Thanks and Tweets: Comparing Two Public Displays

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ABSTRACT
Two public display systems, with different methods of posting, were deployed over several years. One, the Thank You Board, was designed to give people an outlet specifically for publicly thanking and acknowledging others in the community. The other, SI Display, showed any Twitter post directed to the display and did not have explicit usage guidelines. People preferred the flexibility of the latter, but ambiguity about its purpose and norms of usage persisted even six months after deployment and made some people hesitant to post. Also, using Twitter as the posting mechanism facilitated participation for some but also created barriers for those not using Twitter and for Twitter users who were wary of mixing their professional and non-professional contexts.

Author Keywords
Public displays, norms, interpretations, Twitter, adoption

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design, Human Factors

INTRODUCTION
Public posting places with varying degrees of structure, anonymity, and user control are ubiquitous, especially on college campuses. Leaving chalk messages on sidewalks, posting fliers in public spaces and on organized community notice boards, and scribbling messages on bathroom stalls are just a few of the ways that people share information publicly, with varying degrees of structure and formality. Each posting medium has its own drawbacks and barriers to keeping content updated and useful. Digital public displays offer solutions to some of the drawbacks of traditional posting spaces, but create challenges as well [3,4,6,7,9,10,11, 15]

In this comparative case study we report on the use of two specific digital public displays in the School of Information (SI) at the University of Michigan. The first display, known

as the "Thank You Board," had structured input that generated display messages worded as thank yous. The second, "SI Display," displayed any message posted to Twitter containing "@sidisplay." Both displays relied on user-generated content, but while the Thank You Board prompted users for a specific type of post, posts to SI Display are only constrained by the 140-character limit imposed by Twitter.

Wenger argues that negotiation of meaning is a fundamental process in social systems [16]. In the context of public displays, over time the meaning of the display itself, what its purpose is and what it should be used for, will be negotiated. In addition, a shared repertoire of shorthand abbreviations, references, and inside jokes will emerge. Comparing the use of the two display systems gave us an opportunity to assess the advantages and disadvantages of the structured input that pushed people to use the display as a way to publicly thank others in the community. We investigated the extent to which users renegotiated the meaning of the Thank You Board, appropriating it for other types of messages. We also assessed, with the less constrained SI Display, how communal norms for its use emerged.

In addition to exploring the impacts of different amounts of structure constraining the types of messages, we also explored SI Display's use of Twitter as a posting mechanism. When designing SI Display, we hoped that posting through Twitter would be easier for people than the standalone website for posting used by the Thank You Board. In this study, we report on whether the new display in fact lowered the barrier to posting and whether it introduced new barriers. Additionally, we explore how Twitter as a posting mechanism affected the way people perceived and used the display.

Previous work
A considerable amount of work has already been done on the design and use of public displays to facilitate community interaction and communication within work groups. They have been explored as digital outlets for bulletin board-like public posting [4], as a way to encourage interpersonal awareness among colleagues [6, 10] and to encourage workplace interactions [9]. Issues of adoption, in the context of groupware, have also been explored. In Huang et al's study of large displays for instant messaging within a corporate environment, five factors were found to increase adoption: deployment for specific tasks critical to

the user, tool flexibility and generality, visibility and exposure to others' interactions, low barriers to use, and a dedicated core set of users [9].

Though each of these public display systems afforded users different capabilities, they all had more structure than SI Display, either because users were given explicit posting options to choose from or as a result of their associations with common non-digital types of public displays. Also, most display systems described in other work are implemented with the expectation of particular uses and particular benefits [4,6,7,9,10,11]. Though we hoped SI Display would be an asset to the community, we did not have specific ideas about how this should happen.

The popularity of Twitter and the availability of its API have generated interest in using it as a means for generating content for public displays to create peripheral community awareness beyond a single workgroup [3,7]. Like these other displays deployed in university settings, SI Display leverages the popularity and convenience of tweeting, channeling it towards providing content for a public display. While many other displays aggregate all tweets from community members, SI community members must "direct" a tweet to the display by including "@sidisplay" somewhere in the tweet.

SYSTEMS OVERVIEW

Both the Thank You Board and SI Display were deployed for use by the School of Information, an academic community of roughly 530 students, faculty, and staff. The Thank You Board operated from February 2007 through August 2008. The SI Display ran from November 2009 through April 2010. At the time of the deployment, SI was housed in two different buildings, West Hall and SI North, located approximately two miles apart at the University of Michigan, Ann Arbor.

Thank You Board

The Thank You Board was displayed on a 17-inch LCD screen in a centrally located stairwell in West Hall and a 17-inch display located near the main entrance to SI North. Anyone affiliated with the university could post to the display by logging in to the site http://si.umich.edu/thanks with their university username and password; others could not post at all. The web interface prompted them for the name of the "thanker," the name of the person they wanted to thank, and a description of for what they were thanking them (figure 1). When displayed, the field contents were displayed in different colors and fonts, and automatically connected with the phrases "says thanks to" and "for", as shown in Figure 2. Every six seconds, a message from among the ten most recent was randomly selected, so that the order was not fixed. (In retrospect, this was not a desirable feature, as it meant that after reading part of a message, the delay until seeing it again was unpredictable.) On 14 March 2007, an email message was sent to an open email list for faculty, staff, students, and friends of SI explaining what the display was for and how to post to it: "You may have noticed that the monitor on the third floor

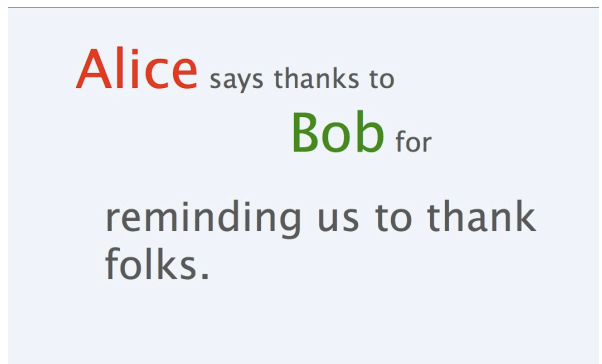**Figure 1. Thank You Board post form.**
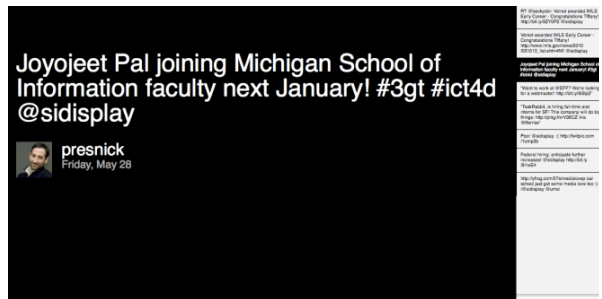

Figure 2. Example Thank You Board post.

Figure 3. Example SI Display post.

stairwell in West Hall is displaying public thank yous. You can thank someone, too! Just go to http://si.umich.edu/thanks." The website address for adding messages was printed and taped to the monitors.

SI Display

SI Display took the place of the Thank You Board in the stairwell of West Hall and was also displayed in lounge areas in West Hall and SI North. The second display in West Hall was in the student lounge, a place most often frequented by Masters' students between classes. The display in SI North was in the "Convergence Room," a central place where meetings and informal interactions

between colleagues often took place. This display was mostly seen by PhD students, faculty members, and staff. The display content could also be viewed from a web page, http://sidisplay.projects.si.umich.edu/, though this was not widely publicized.

There was some concern that it was hard to post to the Thank You Board on the go (few people had full-featured browsers on their phones at the time) and it was hard to remember the URL when one returned to a desktop computer. Thus, SI Display was created with the intent of making posting more accessible. The Twitter API was used to create a system where people could post to the display from their Twitter accounts. This method of gathering content is similar to displays used at several conferences, and the design of SI Display was inspired by a display used at the 2009 Conference on Communities and Technologies. Unlike conference displays, which aggregate public posts containing the conference hashtag (e.g., "#cscw2011"), we gathered posts addressed to the display using the @Reply syntax (@ followed by an account name). This allowed us to show posts intended for the display and gave users more control over whether their other followers would see posts they directed to the display.[1] A Twitter account was created for SI Display and anyone could post to the display by including "@sidisplay" in a tweet. Users with private accounts had to first follow the SI Display account, which would automatically request to follow them in return. Once the user had accepted the follow request from SI Display, they could post to the display from their private account. Users could post any tweet to the display, meaning any message of up to 140-characters (10 of which had to be "@sidisplay").

Though others have discussed the potential exclusion created by requiring community members to have an account with an external service to post [10,13], we did not anticipate it being a problem for SI Display. Even if community members did not wish to link their existing Twitter accounts to the display, they could create a separate, private account and use it only for communicating with the display. We also believed that this barrier was not much greater than remembering and navigating to a website created just for posting to the display, as was required for the Thank You Board.

Display posts were cycled through one at a time with a queue of posts displayed on a sidebar on the right (see figure 3). The display showed all of the posts from the last 24 hours or the eight most recent tweets, whichever was the

greater number posts. We chose to keep the eight most recent posts on the display so that the display would always have something on it, even though this meant that an event post might be displayed long after it was over during times when few posts were made. When "@sidisplay" appeared as the beginning of the post it was not displayed, but if it occurred elsewhere in the tweet it was shown as part of the message. The poster's Twitter username and picture were displayed below each message. If a person's full name was available from the Twitter account it was displayed as well. The display software was also able to expand some image URLs (such as for the service Twitpic) into thumbnail images for display.

An email was sent to the same SI email list introducing the new displays and explaining how to post to them. The message contained detailed information about *how* to post to the displays and *where* they were located, but said very almost nothing about *what* to post: "[the displays] can be used for sharing short, public messages." After the display had been operational for some time, the URL: http://sidisplay.projects.si.umich.edu/how.html was set to point to posting instructions and a sign was put up next to the display directing people to the URL.

METHODS

We examined the 196 posts to the Thank You Board during the 553-day period from 25 February 2007 to 8 August 2008 and the 251 posts to SI Display made during the 149 days from 5 November 2009 to 2 April 2010. Two researchers read through the posts, developed a classification scheme based on the common themes and attributes of the posts, and independently assigned posts to content categories based on the classification scheme. There were two main post attributes that the coding scheme addressed: the content of the post and how it was directed. For each post, decisions were made about whether or not it belonged to any of following content categories: event announcements, congratulations, thank you messages, greetings, questions, information sharing, referencing the display, responses to other posts, and humor. Posts to the Thank You Board were automatically assigned to be thank you messages and were not separately coded into this category. Posts were also coded based on whether they were directed towards specific people, towards particular sub-groups of the School of Information community, or to the display itself. This system of coding allowed for one post to be in multiple categories. Because each of the 447 posts were coded across 11 categories and the 251 SI Display posts were coded into the additional category of thank you messages, there were a total of 5,168 decisions made across all the posts. Agreement between the two coders was high for almost all of the categories (κ ranging from 0.711 to 1 [5]), so we concluded that the coding categories were meaningful. The one exception was humor. Despite multiple coding iterations, the independent coders were unable to come to a high level of agreement about which display posts qualified as humor ($\kappa = 0.624$). We

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[1] Though behavior varies from Twitter client to Twitter client, if a user posted with "@sidisplay" at the start of a tweet, only their Twitter followers who were *also* following the @sidisplay account would see the tweet; if "@sidisplay" appeared later in the tweet, it would be seen by all of their followers. This allowed community members to post to SI Display without cluttering the feeds of their followers outside of the SI Community. Hashtags would not allow for this functionality.

Category	κ	SI Display					Thank You Board				
		1st month		Overall		Example	1st month		Overall		Example
		#	%	#	%		#	%	#	%	
Event announcements	0.92	56	50	79	32	Reminder: CommuniTea at 4p Wednesday SI North.	0	0	1	<1	Maggie says thanks to Rita for all of your work on the Questioning Authority Conference! You are the PR goddess! Looking forward to the Conference in March 08!
Congratulations / praise	1.00	6	5	15	6	Nice talk by @aphdstudent at FIRST today!	1	2	11	6	Ann says thanks to Lisa for being awesome!
Thank you messages	0.90	7	6	11	4	Thanks to the HCI writers group for suggestions on CHI rebuttals at lunch today! #3gt @sidisplay	54	100	196	100	Mary says thanks to Peter for reminding us about thank-yous. They really are nice
Greetings	0.89	7	6	23	9	Hi to everyone in the SI Lounge!	1	2	3	2	Lucille says thanks to the Fall 2007 incoming MSI students for choosing SI for your graduate studies - we are glad you are here! Welcome to SI!
Questions & discussion prompts	0.86	11	10	34	14	know how many links are saved in delicious or how i would access such information?	1	2	1	<1	Adam says thanks to [whoever put this monitor to use] for having a clue (Now, can we set up some displays to non-invasively broadcast pressing questions a la Zephyr and stuff?)
Information sharing	0.78	57	50	86	34	New Oxford American Dictionary 2009 Word of the Year: "Unfriend"	1	2	3	2	Tobias says thanks to SI Career Services for Helping students manage job searches: Starting from resume creation etc. SI Career Services is one of the strongest services available to students at SI!
Response to another post	0.71	6	5	20	8	so internship experience is better than actual work experience? i get it but .. kind of weird rt si_careers @sidisplay http://bit.ly/bx9jk9	2	4	2	1	Jenny says thanks to Lindsay and Maebe for thanking me on this message board.
Referencing the display	0.75	9	8	39	16	we're talking about the @sidisplay in #si688! thinking about who the intended audience will be.	7	13	2	1	Job says thanks to Peter Smith for Setting up this "thank you" display for recognizing others in the SI community :-)
Directed to the display	0.73	4	4	14	6	aw poor sidisplay. I know what it's like to feel unrefreshed!	0	0	0	0	-
To a specific person or people	0.89	13	12	21	8	Thanks to Susan WIlliams and John Anderson for getting this public display operational. You rock!	38	70	142	57	SI Faculty says thanks to Dean Pollack for shorter faculty meetings
To a specific SI subgroup	0.74	7	6	20	8	To all the people studying for #si539 in the lounge--Good luck!	5	9	34	17	Karen says thanks to SI ASB 2007 Participants for Making ASB great this year!
Total posts		*113*		*251*			*54*		*196*		

Table 1. Post categories, prevalence, and examples. Names have been changed in examples.

believe this is largely due to the fact that many of the humorous posts reflected inside jokes that were difficult for coders to recognize without knowing the context. Where there were disagreements (138 cases among the 11 categories other than humor) the independent coders discussed and agreed upon a final classification.

We also conducted 14 interviews with students and staff in SI to explore their use of and opinions about SI Display (Table 2). Interview participants were recruited by an email sent to the SI email list and compensated $10 for participating. Certain users who had posted to the display were also contacted individually to ask for their participation. Six of the people interviewed had been with the School of Information when the Thank You Board was in place and were asked about it as well.

At the time of the interviews, seven of the people interviewed had posted to the display at least once, five had Twitter accounts and had never posted, and two did not have Twitter accounts (and thus could not post without creating an account).

Participant	Role	Has a Twitter account?	Posted to SI Display?	Remembers Thank You Board?
P01	MSI student	✓	✓	✓
P02	MSI student	✓	✓	
P03	MSI student	✓		
P04	MSI student	✓	✓	
P05	Staff	✓	✓	✓
P06	MSI student	✓	✓	
P07	MSI student	✓		
P08	MSI student	✓	✓	
P09	MSI student			
P10	MSI student	✓		
P11	PhD student	✓	✓	✓
P12	PhD student	✓		✓
P13	Staff			✓
P14	Staff	✓		✓

Table 2. Interview participant information

Participants were asked general questions about their Twitter use, involvement with the School of Information community, and use of the display. They were also asked to share their opinions about the display's purpose and usefulness. At the end of the interview, participants were shown 5-9 example posts to SI Display that were selected to reflect a range of different types of content and syntax found in the display posts (Table 3). They were asked to explain what they thought about each post and whether they thought it was something that should be posted to the display. Participants were also asked to describe what they thought others in the School of Information would say about the purpose of the display, its usefulness, and the appropriateness of the example posts. The answers to this type of question were used to gain an understanding of the perceived social norms about the purpose and appropriate use of SI Display.

Interview transcripts were coded using the qualitative data analysis software NVivo.[2] Participants' responses were grouped based on our previously described initial research questions. Additional categories were made for themes that came up repeatedly. This allowed us to explore opinions held about what SI Display is useful for, what its purpose is, why people post, and what types of use are appropriate. Organizing interview data in NVivo also helped us to more objectively identify opinions and ideas that came up repeatedly but that we had not anticipated.

FINDINGS
The 251 posts to SI Display were made by 58 people with each person averaging 4.3 posts (range = 1-54, stdev = 8.1) and 23 of these people posting only once. As of 2 April 2010 SI Display had 95 followers on Twitter, suggesting

SI Display Post	Categorized as
.@sidisplay invite to #cookiebash more coveted than one to google wave. do you know who to ask?	• Questions & discussion prompts • Humor
.@sidisplay Federal Jobs: Easy to Spot Hard to Get http://tiny.cc/l8VJT the good news is that they may be fixing their application process	• Information sharing
Thanks @agradstudent and @anothergradstudent for the python xmlrpc idea as a substitute for qwizdom in #si182 next semester. #3gt @sidisplay	• Thank you message • To a specific person or people
@sidisplay All your base are belong to us	• Humor
Anybody wants to go to the UM vs MSU b-ball game on the 26th? @sidisplay	• Questions & discussion prompts
@sidisplay If a tweet shows up in the SI student lounge and no one is in the lounge does it actually tweet?	• Questions & discussion prompts • Humor • Referencing the display
@sidisplay Current MSI students only: make $10 and help my MSI thesis research – take my web survey on digital texts at http://bit.ly/24vmV8	• Information sharing • To a specific SI subgroup
@sidisplay apparently it is 80s day at CommuniTea	• Information sharing • Humor
@sidisplay Nice talk by @aphdstudent at FIRST today.	• Congratuations/praise. • To a specific person/people

Table 3. Example Tweets shown to interview participants to get feedback on their appropriateness for the display. Names have been changed in this table but were not changed for the interviews.

there are more people who are aware of the display and know how to post, but have not done so. Although the Thank You Board received fewer posts overall, it had more different users with 100 posters averaging 1.96 posts each (range = 1-16, stdev = 2.039), though this was over a longer time period. Posting behavior also seemed to differ between the two displays. People would often make multiple posts to the Thank You Board at the same time, with one user posting ten times in a row. This type of repeated posting was rare with SI Display. Both displays were most heavily used in the month after their deployment, with substantial declines thereafter (Figure 4). The Thank You Board was the only display available over a summer break (late April through August at the University of Michigan) and was almost completely unused during this time.

Though some categories of SI Display posts were more prevalent than others, use was varied. As shown in Table 1, information sharing posts and event announcements were by far the most common. A few of the posts (4%) contained thank you messages.

All posts to the Thank You Board were automatically phrased as thank you messages, but the structure of the
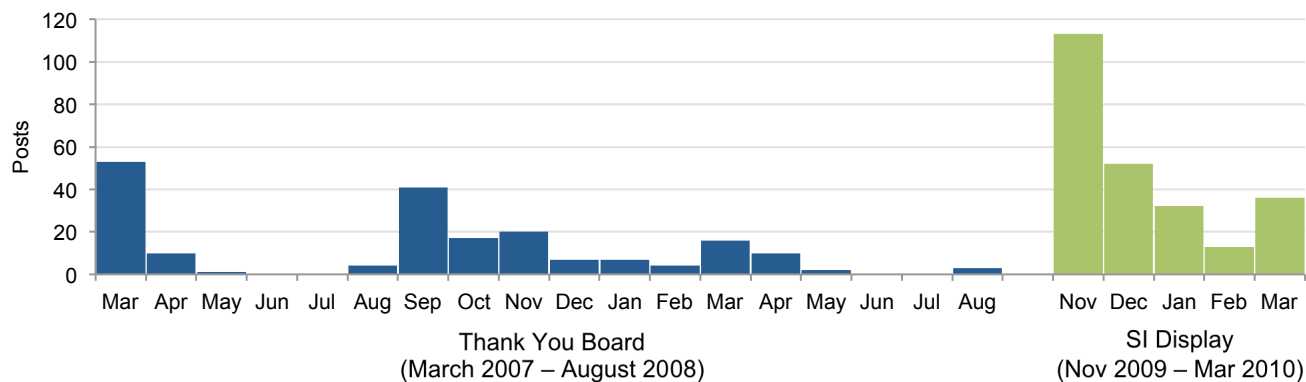
Figure 4. Posts by month for Thank You Board and SI Display deployments.

display did not prevent people from also including other types of content in their messages. Thank You Board posts included eleven instances of congratulations or praise messages, ten instances of posts referencing the display, three cases each of greetings and information sharing, two responses to other posts, one event announcement, and one question or discussion prompt.

Designated use vs. Open ethos

The six interview participants who remembered the Thank You Board reported liking it and feeling that it helped "foster a culture of politeness and pleasantness" (P14). Yet, each reported preferring SI Display and the freedom of being able to post anything to it. In general, participants said they like the "open ethos" (P06) and flexibility of SI Display, with one participant noting that she liked the "serendipity" (P13) of seeing unexpected things posted to it.

Though people liked that SI Display is open to different types of use, they were concerned about using it inappropriately. There was some consensus about some things that *should not* be posted – tweets that were harmful or negative about community members – but not about what *should* be posted. Our interviews revealed that people were unsure of the purpose of SI Display, and this uncertainty made some people hesitant to post. When asked the display's purpose, P09 replied "I have no freaking clue. I really don't." P07, who had never posted to SI Display, stated "people are unsure how it's supposed to be used or how it's meant to be used and because people, I'm a firm believer that if people don't want to offend other people, they won't do something they think might offend them and that might be use the board in a way they don't think other people think it's intended to be used for." P13 expressed the same sentiment when asked what would encourage her to post, saying, "I guess I would feel better if there were more established norms about it. If we knew more about what its purpose was and what are the goals and how people should use it." People also believed that the developers had a specific intended use in mind when the system was implemented, though the developers never expressed any such goals. Exemplifying this, P06 said, "I think it was

designed with the idea of being more of an announcement display of things related to this school."

Despite concern about using the display inappropriately, participants' reactions to example posts during interviews revealed that they were reluctant to discourage any postings even in cases where they were unsure of the post's appropriateness. P08 said, "I don't think anything is too trivial or anything or even too much of an inside thing to be posted." P01 echoed this sentiment saying "I really don't think there's any wrong thing you can post to the display because you want to encourage as much participation as possible and it needs constant participation in order to keep working as a valuable thing."

In addition to being afraid of posting something that others would not find appropriate, four people mentioned that they were concerned that they did not know exactly who was reading the posts on the display, and some were not sure that they knew all of the displays' locations. Concern about how their posts would be perceived by this "imagined audience" made them cautious about posting. There was also confusion about who the main audience of the display posts is or should be. Three people seemed to see students as the main audience, while some felt that the display should reflect a more professional view of the school, directed publicly toward an audience that included school administrators and outside visitors. Two people felt that the display should be moderated in some way, to discourage silly posts and encourage more professional ones. This lack of clarity about who might be viewing the posts, for whom they might be intended, and the mix of social spheres (outsiders, administrators, faculty, staff, and students) created tension. At the same time, people appreciated the openness of the current system and our questions about the appropriateness of example posts revealed that most participants were hesitant to make any firm designations about what does or does not belong on the display.

Though participants wanted there to be norms about how to use SI Display and everyone interviewed had ideas about what types of posts are most useful, the community had not converged on a set of acceptable forms of display use after

six months of operation. P12 expressed an expectation that norms would eventually emerge: "I think this way the community experimented together and on the way they will, the norm will evolve and become settled." P11 voiced the opinion that "it would take some use that people thought was inappropriate and then people would discuss and then social norms would emerge from that," noting that this happens periodically with the open SI email list. However, it is not clear what type of use would generate this discussion; even when interview participants thought that example posts were confusing, uninteresting, or not useful, they were hesitant to call them inappropriate. P03 discussed his annoyance at the links and messages containing lots of Twitter syntax that had been posted to the display and said he had talked about this with a classmate, but without this type of discussion happening publicly, individual opinions are unlikely to have an effect on display use.

Six participants singled out posts with links as being less useful to contribute to SI Display, since the linked web pages did not show on the display and viewers had to access the display's website to click on a link. The use of links on the display also triggered some feedback to at least one poster. When one SI Display user began creating posts with only shortened URLs, not including the actual URL, the title, or a description of the linked item, this prompted backchannel feedback to the SI Display developers, one of whom eventually emailed the user to suggest that they at least include a title or description. This dissatisfaction did not, however, catalyze a public discussion about appropriate or best uses of the SI Display, or, to the recollection of the user who posted the links, direct feedback from anyone other than the developer.

SI Display's limited demands on viewer attention may be one reason that some viewers' dissatisfaction with some posts never developed into a conversation about norms or appropriate use. In our interviews, when participants were shown tweets that they did not find useful, did not understand, or that they found silly, they tended to say that these were posts that they did not need to see, but unlike email (where unwanted messages must be deleted, archived, or otherwise acted on if they not to clutter one's inbox), they could simply not pay attention to these posts. Compared to the email list, "you can ignore [a post on the display] if you want to" (P11). Other participants talked about how the display's bulletin board style made more things acceptable to post in comparison to the email list. For example, when shown an SI Display post asking about others interested in going to a basketball game, P02 called this a "really good way to use it," but said that the same content would be inappropriate for the email list because it was "spammy."

Twitter as Posting Mechanism
Using Twitter as the posting mechanism for SI Display had several advantages as well as challenges. Participants could post from their preferred Twitter client, whether they were at a computer or on their phone. While community

members could only post to the Thank You Board by going to the posting website, logging in, and filling out a form, a process described as "too many steps" (P13) or as requiring them to "go out of [their] way" (P05), anyone with a Twitter account can post to SI Display from anywhere they can access Twitter, making it easier to contribute posts to the community space quickly and easily, something that several interview participants found useful. P01 specifically noted that she prefers SI Display to the Thank You Board because she can post using Twitter and P06 likes that SI Display uses Twitter because she can post to the display and to Facebook at the same time.

However, though Twitter is popular among many in SI, not everyone has an account or actively uses it, and the requirement to use Twitter to post was a greater barrier than we anticipated. The two interview participants without Twitter accounts both wished there was an alternative posting mechanism through a web interface, Facebook, or text messaging, so that they could participate. P03 noted that not having a Twitter account is not the same as not having "contributions that could be useful on the display." Some participants also felt that even though the displays were public, the use of Twitter as the posting mechanism limited the audience who paid attention to the posts or could reply to posts. This was especially true when the post author's identity was not obvious from the Twitter account username and profile photo, as only Twitter users could reply to questions or invitations; for people who did not use Twitter these invitations without a way to respond were "useless" (P03) and "not truly asking the entire SI Community" (P11). In contrast, P01 felt that by making at least some of the SI-related conversation on Twitter visible to people who did not have Twitter accounts, SI Display was actually including more people.

Using Twitter as the display posting mechanism also affected post content and syntax because of peoples' different Tweeting practices and preconceived ideas about Twitter. The posts to SI Display contained a total of 31 instances of "@user" syntax (excluding "@sidisplay"), 43 hashtags (#), 9 pictures, and 66 links, all common Twitter conventions [8]. Interview participants' reaction to the Twitter syntax on the display was mixed. Several, even among the avid Twitter users, felt that Twitter syntax made posts look less personal and interesting, and mentioned "glazing over" at posts with too much syntax (P06) or feeling that it "muddied" some posts (P03). Others, including some non-Twitter users, were unbothered by it and did not feel it inhibited their ability to read and understand the posts on the display. One person also felt that posting through Twitter encouraged the display to be more social and P01 noted that "It's just like the rest of Twitter, some posts are useful and some are just people posting mundane things about their day."

Three people also commented that they found it difficult to compose a message that would be appropriate both for their Twitter followers and for the display. Part of this was a

result of people being unaware that tweets beginning with @replies only appear in the feeds of users who are also following the user referenced. Though most interviewed keep their Twitter accounts public, not everyone uses Twitter with their professional colleagues. P11 was especially concerned about bringing her Twitter use into a professional context describing herself as "self-conscious about my online persona." She was concerned that posting to the display would prompt people who she only interacts with professionally to follow her on Twitter, something she does not want. This illustrates how using Twitter as the posting mechanism can create tension by "leaking" one's Twitter username to the display audience – who may not be part of one's Twitter network – or by sending content intended for one audience more broadly than intended. These are known problems when social network software crosses different social spheres [2].

Though Twitter's simplicity makes it ideal for supplying display content, certain types of Twitter interactions do not translate easily to a public display. P11 mentioned, "There's not much replying that goes on there [on SI Display] and on Twitter that's a way of validating what people say." This idea that responses, @replies, and retweets play an important role in Twitter conversations is supported by work done by other researchers [1,8]. P01 said: "People aren't having conversations. When they're posting things to the display, they don't necessarily expect a response to it." The absence of this type of interaction may have had effects on peoples' perception of how their posts had been received.

DESIGN IMPLICATIONS

The results of our comparison between the use of SI Display and the Thank You Board highlight considerations for the design of other public displays for user-generated content. These include: *single authoritative vs. user interpretations*, *content lifespan*, use of *Twitter as a posting mechanism,* and *social context.*

Authoritative vs. User Interpretations

Sengers and Gaver argue the merits of designing systems open to multiple user interpretations and allowing users to develop their interpretations unconstrained by designer goals or a single, authoritative interpretation [14]. That would suggest that unconstrained input would be better than the structured input used to automatically generate thank-you messages; those constraints limited the potential uses of the display and total use (though other factors, such as the posting method – visiting a web page – also limited the use of the Thank You Board). The users we interviewed all agreed that they preferred the flexibility of the unconstrained input, and more than four times as many messages were posted per day compared to the Thank You Board.

Both the design of SI Display and the email announcing it followed one of Sengers and Gaver's strategies for supporting multiple interpretations for use, *emphasizing usability over use* [13]. SI Display was designed to reduce the effort required for Twitter users to submit content, and the email introducing SI Display to the community contained only instructions for how to post, not what to post.

Six months after the display's deployment, however, community members remained uncertain about how to use the display and wanted to know the designers' intended purpose. Though every interview participant was aware that there were likely multiple interpretations of SI Display's purpose, for some, the concern that their use might not be consistent with some imagined correct or authoritative interpretation for how the displays should be used prevented them from posting or from posting more often.

Our experience suggests that the strategy of emphasizing usability over use may not be effective for encouraging the adoption of public displays. This contrasts with Churchill et al's experience that deploying flexible public displays with only a high level goal of "information sharing" was sufficient to drive adoption [4], but it is more consistent with other deployments of public displays. For example, in another study, Huang et al found that deploying a general tool without an initial purpose can be problematic [9]. Noting that "systems introduced for the sake of promoting specific collaboration or information sharing tasks generally were more successfully adopted than those introduced for general collaboration purposes," they suggest deploying public displays that can accommodate a variety of uses but for an initial, specific task that is critical to potential users. Such a deployment may alleviate some users' concerns about posting the wrong thing, while still leaving the system open to multiple interpretations, but it may also increase some users' anxiety about posting content that deviates from the suggested uses.

Seeing others' use of the display was also not enough for everyone to overcome the barrier to posting created by the lack of a clear purpose for SI Display, and did not, after six months, lead to shared conventions and expectations. More generally, Wenger argues that negotiation of meaning in social systems is hampered when either there is insufficient opportunity to interact directly (participation) or when there is insufficient articulation of shared understandings (reification) [16]. That is, people need to be able to try things and see others' reactions, and they also need to see the communal expectations publicly articulated. In our deployment of the unconstrained Twitter-based SI Display, neither a public airing of people's reactions nor a public articulation of expectations was available.

In the next deployment of SI Display, we plan to introduce the display with an email that suggests particular uses that interview participants told us they found valuable or enjoyed, as well as an explicit encouragement to post other items as well (to suggest uses but not constrain people to those uses), and to repeat this email on a semesterly basis. In times when the display has few recent posts, we would also add a prompt for content to the rotation of messages,

with suggestions (e.g. "Interesting talk coming up? News of interest to SI? Tweet to @sidisplay!").

One solution may be to have some technological supports for negotiating conventions of use over time. The negotiation process could be supported with some public feedback. This is supported by a study of public displays for gaming by O'Hara et al [12], which found that the audience's reactions have both inhibiting and facilitating effects. SI Display had no clear channel for audience reactions – even if a post triggered a strong reaction from a viewer, the author was unlikely to be present – and so adding features that help make these reactions visible are necessary. For example, people might simply be able to touch posts on the displays to "like" or "dislike" them (a feature that the Context, Content, & Community Collage included [10]), and summaries of the feedback could be displayed along with the messages. The system might also include a wiki page where users could collectively author a set of guidelines and examples about how the display should be used. And rather than completely throwing away the idea of templates for composing messages found in the Thank You board, templates could be authored by anyone in the community, and the most commonly used templates might be displayed first on a web page people could access to author new messages.

Content lifespan
Another design decision that requires careful consideration is determining how long to keep content on the display. Taylor, Cheverst, and Müller assert that "stale content" plays an important role on public displays because it signifies what the display is for and that others are using it [15], and Huang et al note that visible interactions can be an indicator of a display's usefulness [9]. However, the comments made during interviews about the uselessness of old event announcements suggest that old content can also discourage use because it may prompt people to perceive the display as being less useful and relevant. A possible solution may be to distinguish between content that is merely old and content that ceases to be relevant once it is outdated. Though there are implementation challenges, doing so could ensure that the display would not be empty and would not be displaying announcements for events that have passed. A first attempt might be to simply filter out posts that include dates in the past (but *not* those that use "today," as that would exclude posts such as "@sidisplay Nice talk by @aphdstudent at FIRST today."), as posts with dates exclusively included event announcements or reminders about deadlines.

Twitter as Posting Mechanism
Twitter can be an effective and useful tool for powering public displays. The generally positive reception of SI Display and the frequency of its use show that using Twitter as a posting mechanism can work. It is also clear that certain aspects of the culture surrounding Twitter use will be reflected in the use of the display, which can lead to varied display use since Twitter practices change and vary by community and context [1,8]. Using Twitter as a posting mechanism, however, also creates unequal entry barriers to posting. For those who already use Twitter frequently, posting to the display is easy, but even they were not always able to learn just from seeing example messages. In retrospect, our design decision to strip "@sidisplay" from the displayed text of messages that began with that address may have made it harder for people to learn that including @sidisplay was the way to post and that putting it at the beginning prevents the messages from going out to one's Twitter followers. Some Twitter users were also reluctant to post because they did not want to share their personal Twitter usernames with their professional colleagues. To include those who do not wish to disclose their social network accounts to the audience of SI Display or who do not wish to sign up for an account with Twitter, we recommend providing an alternate posting mechanism, through a stand-alone web page or possibly through text messages, in addition to Twitter, Facebook, or other popular micro-blogging services. Even if community members rarely used an alternative posting mechanism (posting *only* through a standalone site was a barrier to use of the Thank You Board, though at a time when far fewer people had web-enabled smart phones), it would at least not exclude people who chose not to use Twitter on principle from also participating in the display.

Social context
Though our comparison of SI Display and the Thank You Board highlights several ways that public displays can be designed to encourage use, not all impediments to display adoption and usefulness are system dependent. As described by others in previous studies, having an enthusiastic set of users early in the deployment of a display system can be extremely influential in display adoption [7,9,15]. One participant mentioned in an interview that he felt SI Display needed someone to really promote it if it was going to be adopted. Another participant proposed the idea of having some kind of contest to encourage people to post. These comments demonstrate the importance of considering not only the design of the system itself but also the methods for deployment and encouraging early adoption that maximize use of a public display system.

We also learned that the social context associated with the displays' locations can be problematic, particularly because it made the audience unclear. Not every interview participant knew where all the displays were located, and thus did not know who was likely to see them. A list of display locations on the display's About page may help reduce these anxieties for those who are particularly concerned, or the display could possibly even include live video between the different display locations, adding functionality and making the audience somewhat more real and less "imagined," though this feature would come with other challenges.

The very mixing of audiences, rather than uncertainty about audiences, however, may be problematic. If displays are

placed in locations frequented by different audiences (students; faculty and staff; general public) it may be helpful to display partially overlapping sets of messages. For example, messages mentioning @sidisplay could be shown on all monitors, while those mentioning @sifacstaff, @sistudents, or @sipublic might display only on particular monitors. Allowing for a greater control of which messages go to which social spheres is likely to reduce tensions about posting [2].

Conclusion

Our implementation and study of two public displays with different amounts of structure has allowed us to gain a better understanding of the advantages and drawbacks of each. People's preference for SI Display and the freedom to post whatever they want seems to support the creation of public displays with few usage guidelines. However, this freedom has led to ambiguity and uncertainty among the community about how the display should be used and what its purpose is. Rather than making everyone feel free to use it any way they wish, it has caused some people to be wary of posting because they are concerned about using the display in ways that others would find inappropriate.

Combining a public display with Twitter allows people to quickly and easily share things publicly with the community. However, Twitter has effects on the use of the display beyond the explicit 140-character limit. These effects are not necessarily problematic, but should be taken into account especially if the display is to be implemented for use in a community where not everyone uses Twitter.

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