel photos.

I was surprised by some of the photos taken by one of our Interns. I had no idea of his very diversified and, in some cases, adventurous interests, and his photos showed me a side of him I would have never realized. The photos also give you an appreciation of other people's interests and unique travels. I find the photos absolutely fascinating [sic] and a very strong method of bringing all of us closer.

I[t] was nice to see people putting up "themes". One person had a Star Wars theme, actually happening just by tags, but appeared to me as if a themed series of photos.

Finally, we also asked about how the proactive displays impacted people's use of social media (Flickr), which we will discuss this in the next two sections.

Impact on Social Media Usage

One of our research hypotheses was that the opening of new windows (via proactive displays) into social media in different areas of the physical workplace would increase the use of that media by co-workers. In order to evaluate this

hypothesis, we conducted both quantitative and qualitative analysis of how the use of social media – in this case, Flickr – was affected by the displays. This section reports on the quantitative analysis we conducted.

Survey Results Relating to Flickr Usage

In our survey, we asked about five specific ways in which the proactive displays affected C3C users' use of Flickr. Of the 31 respondents:

- 5 reported that they created accounts specifically to have a content pool for use on the displays
- 6 created or used special tags to specifically include photos in their content pool
- 3 created or used special tags to specifically exclude photos from their content pool
- 6 deleted or marked private one or more photos in order to remove them from their content pool
- 13 posted one or more new photos to Flickr specifically to add them to their content pool

We believe all of these usages are representative of the social (vs. self) motivation that Ames & Naaman [1] describe in their analysis of the motivations behind tagging in an online photo sharing system. Analyzing the functional motivations – organization vs. communication – noted by Ames & Naaman is a potential topic for future work.

Analysis via Flickr's Web-based API

Of the 36 registered users of C3C, 10 created Flickr accounts during the initial four-week period. We can't claim that all of these accounts were created solely for providing content for the proactive displays, but we do know from personal discussions with several C3C users, as well as survey results (reported above) that several of these were created primarily for that purpose. We also know that during the 10 weeks preceding the deployment of the system, 8 C3C users had created new Flickr accounts.

We measured the average number of photos posted to Flickr per day across all the C3C users who had registered Flickr accounts. As noted earlier, some C3C users used only generic Flickr search terms and never associated Flickr accounts of their own with their C3C account (indeed, many did not have Flickr accounts). Our analysis reveals that 28 users associated their own Flickr accounts with their C3C account, and this group will be the focus of the analysis in the remainder of this section.

The average number of photos posted per day by C3C users during the 10-week period preceding the deployment of the proactive displays was 1.3. During the four weeks after the deployment, C3C users posted an average of 2.3 photos to Flickr each day.

We decided to analyze the usage of Flickr more carefully, by differentiating between C3C users who had Flickr accounts before the deployment on July 19 ("veteran users") from those who created Flickr accounts after the

deployment ("new users"). Since we had a group of interns who started in May and June, we decided it would also be worthwhile to separate out "recent users" who had created accounts between May 1 and July 19. These groups contained 9, 8 and 11 members, respectively.

As Figure 6 shows, the veteran Flickr users increased their average uploads per day once we deployed the proactive displays – jumping from 1.8 photos per day just before the deployment to 4.8 photos uploaded per day after the deployment. They uploaded an average of 2.5 photos per day before May 1, but we believe that the difference between the usage before May 1 and between May 1 and July 19 is attributable, in part, to the typical "spike" that occurs when a user first starts using an online photo sharing service (uploading a backlog of "old" photos).

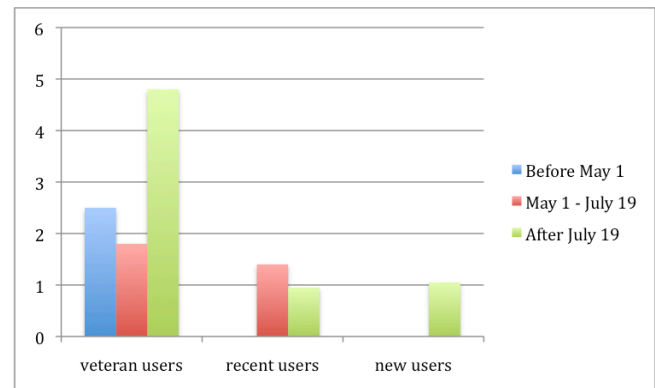


Figure 6: Average daily uploads by different C3C user groups

The average daily upload rate of C3C users who had recently created accounts (between May 1 and July 19) declined a bit – from 1.4 to 1 per day - after the proactive display upload. As with the veteran users, we believe this is attributable, in part, to the aforementioned initial spike when people first join Flickr.

The new users who created Flickr accounts after the C3C deployment uploaded an average of 1 photo per day during the 4-week period under study – the same as the recent users. This level of use would presumably include any initial "spike" in the other two groups, so it will be interesting to see how the usage of these groups continues to evolve over time.

Interviews

As noted earlier, we conducted semi-structured interviews with several members of the lab to better understand the impact of the displays on their interactions and relationships, and on their social media usage. Although the interview findings span a variety of dimensions, we report them separately in this section, where they can provide a more complete picture of the individuals impacted by the displays. The interviews were not recorded, but the interviewer kept careful notes during the course of the interviews.

Before reporting on the interviews, we provide more information on the organizational context from which the interview subjects were selected. The laboratory residents can be categorized into 5 main groups: senior management, team leads, members of research staff, members of administrative staff and interns. The senior management includes the head of the lab, the visiting head of another lab and people further up the chain of command. Each of the six research teams has one team lead and several researchers and interns who carry out the research on that team; the average team size is 9.5, ranging from 5 to 17. The nine members of administrative staff support the lab and the other personnel at the lab in a variety of roles. During the initial four weeks of the deployment, the lab employed 22 interns, five of whom – including our interview subject – left before the end of the 4-week period.

The interview subjects were selected so as to represent as broad a range as possible among the dimensions of rank in the organization, membership on different teams, and amount of social media usage (in the context of the C3C system).

- Subject 1: Senior management, registered phone, did not register any Flickr streams
- Subject 2: Team leader, did not register phone or Flickr streams
- Subject 3: Member of research staff, registered phone and several Flickr streams
- Subject 4: Member of administrative staff, registered phone and one Flickr stream
- Subject 5: Intern, did not register phone or Flickr stream

Rather than simply describe the results of the interviews, we will highlight certain dimensions of importance that were uncovered throughout the interviews.

S1

Subject 1 (S1) does not use an online photo sharing service and has no interest in doing so. He does take photos with his cameraphone, but uploads them only to the computer. He would be willing to upload them to the C3C display system, if there were an easy way to do so (and a way that did not require posting photos publicly on the web). He enjoyed the social aspects of the displays, “learning little things about people”, and preferred seeing family photos and “beautiful” photos (e.g., nature scenes), though also enjoyed a series of “Bourne Identity” photos that were selected via a tag by one of the C3C users. Among the potential extensions suggested were integrating the C3C system with other project team systems, being able to commandeer the displays for a presentation, and showing announcements – all very understandable, given the roles and responsibilities of this person.

S2

S2 noted that “whenever you enter an area where one [C3C display] is deployed, it always immediately catches your

eye” and likes the “ambient aspect” of the displays (showing photos without requiring direct interaction). He described the “flag as inappropriate button” as “the nuclear button” and said that for him, personally, there would be a very high threshold to cross before pressing that button in a public setting. He noticed when one colleague joined the system, and how “suddenly there was a flood of [that person]’s photos ... seemed like a self-promotion exercise”, which he said may be part of why he has not chosen to create an account. He enjoyed learning about people, places (“Americana photos”) and cultures (“Finnish people have pictures of snow”) from the stream of photos. He said that interacting with the displays is more fun when other people are around.

S3

S3 is a power user of both Flickr and C3C. The Flickr API revealed that he has uploaded more photos to Flickr, and is a more active Flickr commenter, than any other C3C user, and he has updated his C3C profile more often than any other user. He has photos in all Flickr categories: public, friends & family, friends, family, private. He uploaded certain photos shortly before the interview mostly due to “boredom with my current photo stream”, and although “in the back of my mind, I know that if I take an interesting photo it may appear on the proactive display”, he said that his upload rate is not consciously affected by the proactive displays. What does affect his upload rate is view counts and comments on his photos via the Flickr interface. He has experimented with constructing Flickr search terms in his C3C account to reflect different themes, e.g., snow, lamppost, summer cottage, and was disappointed that no one seemed to notice or comment (it is interesting that S2 had enjoyed photos of snow, but obviously did not comment on this to S3). He observed that another Flickr user was “clearly using Flickr to communicate with people in the lab about his family”. He sometimes leaves his mobile phone at his desk when he goes to the kitchen – intentionally keeping it more than an arm’s length away [14] – so he can see only other people’s content on the display there.

S4

S4 was another C3C power user, although she is not a Flickr power user (in the same way as S3). She created a Flickr account in May in order to upload and share the large number of photos she’d taken from a team leader offsite event, and then uploaded other work-related photos after that. After the C3C system was deployed, she felt more incentive “to take more photos at an event to post to Flickr so they will end up on the display”. After she noticed that others were sharing personal photos, she started uploading her own personal photos – in addition to lab-related photos – to Flickr, and marking some old photos “private” so that they won’t appear on the displays anymore. S4 had the largest number of personal stories about interactions she had with people based on photos showing on the displays, and the things she learned about people. However, she also

noted that “I like gadgets, I like pictures, and I like people” and “I really enjoy helping people”, so it is likely that the displays simply offer a new tool for her to indulge in these natural inclinations.

S5

S5 was one of our most socially active interns, and yet did not create a C3C account. He said that he created a Flickr account over the summer to share photos of group events with other interns, but did not create a C3C account because he did not carry a Bluetooth phone. He enjoyed seeing photos of “people we don’t see very much in person” (mostly senior management, who showed up in pictures taken by others) and wished they posted photos themselves. He was delighted to discover the photography skills of some of his colleagues, as well as their travels and families. He noted that there were two groups of interns (sitting in two sets of cubicles), and that people in one group – near display #7 – tended to have electrical engineering (EE) backgrounds and the other group – near display #3 – had computer science (CS) backgrounds. He observed that people in the first group didn’t seem to post photos or interact much with the displays, and hypothesized that this was due to the different backgrounds: “proactive displays were more related to their [CS interns] area of research”. He also noted that personalities – which are, of course, related to country of origin, career choices and a number of other interrelated factors – may play a significant role in participation: “the displays are for self-expression, and some people don’t feel the need for that”.

DISCUSSION

The observations made by our interview subjects – particularly S5 – suggest that additional factors such as organizational rank, group affiliation and office or cubicle location may influence adoption and use of the C3C system.

Cursory inspection of usage patterns suggest that people of higher organizational rank are less likely to use the system than people of lower rank, e.g., 1 of 6 senior managers (17%) use the system vs. 12 of 23 interns (55%). People of higher rank generally tend to be older, have longer histories with the company, and be more widely known than people of lower rank, so there are a number of potentially confounding factors that may influence their motivations to use the system.

Lab members working on project teams that focus on human-computer interaction and/or technical innovations for cameraphones (18 of 31, or 58%) are also more likely to be users of the system than project team members that focus on topics that are not related to either HCI or cameraphones (9 of 41, or 22%). The C3C system was developed by members of the project team in the former group.

We earlier noted a wide variance in the level of interaction at different displays, and that interactions on three displays – the ones in the kitchen, main open area and near one row of intern cubicles – accounted for the vast majority of all

interactions in the system. It’s hardly surprising that the site of the largest number of interactions with the displays was the kitchen. The kitchen is the most common area for people to congregate, and the display there is situated very close to the refrigerator and espresso maker – the two most popular appliances in that space – so many people come within close proximity of the display itself on a regular basis. However, there was a surprisingly large difference between the number of interactions at display #3 (6,102) and the number at display #7 (3,810), which are situated in nearly identical physical contexts.

The interactions between use and impact of the displays and organizational rank, team membership and office or cubicle represent a fertile area for further investigation.

CONCLUSIONS AND FUTURE WORK

Our initial analysis of the C3C display deployment indicates that we are increasing awareness and interactions, and improving relationships among people in the lab. Thus far, the relationship improvement has been primarily in the personal dimension, although we believe there is some indirect benefit to professional relationships. The future development of new work-related content modules may enable people to more easily share aspects of their professional lives on the C3C displays, and thereby result in more significant improvement in professional relationships.

Our survey and interviews revealed a number of ways that showing online social media on public displays affects the use of social media. The survey showed that a number of people either created Flickr accounts or changed their use of the accounts in response to the proactive displays. Two of our interview subjects (S1, S2) did not post social media online before our deployment of displays, and were not motivated to post social media after our deployment. Another subject (S5) did post social media online but was not motivated to participate in the C3C system. Two subjects (S3, S4) posted social media online before the deployment, and became active users of the C3C system. Both of them revealed ways that our physical windows into online media affected their use of that media, e.g., changing privacy settings on Flickr and using C3C tag settings to make different sets of photos available on the displays.

The interviews we conducted, along with other comments made by users in our survey and in other settings, suggest a number of additional features that could improve the C3C system. These include: adding the capability for users to interact with the displays via their mobile phones in more interesting ways (such as uploading photos from the phones), adding a mode to support more focused collaboration tasks with media (such as commandeering a display to show Powerpoint slides), adding feedback mechanisms so that C3C users would know more about who has viewed their content and be able to rate or comment on photos they see on the displays, and better mechanisms to ensure “freshness” of the social media shown on the displays.

In addition to adding new features to the system, further gains may be realized through conducting more longitudinal evaluations of the user experiences with and around the displays, to better understand the long-term effects the displays have on relationships among members of the lab, as well as their impact on people's use of online social media. These evaluations could be enhanced by incorporating more structured observations of display deployment sites [7]. It may also be helpful to explore potential connections between the use of proactive displays to personalize workspaces and environmental psychology studies that have investigated other ways that people have personalized workspaces – and the effects that personalization has had on those workers ([18]).

We believe that the Context, Content and Community Collage offers a promising platform for exploring the myriad paths through which elements of our workplace sociotechnical ecosystems – physical devices such as mobile phones and large displays, personal and professional digital content, and the people who carry or encounter those devices and produce and consume that content – can interact in new ways that offer ever-increasing individual and organizational benefits.

Of course, these sociotechnical elements and ecosystems exist outside of workplace settings. With the proliferation of large displays and mobile phones, and the increasing numbers of people producing and consuming social media [9, 10], new opportunities are emerging for bridging the gaps between people by bridging the gaps between the online and offline worlds. We hope to see these kinds of technologies enhance the sense of community through the sharing of online content in a broadening range of physical contexts in the future.

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