Social and Privacy Aspects of a System for Collaborative Public Expression

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ABSTRACT

In this paper, we are concerned with how a real-world social situation shapes the interaction with a novel technology that combines collocated mobile phone and public display use for groups of people. We present a user study of a system that allows collaborative creation and sharing of comic strips on public displays in a social setting such as a pub or café. The system utilizes mobile phones and public displays for shared collaborative expression between collocated users. A user study spanning three sessions was conducted in real-world settings: one during the social event following a seminar on games research and two in a bar on a regular weekday evening. We present and discuss our findings with respect to how the larger social situation and location influenced the interaction with the system, the collaboration between participants of a team, how people moved between different roles (i.e., *actor, spectator* and *bystander)*, and the privacy issues it evoked from participants.

Categories and Subject Descriptors

H.5.3 [**Information Interfaces and Presentation (e.g., HCI)**]: Group and Organization Interfaces - *Collaborative Computing, Evaluation/methodology.*

General Terms

Design, Experimentation, Human Factors.

Keywords

Mobile phones, collaborative interaction, public interfaces, social context, evaluation

1. INTRODUCTION

Mobile phones are ubiquitous in contemporary societies. Although these devices were originally conceived for personal use, the Social and Spatial Interactions (SSI) platform [11], has been exploring the shared use of mobile phones to generate collaborative interactions between multiple collocated users. Some of the possibilities behind the SSI platform have been demonstrated in two applications, a brainstorming tool [12] and a photo-sharing tool [13]. At the same time public interfaces, such

as interactive billboards, are becoming more and more common in urban centers [6]. In recent years there has been some interest in how to design interactive systems for public and semi-public places (for an overview see [16]). Most of these studies have focused on interactions with large public interfaces, although some have considered aspects of using personal and mobile devices as part and parcel of the interaction (e.g., [19] and [10]). The combination of collocated use of mobile phones and public displays generates interesting possibilities for sharing information and media, as well as for socializing.

In this paper, we are concerned with how a real-world social situation (i.e., a pub) shapes the interaction with a novel technology that combines collocated mobile phone and public display use for groups of people. Our interest is in understanding the following issues:

- How do people perceive their own interaction with the system within the larger social situation?

- How does the location shape the interaction?

- How acceptable are such situated interactions from the participant's perspective?

- How do people move between *actor, spectator,* and *bystander* roles?

To explore these issues, we conducted a study of *MobiComics,* a system for collaborative expression using mobile phones and public displays in a pub. With *MobiComics* people can use their mobile phones to collaboratively create comic strip panels from photos by adding graphic elements such as speech bubbles and text boxes to captured photos. These co-created panels can then be shown on public displays to all people within the same place. *MobiComics* was designed as a type of provocative technology probe [8] to tease out the users' needs, desires, and concerns and to test how the technologies involved would work in a real-world setting.

Erving Goffman has examined the nature and dynamics of social situations and social interaction. His landmark book "Behavior in Public Places" [5] focused on how the social situation and the place influence the interaction between people. According to Goffman, a *social gathering* consists of a set of people having mutual awareness of each other at a given time. In *MobiComics*, this involves the people actively participating with the system (i.e., the *actors*) as well as both the witting and unwitting bystanders. These bystanders are basically the people in a social setting that are aware (witting) or unaware (unwitting) of the interaction with *MobiComics*, but not actually using it. Goffman also defines a *social situation* [5] as the full spatial environment where a person can become a member of a social gathering. *MobiComics* was deliberately deployed in a public, social

situation in order to see how the social situation itself exerts influence on the interaction with the system and with the other collocated participants.

Public and semi-public places such as pubs and cafés are places for leisure-time socializing. The activities carried out in such places include chatting with friends, getting acquainted with new people, and involvement in mutual pastime activities such as playing games. The place itself and the other amenities provided, such as food and drink, provide the context and the occasion for socializing. Moreover, the social nature of behavior in such places relaxes the usual standards of interaction with other people. In pubs and cafés, it is not uncommon that one interacts with not only the people within their social group, such as a small group of friends having a pint after work, but potentially with the other persons in the same social situation (e.g., Pub Quiz nights). Interruptions, brief social encounters with strangers, and constant monitoring of the surrounding social environment are basic features of behavior in these places. People also constantly come and go so the composition of the social gathering is always in flux. These characteristics make cafés and pubs ideal places for studying the influence the social situation has on mobile expressive interactions with public displays.

Following Finke et al. [4], we will use the term *actor* to denote the persons who are actively interacting with the *MobiComics* system. In contrast, *spectators* (in Goffman's terms witting bystanders) are people present at the pub following the interaction through the public displays, and *bystanders* (in Goffman's terms unwitting bystanders) are people who are in the same social gathering but who are not paying attention to the interaction. We follow Finke instead of Goffman for the sake of clarity.

The rest of this paper is structured as follows. First, we will provide a brief overview of related work in the use of public displays and mobile phones for collaborative expression. Next, we will outline the key features of the *MobiComics* system followed by the study methods. Finally, we will provide a detailed analysis and discussion of the study results, followed by our conclusions and future work.

2. RELATED WORK

MobiComics builds on a body of earlier research in the areas of mobile content creation and interaction with public displays.

2.1 Mobile Content Creation

Part of the fun in using *MobiComics* is to be able to create and share comic strips with a camera phone. Salovaara [18] describes a case study on the use of Comeks, a mobile tool for creating and sharing comic strips as MMS messages using predefined graphical elements. The style in Comeks however, was more "comic strip" like than in *MobiComics* even though it was possible to use photos as backgrounds. More importantly however, the interaction in Comeks is between single individuals, where the user sends the created comic strips to another person as a Multimedia Message (MMS). By contrast, the panels in *MobiComics* are shared on public displays for everyone present to see.

Jokela et al. [9] report a study of a mobile multimedia presentation editor, which allows creation of audio-visual stories using mobile devices. The users can compose fairly complex multimedia presentations with their phones. The basic features are similar to *MobiComics* and include annotating existing photos with graphical elements such as speech bubbles and predefined symbols. These user created pages can then be arranged on a time-line for a full presentation. Similar to Comeks, the mobile multimedia presentations are only shared between other mobile phone users. The use of public displays for sharing makes *MobiComics* expressions more public than private.

PhotoPhone Entertainment [21] describes several applications for camera phones ranging from simple, single player games to elaborate, collaborative story-telling systems. Two of the applications also involve using public displays at bus stops for involving spectators and bystanders. The interaction with the public displays, however, was only one way; the user could submit a photo to the bus stop display but could not retrieve them for further editing. Also, the user-to-user interaction was asynchronous and there was no real collaboration in creating the comic strips themselves.

In Automics [3], visitors to a theme park could create photo-stories of their visit using a camera phone to capture, annotate and share photos. Later, these photo-stories could be arranged and printed out as souvenirs. The photo capturing, annotating and within-group sharing functionality is similar to *MobiComics*; however, the sharing is limited to users of Automics, and not with other people.

2.2 Interaction with Indoors Public Displays

The focus of our research was on shared interaction with indoor public displays through mobile phones, where the studies were conducted in an ecologically valid setting and meant for entertainment. Both the MobiLenin [19] and Schminky [17] systems were also deployed in an authentic social setting. MobiLenin allows a number of collocated people in a pub to simultaneously interact with a music video shown on a public display with their mobile phones. The authors conclude that MobiLenin is a new form of interactive entertainment for pubs and other public places that has a positive effect on the social interactions that take place there. In Schminky the users play together a spontaneous, networked sound-based game using mobile devices (iPAQs) and public displays in a café. Even though the main focus of the study was on sound-based games, the authors also report findings on how the mobile devices and the structure of the game allowed the play to interleave with other activities.

Brignull et al. [2] studied how interaction with the Dynamo system, a set of large interactive surfaces, evolved over a period of time. To study this in a social setting, Dynamo was brought into a communal room in a high school. The students developed varied ways of using the system, including sharing and exchanging information and socializing with their friends. These uses both reflected and extended the existing social practices in the communal room. *MobiComics* is intended to be integrated into normal communal activities of a bar in a similar way.

2.3 Interacting with Outdoor Public Displays

Despite the fact that our focus was on interaction with indoor public displays, findings from studies conducted outdoors are also relevant. Although O'Hara et al. [14] explore how users initiate and coordinate collaborative play with large urban screens, the social situation itself is quite similar to *MobiComics*. The study revealed that play in the context of large urban screens is shaped by audience and spectatorship.

Peltonen et al. [15] report a study of their CityWall system, where large interactive displays were dispersed around the city of Helsinki during a large-scale event. The participants could use these CityWalls for sharing photos and videos from their camera phones and comment on the shared media. The results suggest

that people are willing to use the public displays to share their personal media even with strangers, which is also what we expected *MobiComics* to do.

The Manhattan Mash-up [20] staged in New York used mobile phones and large public displays for a story-telling game. The players used their mobile phone cameras to take photos according to instructions from the game system. If the players succeeded in following these instructions, a web-player used a storytelling tool to create a story out of the photos. The stories were then displayed on a large public screen in Times Square. Similarly to *MobiComics*, the public display was used to share photographic stories to other people not using the system. The setting however, was different. The people creating the stories were not in the same physical location, making the interaction with the spectators indirect. Also, the web-player acted as a moderator for the photographs to be published.

Together, the foregoing studies reveal that people are willing to interact with public displays and use them for personal expression. *MobiComics* highlights the collaborative and expressive side of collocated interactions and combines it with the intuitive use of mobile phones.

3. SYSTEM DESCRIPTION
3.1 Overview/Implementation
MobiComics allows small groups (hereafter teams) of people to create and edit comic strips using their mobile phones, and then share their individual comic strip panels onto two public displays. *MobiComics* was implemented on Nokia N900 mobile devices with touch screens running the Maemo Linux operating system. The prototype was implemented on top of the Qt 4.7 software framework. The user interface was implemented in QML, and OpenGL ES 2.0 rendering was used for user interface graphics. In order to track the positions of participants around the room (e.g., flicking a panel to another device or public display) the N900 devices were enhanced with radio tracking technology [1]. For device-based gesture recognition, the internal accelerometer of the N900s was used for detecting when a device was picked up from the table, and when a given tilting gesture was performed.

3.2 Within-Team Collaboration
In *MobiComics* nine users are split into three teams, where each team is assigned one color: cyan, magenta, or yellow. Each team member can then start creating panels from their device. To create a panel, users must first take a photo with their camera-phone, which is then used as a background for a comic strip panel. Each captured photo is automatically shared with the team through a panel collection, which can be browsed by scrolling the panels left or right.

Users can add speech bubbles to the panel by performing a long press on it with their finger. These bubbles can differ in content (by directly typing on the physical flip keyboard), size (depending on the amount of text), shape (i.e., speech, thought or text), and bubble and tip position. Existing speech bubbles can also be deleted. All team members can edit panels simultaneously, but only one person can edit a given bubble at a time. The participants could observe the edits made by other team members in real-time.

Each of the team members has access to all panels created within the team but not directly to the other teams' panels shown on public displays. In order to browse the panels shown on public displays two users must align their devices horizontally on the short edge and then pinch their devices together. When pinched together, a collection of panels previously shown on the public

display is presented on the tiled displays. Users can browse the panels by scrolling left or right through the collection. Physically picking up the devices disconnects this tiled view.

3.3 Between-Team Collaboration
MobiComics allows users to share panels in multiple ways. First, users can send a panel from their own collection to one of two public displays in a given room. To share a panel to a public display, users must simply flick the panel in the direction of the desired public display. Panels are shown on the public displays until a new panel is shared by any of the three teams. The devices are fitted with the necessary wireless sensors to detect the locations of the other devices as well as the two public displays. Second, users can send a panel from their own collection to another team. To achieve this, one team member on the receiving side must first verbally ask for a panel and then hold the phone up in the air (entering 'receiving mode'), thus expressing the intention to receive a panel. Once a member from the other two teams has spotted this cue, they can then flick a panel to the team that is holding one of their devices up and they would receive the sent panel. Third, users can take a panel from a public display and add it to their own team's panel collection by pointing at a public display and tilting the device vertically towards them. For all these sharing methods, multimodal feedback is provided by means of visual, auditory and vibrotactile feedback.

The highlight of the session consists of involving all three teams and the audience in a public vote for the best panel. To trigger the voting mode, two members, each from a different team, must align their devices vertically on the long edge and pinch them together. When pinched together, the tiled devices display an overview of all the panels that have been shown on the public display. This overview of panels is also shown on the public displays, creating an opportunity for other users and especially the audience to influence which one the users should vote on. All remaining team members that have not pinched their devices together can then cast their votes in favor or against the currently displayed panel, where the votes cast are immediately shown on the public display. To end the voting mode, users must physically pick up the connected devices.

4. METHODS
4.1 Participants
27 participants (18 male, 9 female) aged between 20 and 43 (M=29; SD=5.4) were recruited for participation. The participants were selected so that within-team members knew each other, but they did not necessarily have to know the other teams. This was done to ensure that within-team members felt comfortable expressing themselves around one other. The majority of participants had a technical background (19/27). Additionally, all participants were owners of a mobile phone. Most participants frequently went to pubs and cafés. However, when asked about their history of expressing themselves in public, it was surprising that very few (5/27) had engaged in bar doodling[1] and public expression in general, with the notable exception of partaking in karaoke sessions.

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[1] Drawing doodles on materials available in a bar, e.g. beer mats, receipts,
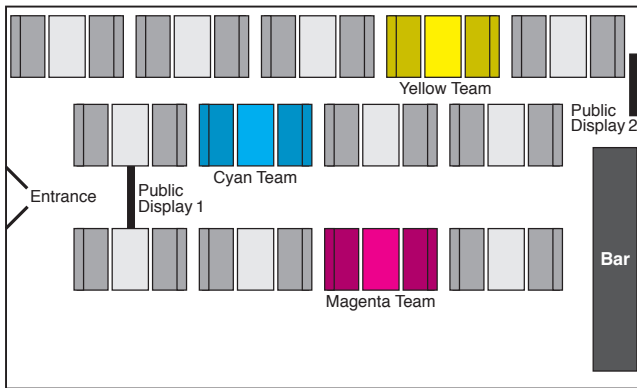
Figure 1. Floor plan of the experiment setup at the Dog's Home pub showing the location of the three teams and the two public displays on either ends of the pub. Although session one was conducted in a different location, the general layout and main components involved in the interaction were similar.

Figure 2. The *MobiComics* prototype. Members of the yellow team are creating panels (left) while the magenta team has shared a panel to one of the available public displays (right). Two pub guests can be seen in the background.

4.2 Setting

The user study spanned three different sessions: one at a social event of an international research seminar, and the other two at a well-known pub ('The Dog's Home') in Tampere's city center.

Session 1: The first session took place in the common room area of the Game Research Laboratory of the University of Tampere following an international seminar on games research. The seminar included attendees with backgrounds that spanned both technical and humanistic disciplines. Thus, the setting comprised mostly participants from the seminar, creating a casual, 'chatty' atmosphere that included light drinking and snacking. This informal session provided us with a suitable social context for deploying *MobiComics*, especially given the seminar attendees' interest in games. The two public displays used consisted of one large projection on the common room wall, and the other on a laptop monitor situated on the opposite side of the room. The devices were set on three separate tables that the participants stood around, where each table was (as much as possible) evenly spaced from the other two. This setting ensured that two of the teams faced one public display (the large projection), and the remaining team the smaller public display. By maintaining this spatial structure, we hoped that the interaction would be smoothly balanced both across teams and with the respective public displays.

Session 2: The second test session was conducted at The Dog's Home pub during the early evening (18:00) on a weekday. The pub is quite spacious and frequently hosts local bands, making it a popular hangout place amongst the locals. Inside the pub (Figures 1 and 2), there are 4-5 person-seating areas distributed all over, with two large public displays on either ends of the pub. The first pubic display is situated near the entrance, and the second one other adjacent to the bar, and directly above a foosball table. On that particular day, aside from an early evening on a working day, the weather was quite nice that day, leaving most of the city's residents sitting outside on terraces. Due to these factors, there were very few people in the pub during the test session, which possibly weakened any effect there was from having a rich, social context. Nevertheless, with the jukebox playing, early evening drinking and chatting, the atmosphere felt quite natural, despite being a little quiet. Here again, we tried to ensure an initially balanced spatial arrangement of teams, so that interaction would flow naturally and evenly between teams and with both public displays.
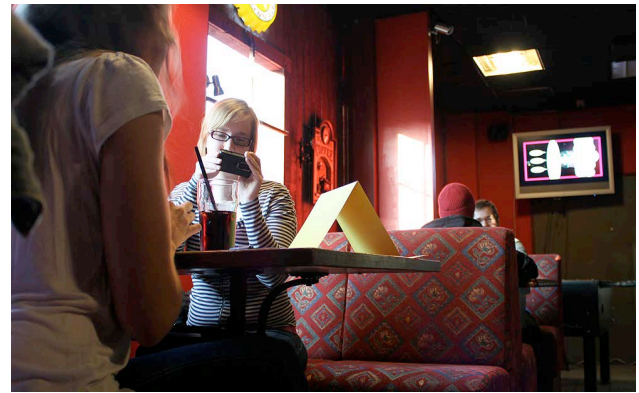
Session 3: Given the naturalistic context of a pub setting, we decided that another session at The Dog's Home is warranted. This time however, we tried to ensure that the pub had more guests. This was achieved by conducting the session later in the evening (20:00) and on a Thursday, which usually draws more people than on other weekdays. Indeed, in this third session, there were many groups of people in the pub drinking and conversing. In fact, at some stage in the session a drunk walks in the pub, and shortly thereafter walked out of the pub. As in session 2, there was music playing, drinking, but with more prominent chatter given the larger number of people there that evening. Similarly, we again tried to impose our initial spatial structure so that interaction between participating teams flows evenly, as does their interaction with the public displays at each end of the pub.

4.3 Procedure

Each session (~2 hours) consisted of four parts: introduction, exploration, test, and debriefing. First, we welcomed participants (and bought them a beverage), briefly introduced them to the study, and asked them to fill in the informed consent form and the background information form (10 min.). With the latter, we collected basic demographic information as well as participants' history of frequenting public places and their history of public expression.

Second, we explained the idea and system functionality behind *MobiComics* in more detail, and gave them a tutorial on how to perform the designed interaction techniques both individually and collaboratively (20 min.). Upon doing so, we ensured that all participants successfully performed a given interaction technique at least once. Upon completing individual interactions (e.g., retrieving a panel from the public display), participants were then given a chance to first perform within-team tasks (e.g., joint collection browsing) and later between-team tasks (e.g., voting). In the meantime, we were readily available for any technical or instruction-related support.

Third, all three teams were told to freely play with *MobiComics* (30 min.), at which time session recording began. We made sure that participants knew they could walk around and express themselves freely during the interaction. Finally, each team was debriefed separately through a series of semi-structured interview questions (60 min.). These open-ended questions were aimed at providing each participant an opportunity to reflect back in a structured manner on their interaction experiences with

MobiComics. After the interviews, participants were thanked for their time and given one movie ticket each to compensate for their study participation.

4.4 Data Collection & Analysis

For each session we collected qualitative data, which consisted of direct video recordings of each test session, video recordings of the semi-structured interviews, and finally the panel content created by each team. For each test session, video cameras (3 in total) were mounted on tripods and camera angles positioned to capture each team's interaction around the table. Given the intrusive nature of tripod-mounted video cameras, we tried to side step this issue by placing the cameras at inconspicuous positions that would minimally be out of participants' way when moving. At some points, team members would leave their table and temporarily interact with another team, and this was noted from the latter team's video footage. Additionally, some of the researchers present would take notes of their observations as well as subtle digital snapshots of the setting and bystanders.

For the semi-structured interviews, there were three key content areas we wanted participants to address: their current and past engagement in collaborative expression (including history of public place visits, bar doodling, and partaking in karaoke publicly), their opinions and experiences about *MobiComics* in general (including overall impression, intra- and inter-team collaboration aspects, use of interaction techniques, social context influence, envisioned actual system usage), their opinions and experiences concerning the Social and Spatial Interactions (SSI) platform (including using personal phones for collaborative goals, the tangible aspect of interaction, use of multimodal input and output interaction methods, and the spatial arrangement of persons for interaction modulation).

For analysis, all sessions including the semi-structured interviews recorded on video were transcribed. There were a total of 9 videos (3 per session) that required transcription and analysis. Affinity diagramming [7] was used to analyze the transcribed data. Two researchers independently made notes of each video recording. Later, during the clustering phase in affinity diagramming, all researchers were exposed to the inter-coded data. The affinity diagram supported categorization and visualization from all researchers of the main themes emerging from the inter-coded data, which we discuss below.

5. RESULTS & DISCUSSION

5.1 The Influence of the Larger Social Situation

The general impression from the participants was that *MobiComics* was a fun social experience (19/27). The views on actually using the system, however, were divided. Some of the participants (9/27) remarked that they could use the system themselves with their own phones, especially if it would be more widespread. At the same time some participants (5/27) said that they either would not want to use the system or would not see a point in using the system. *"[P3.3] My general impression of MobiComics is that I personally would not need it, but someone may like it."* This discrepancy between considering *MobiComics* as fun to use but not necessarily wanting to use it might arise from the public social situation used in the test settings. Many of the participants (18/27) explicitly remarked that the pub or a café would not be the suitable social context for the system and preferred a relatively more private environment. Home parties and student events, weddings, and family gatherings were suggested

as more comfortable social situations *"[P2.1] In some student event where people know each other this would be fun"*. One participant, however, preferred to use the system in an even more public environment such as a rock concert.

The more private situation entails that people in a given situation where *MobiComics* is deployed would generally know each other. Also, in the suggested alternative contexts, such as weddings, it is already customary to take photos of other people where the content created during the event can be used as a souvenir or memorabilia (*cf.,* [3]). This is also reflected in the general content of the photos taken during the sessions, where the main focus was on the immediate physical environment, and less so on other people present. In some cases, the *actors* switched roles and became themselves *spectators*, as when they became photo objects for other teams. For example, in session one there was a series of pictures taken from another team's participant staged in a recursive loop (Figure 3).

One crucial aspect relating to the fun in using *MobiComics* is the ability to make something funny and/or clever and show it to other people around. This sought after social gratification punctuates on the competitive elements such a system can foster, especially given the social reward reaped later during the voting phase. Indeed, many participants stated explicitly that they wanted to show others something fun and creative they could make with the system. *"[P1.8] We were trying to make funny stuff, or maybe some arty or creative stuff."*

The creative aspect also arose from reacting spontaneously to a situation at hand. A few participants (3/27) stated that they would have wanted to use the system more spontaneously, reacting to something funny happening at the current moment (e.g., by making a reciprocal panel). This did not come through as clearly from the sessions as they were limited in the amount of time they could use the system. What is perceived as humorous however is quite subjective. Even though there was only one instance of potentially offending material shared during the three sessions (a photo of a sexually explicit drawing), some participants commented that in a situation where there would be more people present in the pub, it would be different. The system does have potential for offending other participants and especially *bystanders. "[P1.4] If there are complete strangers and booze this would be difficult."* However, this will be elaborated on further when discussing the raised privacy issues (see section 5.5 on Privacy).

Figure 3. A recursive panel created during session 1. The yellow team captures one participant from the Magenta team successively.

5.2 The Influence of the Location

Participants reported an unpleasant feeling of self-consciousness when capturing and sharing panels. There was some concern about the pub setting, which combines a public place with the consumption of alcohol. The participants had concerns not only on what others might share, but that they themselves need to be aware of what to share *"[P3.1] MobiComics enables bullying, as you can take embarrassing pictures of others and send them to the screen for everybody to see"*. One participant remarked on how showing pictures on the public display is good, as long as there are no pictures posted of people in questionable situations. Another participant thought people might get used to having their images on public displays in pubs where this is in use. Pushing this public exhibitionism further, another participant expressed that if there are questionable adult pictures posted throughout the evening, it might be possible to get used to it. A couple of participants however thought that there could be problems if the images taken before the *MobiComics* session could also be sent to a public display (2/27). The content of such images might feel suitable for sending to the public display when drunk, but doing so might feel bad afterwards. Indeed, some participants had clear reservations on what to write on the pictures that were posted to the public displays, as they simply wanted to avoid sharing bad things.

Participants commented on the lack of discrete communication channels to coordinate actions between groups (e.g. a chat channel). As there was no way of electronically communicating with other groups through *MobiComics*, participants needed to move closer to the other groups in order to coordinate actions with them. One group specifically commented that yelling to another group did not feel very appropriate, especially when seated far away from another team. While some of the *MobiComics* features requested from participants to engage explicitly with other teams, participants also showed their devices to others irrespective of those designed features *"[P3.1] Showing the display of your own screen to others depends on the content on the screen and in this case, it was ok."* One participant stated that as a phone user, he is used to the screen being private to him and that the barrier to start showing the screen to others is high. Another participant believed that showing the phone screen to others would require being quite social and daring, as this is an action that some participants would not like to do.

Overall, the dominating impression amongst participants was that while some of the design features in *MobiComics* may not feel socially acceptable now, the system overall would eventually be accepted. This would happen mainly due to a change in people's attitudes towards how the pub experience is supposed to be like, where taking photos in pubs would be the norm, not the exception to the rule.

5.3 Collaboration Between Participants

Team members occasionally helped each other, but there was little within-team collaboration or planning beyond that. An exception to this happened in session one *"[P1.7] Okay, this is the plan: I'll put it on the screen and then they watch the screen and then I'll take another picture."* In other sessions, this kind of collaborative effort was lacking, which was also evident later in the interview sessions *"[P1.5] It was a bit problematic that X was the only one taking pictures and then he took one picture and instantly started to write something on it so we did not have that much to discuss."*

Switching devices happened quite often within a team so that all team members could both take images and share them to a public display. A few participants felt that it would be better to have all the functionalities available in all the devices (5/27). In one team, having two types of devices even caused a small problem where one team member assumed a leadership position by almost solely taking images himself *"[P1.1] That might have been (a problem) because I always had an idea even before taking the picture."* In other teams, the situation was more coordinated across team members, where it seemed everyone had a chance to take images and also edit panels and share them with others. It was interesting to see that participants did not mind that other team members were editing the images they had taken, which runs the risk that the panel owner's original idea may be spoiled. Instead, editing images together was seen as one of the most interesting and fun features that *MobiComics* offered. Related to this, when the other teams' panels where published on a public display, they sometimes served as inspiration for new images and speech bubbles. In fact, heightened interaction across team members occurred precisely when some interesting speech bubble was created. This was evident when participants pointed to a public display, and showed their device to the other team members. In such particular cases, the public display content proved to be a rich source of creativity.

In some teams, the interaction between members appeared to be quite lively, marked by many discussions and laughter, while in other teams, members did not seem to be very engaged with the interaction offered by *MobiComics*. One reason for this might have been due to group dynamics, where the difference in social relationships between the team members may have structured the interaction accordingly. In a team where all members know each other equally well and share similar humor, the collaboration and interaction is likely to increase within that group. However, as stated later in the interviews, these situations may result in lessened between-team interaction, as the content of the panels may be too personal.

5.4 Moving Between *Actor, Spectator* and *Bystander* Roles

Some participants perceived *MobiComics* as some sort of game where teams are competing against each other. Indeed, in the design of *MobiComics*, game-like elements fostering competition through voting were an explicit design choice aimed at facilitating playfulness. In voting situations, in order to initiate the voting mode, a participant needed to go to another team and connect their device with a member of the other team. Voting happened in all the sessions at least a few times. However, voting was perceived by some to be more or less artificial and distracting from other activities (10/27) that were ongoing during that time. *"[P3.11] Apparently you have to vote when someone is in this voting mode since you cannot do anything else"*

One feature in *MobiComics* was specifically designed to study how people would move between *actor* (e.g., one of the nine direct users of the system), *spectator* (e.g., people at the pub following the interaction through the public displays), and *bystander* roles (e.g., people present at the pub but not paying attention to the interaction). During voting, we were expecting at least a couple *spectators* to transition towards an *actor* role. We were hoping *spectators* to first actively influence which panels would be voted on, and second that *spectators* would even try to directly cast a vote (i.e. by borrowing one device from an *actor*). None of the above took place. In practice, people at the pub briefly transitioned back and forth between *bystander* and *spectator* roles, but never between *spectator* and *actor* roles.

Regarding the lack of input from the audience prior to voting, one explanation may be that there were not enough people present in the crowd acting as *bystanders*. As for the lack of participation during voting, it was difficult to motivate people to participate due to the public nature of voting.

Voting involved turning the phone so that a thumb presented on the screen of the device would point up or down. Voting in this open manner requires participants to publicly reveal their vote to others, which was not seen as socially acceptable by a few participants (6/27). Voting thumbs down in such a social context raised concerns to some participants *"[P3.7] I have the desire to vote in secret, especially when voting thumbs down."* Even though the system displays a large thumb on the screen during voting, it was actually possible to vote without revealing the vote. In fact, two participants were observed performing voting gestures in a secretive manner. This was corroborated when one of the participants explicitly mentioned that he liked the fact that one can make a small voting gesture that was not visible to others. The social acceptability of voting and receiving panels notwithstanding, a few participants also commented that if someone would be standing next to them, it would affect how they would perform gestures (3/27). One perhaps stretched example provided by participants is that if a motorcycle gang member were next to them, they would certainly hide most explicit gestures required for interacting with *MobiComics*.

5.5 Privacy

Some participants expressed strong concerns over privacy and security issues related to the use of *MobiComics*, especially in a pub environment where people generally do not know the other people present *"[P1.2] The privacy issues are going to kill this application."* The main concerns had to do with taking photos in a semi-public place, posting of potentially manipulated photographs of other persons on a public display, and the permanency and distribution of the pictures after a *MobiComics* session ends.

Some participants (6/27) felt uncomfortable being photographed in a semi-public place like a pub *"[P3.9] It is unpleasant if people take pictures of you without your permission in a bar."* Respectively, many participants felt it difficult to approach unknown persons in the other tables to take photographs of them (8/27). As the camera phones used in the study had limited zooming capabilities, the participants were forced to approach to a few meters distance to take portrait photographs. In general, taking photos of unknown persons in a pub was considered to be inappropriate and against the prevailing social norms (16/27), where some participants thought it was even illegal. The issue concerns the perceived consent (or lack of it) from the participants who could potentially be the objects of captured photos. According to the CityWall [15] study, many of the participants in the study did not object to showing photos and comments of themselves or other participants on the public screens. This is also evident in the current social acceptability of sharing photos online (e.g., in Flickr[2] or Facebook[3]). Given our findings, it appeared that the social model applied (at least between system participants) assumes that if a person you already know does not explicitly object to being photographed, then it is acceptable to publish the photo. In our test setting the participants did not necessarily know all the other participants. Especially, they did not personally know the *bystanders*. This lack of perceived consent is one factor explaining why there were few photos of other people. One

participant even suggested that the pubs could organize *MobiComics* nights, meaning that a person entering the pub gives an implicit consent for being photographed for a panel.

Another source of concern was the publishing of photos on a public display. These concerns included the risk of accidentally publishing pictures that one did not want to share, the fear of becoming unwillingly the center of attention in the pub, as well as the possibility of others publishing embarrassing or intentionally insulting photos *"[P1.2] You can offend someone a lot [with this system]."* These concerns were further strengthened by the system feature to manipulate photos by adding textual comments and speech bubbles, allowing participants to completely change the interpretation of the pictures or "putting words into one's mouth." This potential threat was even more pronounced by the possibility of any participant to pull published pictures from the public displays, manipulate them further, and republish them. A few participants explicitly proposed some kind of moderation (5/27), either by a human operator or by automatic filtering algorithms, as a potential solution to these privacy issues. Other participants however, commented that they did not like the idea of censorship.

A few participants also raised questions about what happens to the published photographs after a *MobiComics* session ends (6/27). These participants were especially worried about pictures leaking out of the *MobiComics* system by people pulling them from public displays to their own personal devices *"[P3.9] What if an unknown person takes your photo and stores it in his or her device? Your photo can end up anywhere. I would not like to have my photos on [a public display] so that anybody can grab them."*

Despite that there were a number of privacy concerns expressed, many participants ultimately did not take these concerns so seriously; as one participant stated *"[P1.9] It might feel somewhat unpleasant if somebody published a stupid picture of me with something nasty. But in the end, that would not undermine my ego so much."* While some participants mentioned they would probably think twice before going to a pub running the *MobiComics* system, none of them said that it would be an absolute reason not to go. Some participants even appreciated the opportunities *MobiComics* provided for breaking the established rules and norms in a playful way *"[P2.1] MobiComics might be immoral, but I think it would also be very fun."*

6. CONCLUSION & FUTURE WORK

We have presented a user study of a system that allows collaborative creation and sharing of comic strips on public displays in social settings. The system utilizes mobile phones and public displays for shared collaborative expression between collocated users. *MobiComics* allows small teams of people to create and edit comic strips using their mobile phones, and then share their individual comic strip panels onto two public displays. We wanted to particularly investigate how a real-world social situation (i.e., a pub) would shape the interaction with such a system during collaborative expression. We were also interested in how acceptable such situated interactions would be from the perspective of the participants. We conducted a user study spanning three different sessions: one at the social event of a research seminar, and the other two at a well-known pub in Tampere's city center.

Regarding the larger social situation, participants remarked that this type of system would be better suited for more private gatherings as it does have potential for offending other people present. As for the location, participants were concerned about the pub setting as due to the combination of a public place with the

consumption of alcohol (i.e., regretting sending things to the public display while drunk). People at the pub swiftly transitioned between *spectator* and *bystander roles,* however there were no opportunities for us to study how people moved between *spectator* and *actor roles.* Finally, participants raised privacy concerns of using such a system in a pub. These issues surfaced due to both the created public expressions themselves and the methods of interacting with public displays through mobile phones in a social situation.

Future work will address more closely the social acceptability factors at play as well as the naturalness of the designed interaction techniques in social settings. Additionally, we plan on conducting more test sessions that involve an even larger number of bystanders, to better understand how non-participating bystanders perceive the system in use. Together, this work brings us closer to understanding how personal technology (through mobile phones) and public displays can be used in real-world settings, and how that can potentially transform social interactions both between system participants and with strangers.

7. ACKNOWLEDGMENTS

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