

Social Displays on Mobile Devices: Increasing Collocated People's Awareness of the User's Activities

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ABSTRACT

Activities that traditionally have been performed with tangible artifacts, e.g. reading the newspaper and browsing printed photos, have increasingly moved to mobile devices. This has made it harder for the surrounding people to observe an activity a person is doing with the device. As a result, the possibilities for serendipitous social interactions between the actor and the collocated people have diminished. We introduce *social displays*, additional displays on mobile devices that provide social cues about the device user's activities for surrounding people. We conducted five focus groups with in total 23 participants, each discussing four scenarios and co-designing the presentation of cues on the display. The results suggest that the display has potential to break the private bubble of mobile device activities, as well as to provide tickets-to-talk to enhance social interaction, especially between acquaintances. We discuss social opportunities and challenges as well as possible design directions for social displays.

Author Keywords

Collocated interaction; activity awareness; social interaction; mobile device; backside display; social display;

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g. HCI):
Miscellaneous.

INTRODUCTION

Mobile devices have been designed for personal use and are perceived as personal devices [8]. This is evident from, for example, their small display, touch-based input, and vibration feedback. Mobile devices have enabled people to be increasingly connected to remote people and access information anytime and anywhere. However, in many

situations, people engaged with their activities on mobile devices create their own private bubble or “cocoon” [1]. Especially within families or groups of friends, this can hamper the sense of community and create feelings of social isolation [1]. Although mobile devices are in fact also used as tools in face-to-face social interaction, those interactions are often initiated by the device user [2, 24].

In addition to the private interface, current mobile devices are designed to enable a broad range of activities that were previously carried out with specific artifacts. Many activities that have traditionally enabled social aspects, such as easy observation and even joining in the activity, have become private. For example, reading a newspaper allows others to see what one is doing and even ask about the content. Similarly, browsing photos or watching videos on mobile devices has lost many of the social elements that physical photos and televisions used to involve (e.g. a joint focus and a shared interface). In other words, mobile device interfaces have decreased the awareness co-located others have of the mobile user's activity. As a result, the chances of creating serendipitous social interactions and shared experiences around the activity may diminish.

Dourish and Bellotti define awareness as “understanding of the activities of others, which provides a context for your own activity” [6]. Raento and Oulasvirta define social awareness applications as “the idea of a group sharing real-time context information via a personal and ubiquitous terminal” [18]. In this paper we use the term *activity awareness* to refer to the awareness that collocated people have of the activities mobile users do with their devices.

Our study explores how the activity awareness could be enhanced with visual cues on a *social display*. Social displays are envisioned as additional displays on mobile devices that provide various types of cues to nearby people about the mobile user's activities in the digital realm (e.g. mobile services, applications, or content). To study the concept with contemporary technology, we chose to use a display on the back of a mobile device as a form factor. Further, as awareness information can trigger informal interaction [21], we expected that, ideally, social displays would also encourage face-to-face interaction or foster other social experiences – particularly between and among people who know each other, such as friends, family members, or colleagues. The overall approach builds on the

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research on Social Devices where the general aim is to enhance interaction between collocated people with technology [11]. The contribution of this paper is two-fold: first, we present the novel concept of social displays with various example scenarios. Second, an exploratory study of the concept, through scenario evaluation and co-design, sheds light on the perceived social opportunities and challenges of the concept and highlights various viewpoints to consider in the research agenda around the concept.

RELATED WORK

Overall, technology increasing social awareness has been actively studied in computer support cooperative work. In remote communication, technology provides additional cues to mimic missing physical cues (e.g. [5, 7]). In the context of people in close proximity to each other, technology increasing awareness encourages collective interactions and increases a sense of community. The Break-Time Barometer, for example, provides information about other colleagues during break time in a workplace [12]. The aim was to encourage people to convene together during their coffee breaks. A stationary alarm-shaped device provides social activity information occurring at different locations. Walky applies microblogging to mundane activities such as walking to tell other seniors in a community when someone is going out for a walk [13]. The information thus encourages further interaction between seniors within the community. Jabberwocky is a mobile application that enhances a sense of community by informing whom in their surroundings have been previously encountered in public places [16]. This awareness information is also a resource for developing further social interaction. StudioBRIDGE provides additional information related to other people, groups, locations, and events that can help users to decide the appropriateness of initial online and face-to-face interaction with others in workplace [26]. ContactContexts provides callers with current status of the person they which to talk to in order to help them decide whether it is appropriate for them to make a call [15].

In co-located situations, people are aware of others' physical presence. However the activities that are happening in the digital world (e.g. with a smartphone) can remain unknown, which creates a design space for the technology itself to increase activity awareness and create shared experiences in collocated situations. Some earlier research has explored this design space through different approaches. O-SNAP supports collocated collaborative search on mobile devices by providing a collaborative mode that contains search-related information for each user's mobile device [22]. Pac-Man Must Die enhances the collocated game experience by creating a shared display out of multiple mobile device displays and making it advantageous if the players perform shoulder surfing while playing [20]. Reetz and Gutwin study the effect of different gestural interaction sizes in maintaining awareness among collocated people in a group. The results show gesture sizes

do not have significant effect in their visibility and awareness to surrounding others [19]. However, the study limited to the observability and visibility of the gestures, and did not cover an understanding of what the user was working on.

Attaching a pico projector is an approach aimed at rendering the interaction with a mobile device to be more visible and shareable to collocated people. Cowan et al. suggested several use cases in which projectors attached to mobile devices could support face-to-face interaction, including facilitating spontaneous sharing, conversation triggers and playful interaction, collaborative coordination, and personal expression [3]. Tweeting Halo uses personal projector as a way to allow people to express themselves in public by projecting the user's Twitter message on the ceiling above the user's head [14]. However, using a projector to extend the display to the environment has been found challenging in overcrowded shared spaces with respect to privacy [3, 14]. The privacy issue concerns both private content being shared in public places and forcing eavesdropping, that is, others seeing content by mistake.

Backside of mobile devices has been widely explored as an alternative input channel for touch screen gestures (e.g. [4, [25]). In this research, using a social display is an alternative approach for making interaction with mobile devices noticeable to others in one's surroundings. The backside displays have been explored in face-to-face interaction between customer and the service provider in a service encounter with stationary technology [9]. The authors argue that having a double display at a service counter has the potential to enhance trust, effectiveness, and collaboration in the service encounter. Zhu and Höök, similar to Tweeting Halo, share users' tweets on Twitter to collocated people via the phone case [29]. Yotaphone [27] and InKcase [10] are existing commercial products that offer a second screen on the back of mobile phones as a supplementary information channel. Although these are mainly marketed for personal use, we considered the backside display a promising form factor for increasing activity awareness. Such a display is less intrusive with respect to privacy than a pico projector, but may still allow for subtle presentation of one's current activity with a mobile device to other people in one's physical surroundings.



Figure 1. Mobile phones with screen captures of various applications were provided as stimuli.

In summary, this study extends the research on social awareness with a purpose and approach that have not been well undertaken before. In particular, we explore the potential of the novel concept of social displays to create opportunities for those people around a mobile device user to initiate interaction based on the visual cues they see from the user's activity on mobile device.

FOCUS GROUP AND CO-DESIGN STUDY

To study the concept, we built four illustrated scenarios and a simple paper-based mock-up of the backside display (see Figure 1) as stimuli for discussion and co-design. In five focus group sessions with four to six participants in each group, we discussed the practicality, opportunities and challenges of the concept. Each session included co-design activities to understand how the participants would like the backside display to present their activity to others and their interests to see the activity of others.

Altogether 23 participants participated in the study (11 male and 12 female). The age distribution was 23-46 years, with an average age of 29.5. The participants were university students or university personnel, representing a wide variety of nationalities; (13 nationalities, *anonymized nationality* was the most common). A movie ticket (worth 10 EUR) was offered to participants as a token of gratitude. The sessions were audio recorded and transcribed. The transcript was analyzed with qualitative content analysis [28], in particular with a physical affinity diagram that produced a data-driven and bottom-up hierarchy of themes.

Before presenting the scenarios, the concept was introduced on a general level without any illustrations, to avoid influencing the participants' initial impressions with overly detailed mental images. The emphasis of the introduction was on the problem statement, which regarded how mobile interfaces have made activities like reading newspapers and browsing photos more private than what they used to be, hampering the probability for serendipitous social interactions.

Scenarios

After an initial round of group discussion we presented four scenarios to stimulate discussion further. The scenarios demonstrate different use cases of social displays (particularly mobile phones with backside displays). We

included different familiar social contexts (family, colleagues, and friends) and different digital activities (e.g. reading news, exercise data, social media content) as well as both opportunities and threats in the scenarios. This diversity was intended to help the participants form a broad understanding of the concept and thus be able to evaluate it from various viewpoints. The following summarizes the main elements in each scenario and Figure 2 provides excerpts of the illustrations. The scenario-based discussion part lasted approximately 90 minutes.

Family Breakfast

John and Kelly are a couple living together in a small city. During breakfast, John usually checks the news on his mobile device. He recently bought a device with a backside display. This helps Kelly see what John is browsing. She notices that John is reading the sport news and asks him about the football match yesterday.

Colleagues in a Meeting

Edward is really busy today as he has emails to respond to. Additionally, there is a weekly meeting today that he has to attend. This forces him to work on his device during the meeting. Fortunately, the backside display on his device shows other colleagues in the meeting that he is busy working, not engaging in leisure or other inappropriate activities. Edward, in turn, feels more polite using his device during the meeting.

Timothy is bored during the meeting and almost falls asleep. To stay awake, he uses his device to check Facebook. However, to seem polite, he changes the content of the backside display so that it displays a document.

Colleagues during a Coffee Break

Alan is a cyclist, and today he biked to work. He comes to the office kitchen to get coffee and get ready for work. He joins Victoria at the table and puts his device down. Victoria notices Alan's biking activity and notice of calories burnt on the backside display of Alan's device. She compliments him and starts sharing her own mountain biking experience from last month.

A Group of Friends in a Restaurant

Laura, Ellen, Sean, and Alex go out for lunch together.

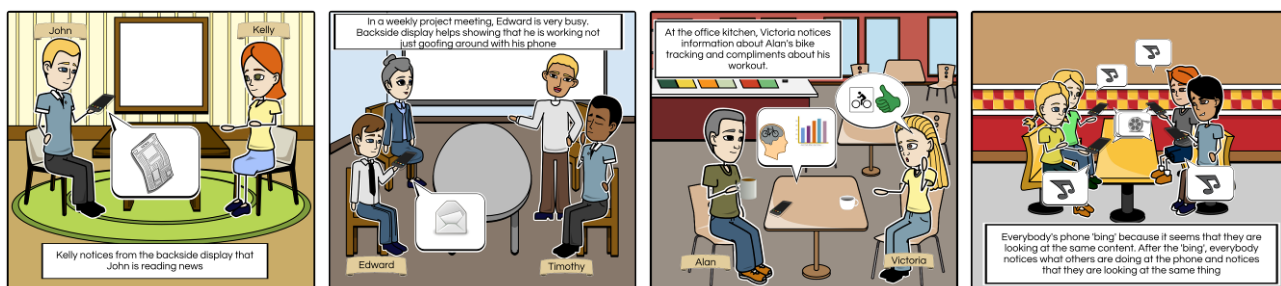


Figure 2. Excerpts from the scenarios (left to right): Family breakfast, colleagues in a meeting, colleagues during coffee break, a group of friends in a restaurant

While they are waiting for their food, they all play with their mobile phones. Suddenly a bing sound is played by all the devices at the table. They look at each other to see what is going on. They notice from the backside display of each other's devices that they were actually looking at the same recently shared set of photos on Facebook. Laughing, they start discussing the photos.

Co-Design Procedure

After the discussion about the provided scenarios and the overall concept a co-design activity was carried out. The participants were asked to design and sketch content for the social display, regarding how they would like others to see their activity with their mobile devices. As stimulus, we provided mobile devices with screen captures of various mobile applications attached on the front display (Figure 1: left). The applications were related to news, social network services, leisure and entertainment, web browsing, and emails and communication. Participants were then instructed to design how they would like to display different applications on the backside display (Figure 1: right), considering different contexts of use. Participants later presented and discussed their ideas and drawings to others in the session. This hands-on design task lasted approximately 45 minutes.

RESULTS

We first report on the participants' initial impressions of the concept based on the introduction given in the beginning of the sessions. This is followed by the participants' preferences among the four presented scenarios, including report on the scenario-specific perceived challenges and opportunities. Finally, we present the results of the co-design, including the participants' sketches of their visions of the social display and presentation of their activities and application content.

First Impressions of the Concept

To begin with, all participants admitted that they actively use mobile devices while interacting with others face-to-face. In their opinion, such behavior has become common and socially acceptable, but they admitted that they also get annoyed when others behave like that. However, it was considered unusual for people to complain about such behavior. Often when one person in a group starts using the phone, it is seen as the starting point, or permission, for others to do so: *"If I see somebody doing something with their phone, I have a feeling that maybe somebody wrote me something as well"* – (Female, 23).

Overall, the participants had diverse opinions about the concept in the beginning. The minority was open-minded and not bothered by privacy or other issues: *"I think most people know what I am doing and I don't really try to hide or care if others see"* – (Male, 24). They saw that people around them could already guess what they were doing with their mobile device, as it was partially visible anyway:

"Even if others cannot see my screen it is kind of possible to guess what I am doing" – (M, 28). The mobile display is often too small for others to see the details on the display. Additionally, it can be tilted or covered to avoid others seeing their activity on the display, thus not creating any significant privacy issues. Moreover, shoulder-surfing or looking at another's mobile device display is generally considered impolite, thus people usually keep their eyes away from others' displays.

Nevertheless, most of the participants were hesitant about letting their actions be observed by people around them. They were concerned that the display would expose overly detailed information to others, such as others seeing the messages they were writing, other people's Facebook profiles they were browsing, or the possibly inappropriate content they were browsing on the internet: *"If I am reading some sexy articles, I don't want others to see that"* – (M, 35). Another concern was that the display would be constantly visible in the physical surroundings and to anyone there. The discussion hence brought up the needs to be able to turn the display off quickly if the social context were not opportune for any fruitful social encounters. As a result, a few participants speculated that they would be forced to check what is shown on the display frequently and possibly try to cover it with their hand.

Another concern related to how others might see the user in public, i.e. self-presentation. In contexts such as offices, the displayed information can create the impression that the user is not acting appropriately: *"Sometimes I quickly check if there are any new things on Facebook or a news website while at work. I wouldn't want others to know about this"* – (F, 36). Several mentioned that if their activities were visible to others in detail, they would cut down on texting and checking Facebook as it might seem impolite. Moreover, it could put other people into an awkward social situation, such as when having a conversation with new friends: *"When being with colleagues and acquaintances, if they know that I am using Facebook they might get offended, like that Facebook or video on YouTube is more interesting than our conversation"* – (M, 23).

The last concern here related to the form factor chosen for the study to represent the social display, i.e. the backside display. It was noted that people often hold their phone in such a way that the backside display would face the ground.

All in all, the presented concerns are understandable when one has heard only the overview of the concept. The provided scenarios allowed the participants to understand better the possible social benefits of the concept, rendering the overall attitude slightly more positive. The following discusses further user perceptions for each scenario to identify aspects which was considered opportune and which disputable, as well as highlights various opportunities identified for the concept of social displays.

Scenario Preferences and Evaluations

Credible Tickets-to-Talk

Colleagues during coffee break was selected as the preferred scenario by 13/23 participants (Table 1). The participants appreciated the backside display as something that could truly provide a ticket-to-talk: “*At work, I share a coffee room with 60-70 people and most of them I only know by face [...] maybe this could bring more possibilities to discuss something else rather than the weather or the quality of the coffee*” – (F, 42). One participant mentioned that a similar situation had actually happened to him: “*I have a picture of a cat on my home screen. I was in an elevator with someone I know. He accidentally saw the picture on my phone and asked about it. I ended up opening my cat album and showed it to him*” – (M, 28). The scenario was seen to allow not only the mobile devices users but also those around them to initiate interaction related to content on the devices.

Participants agreed that being aware of what other family members do (as in the *Family breakfast*) has potential to encourage interaction. It creates opportunities to develop interaction based on the current activity: “*You can recommend something to the other person. If I know he is watching a video on YouTube, I can suggest [that he] look at another interesting video*” – (M, 29). It was also seen as a social cue for others to behave in a more context-sensitive way: “*If I saw that my husband is watching a video on YouTube and it is ending soon, I could wait a bit instead of interrupting him in the middle*” – (F, 36).

Social and Activity Context Matters

A group of friends in a restaurant, on the other hand, was not perceived as a credible scenario. First of all, it was not considered that a group of friends would have been looking at the same content on their mobile phones. If it actually happened, some participants noted that there would be no point in bringing it into discussion if the content was not interesting: “*If nobody thinks it is funny, nobody wants to comment on it. It is only if someone thinks it is funny, then you show it*” – (M, 24). On the other hand, positively-reacting participants saw this as a reminder for them to be social with the people in their physical surroundings rather than those online.

Finally, *colleagues in a meeting* was the least-favored scenario. Predictably, participants preferred not to show any entertainment activities on their backside display while in a professional working context. Comments related to the mobile device user’s point of view were very different from those around them. Participants commented that the backside display could be a way for a device user to communicate to others why he or she is not paying attention to the meeting. However, the participants looking at the situation from people around the device user point of view commented that there was no use in making activity visible in the meeting context: “*I wouldn’t check what was on the*

Scenarios	Score	Most Favored	Least Favored
Family Breakfast	63	7	2
Colleagues in a meeting	44	2	11
Colleagues during coffee break	74	13	2
Friends in a restaurant	49	1	8

Table 1. Total preference scores for each scenario and the numbers of participants who selected each scenario as most/least favored. In counting the total score, 4 points were given for the most favored, then 3 and 2 to 2nd and 3rd respectively, and 1 to the least-favored.

person’s backside display, regardless of what he was browsing. [...] It doesn’t matter what he is doing if he’s not concentrating on the meeting” – (M, 46). The backside display would just create additional distraction to others in the meeting.

Alternative Opportunities for Social Displays

The provided scenarios were helpful in allowing participants to understand the possible benefits of the backside display, and thus increased their appreciation of the overall concept. Consequently, the group discussion brought up various alternative ideas for how the concept could be developed in various directions.

Besides making *current* mobile device activities visible with the backside display, participants suggested that the display could also show something interesting that has happened recently (e.g. recently-read e-books or articles). The display could also be an additional channel for people to express themselves. After all, mobile devices are often considered to be extensions of one’s personality or appearance. Thus, the social display could serve as an advertisement channel, expressing one’s style, or even be used to brag about one’s achievements. In this respect, the social display provides opportunities somewhat similar to those of social network services (SNS) for expressing one’s personality and self-expression. However, a social display was considered more easily accessible and effective than SNS for opportunistic use between people who are co-located as the information is visible in situ. “*I think it is better than Facebook. If Victoria [the character in the scenario] saw this later on, the moment for starting a conversation would be already gone*” – (M, 23). A few participants also perceived the social display as a more secure way of sharing than SNSs: “*I am very strict about putting photos of my kids on Facebook or the internet. Here if I want to show them to others, I can just put the picture on the display and it remains there. No one can steal it*” – (F, 36).

Furthermore, the concept was seen as a tool to raise awareness about what one is interested in at a certain time, such as a campaign or a challenge they are trying to achieve: *“If I am interested in the breast cancer campaign, I can promote it there, just to get others to notice and maybe become interested too”* – (F, 36). One participant thought that this way of increasing awareness would be more motivating and encouraging to others, as it is also supported by other modalities of interaction, such as talking or non-verbal communication, and the continuous activity itself. In the digital world, such as that of SNS, information is limited by what the system provides and usually disappears with the flow of information over time.

As mobile device users create a private bubble around themselves, the people around them might also get the impression that they should not interrupt. The social display could help indicate to others that the person is not doing anything so crucial that one could not interrupt them: *“Maybe it can be useful if you are hanging out but you have to use the phone, so others can see that you are checking emails or doing something that is probably important. [...] But if you are just browsing something, then I could encourage you to put the phone down, at least I will do that with my friends”* – (M, 28). Consequently, the social display was seen as a tool to fight the formation of those the private bubbles and allow others to encourage the user to focus on the interaction with the collocated others.

Several times mobile devices are used for remote communication. Participants considered backside display to increase the opportunity for others in the surrounding to also interact with the person at another end of the mobile device. A participant whose daughter just left home mentioned: *“We are all missing [the daughter]. I wouldn’t mind showing at home when I am chatting with her, so others knows and could say something to her”* – (M, 46).

Finally, the social display could also allow surrounding people to understand a device user’s situation and offer help in problematic cases: *“Google Map and Google Translate would be useful. Quite often you are lost in a city when you are travelling and you are checking the map on your mobile phone. Other people could probably notice that you are lost or looking for directions”* – (M, 24). The map is hence another example of modern digital interfaces replacing

traditional physical tools, which has led to decreased activity awareness and approachability.

Co-Designing Content for the Backside Display

Participants presented diverse design ideas for presenting content on the social display related to specific applications and activities. For some applications, there were very open and detailed designs, while for others the designs were more privacy-sensitive and cautious. There were two main directions in the participants’ designs. When plotting their designs, some of the participants were not bothered by who people surrounding the device user might be. The same content would be shown on their display regardless of the relationship with those around him or her: *“For me, others are everybody, starting from my friends and family to strangers. I cannot say what I want to show to my mom or to strangers. It is kind of the same thing”* – (F, 23). At the same time, some others had different designs based on the envisioned audience. The closer the relationship was between user and the surrounding group more information would be revealed. The following elaborates on the observations of the participants’ designs.

Icons for Automatic Activity Cues and Explicit Sharing

As the size of the backside display does not allow for the display of much detail, an application icon would be an easy way to relay activity with the mobile device. Most participants considered the backside display to be a channel for providing brief, summarized information about their current or recent activities. Application icon or name was considered already to be able to convey some cue about the activity with relatively little information (Figure 3: left). If others found this cue interesting, they could ask about it and develop further interaction. *“Rather than showing everything on the [backside display], I prefer we come close to each other and look at it together, so most of my designs are just logo-based”* – (F, 27, Bangladeshi). This was a common design choice made by most of the participants. In familiar and leisure-oriented contexts, additional detail of the current application was seen as something that could be shown (Figure 3: right).

An application icon was also considered practical with respect to privacy, as it concealed details of the activity, for example when chatting with someone or checking emails or Facebook. One idea was that the icon would only be changed to a more descriptive representation when the user decided that his or her current activity on the mobile device was acceptable or worthwhile to share through the social display: *“It doesn’t make sense to share everything while just scrolling through a lot of content because I think it is not interesting. I would prefer deliberately choosing what to share”* – (F, 27). Some commented that the user’s explicit selection of the content to share could hint to others that the selected content would be interesting to them. Web browsing on mobile devices is a good example; most participants did not want the backside display constantly to

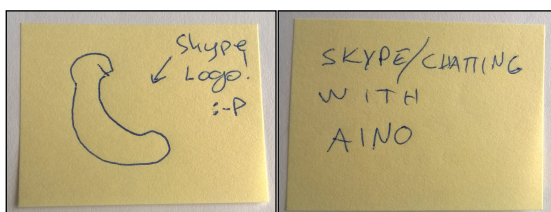


Figure 3. Examples of designs for Skype with icon and additional detail. Left: a participant preferred just an icon. Right: Additional detail is added in a participant’s home context

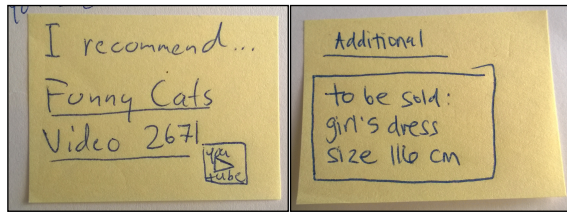


Figure 4. Examples of advertisements as an alternative use of the backside display.

show in detail what they are browsing on the internet. They mentioned that one never knows what a link on the internet might lead to – including strange or inappropriate sites: “*I am browsing here and there, and when I see something that appears interesting I just follow. It might lead anywhere. People might get me wrong with what I am doing*” – (M, 46). Internet browsing and photo browsing were considered something people do to pass time in an unplanned and opportunistic situation. If the user cannot explicitly select the content to be shown, many participants preferred to have just an icon to represent a cue to the activity, or to leave the display blank while browsing.

Presenting a General View of Interests

Because of the diversity of the activities people do on mobile devices as well as the social contexts in which they are performed, the concept was considered appropriate only for some activities: “*Reading books and news are activities that fit perfectly [with the concept], but there are also other*

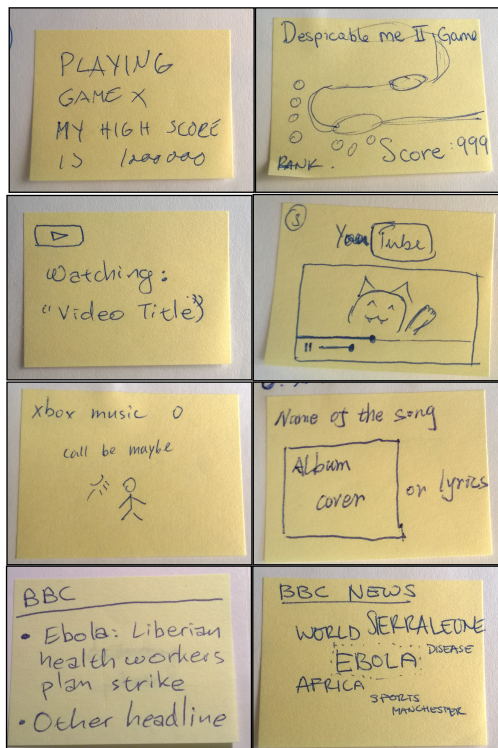


Figure 5. Different backside display designs for games, YouTube, music, and news.

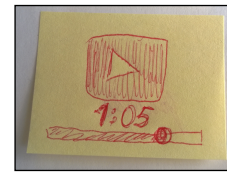


Figure 6. A design for YouTube shows time left on a video

activities that I do on the device” – (M, 23). At the same time, some participants did not see the social value of displaying just an icon: “*What’s the point of having the second display if you just show the logo?*” – (F, 27). The participants proposed alternative designs to follow the original idea of increasing awareness of a device user’s activity to those around them in order to increase social opportunities. They suggested having a *general view* to show on the display when they did not want to others to be aware of their mobile activities: “*I have ‘general view’ which shows things that I like or am interested in. I would like to use it for several applications where I don’t want others to know exactly what I am doing: for example, when I am browsing the internet, Facebook, or Twitter*” – (F, 36). The general view could provide alternative tickets-to-talk besides the user’s actual activities on the mobile device. This was envisioned to include information about personal interests as well as user-selected pictures or other specific content from the mobile device. Photos were considered one of the fruitful content types for stimulating social approaches: “*I like taking photos. My phones could be a default screen. It is something you can start your discussion about either your travel photos or photos of your children*” – (F, 42). Additionally, it was suggested that the general view could be a channel for promoting or advertising self-created content, topics of discussion, upcoming events, or other personally interesting matters (see e.g. Figure 4). Especially one participant who is a contributor on a YouTube channel emphasized on this: “*I don’t see the use of just showing logo, so I would go for advertising my own video*” – (M, 32).

Leisure Applications on Backside Display

In general, for entertainment-related applications, a rather extensive level of detail was considered to be acceptable to show on the display mostly in non-work related context (Figure 5). The information could include not only the application name but also details about the current content being viewed. A participant whose husband often watches YouTube videos suggested one design for YouTube, showing how much time one has left on the video (Figure 6). This was to let others know when others could interrupt at a suitable moment.

In addition to context and application being used, the intentions to use the backside display create differences in participants’ designs. Some participants designed the presenting content to let others around them know about their the current activities with the device; for example,

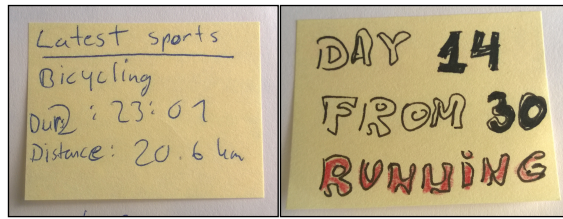


Figure 7. (Left) common design of fitness application; (right) twisted design of fitness application

game high scores, title of the video, the name of a song, or headlines of the news (Figure 5: left column). Other participants, on the other hand, tried to design the content on the backside display which are interesting to others; for example, parts of the live game or video, album cover or lyrics, or news tag cloud (Figure 5: right column). Similarly for fitness applications, several participants were open to providing a lot of details of the fitness information (Figure 7: left). However, some participants considered this boring and hard to understand. They instead proposed an alternative design (Figure 7: right): “*Now there are a lot of 30-day challenges. You could put that this is my day 14 of my biking challenge. Others can see the process and ask about it*” – (F, 23). One participant also commented that it is more interesting to see the progress in sports regarding long-term goals, rather than the same day-specific fitness details (e.g. step count) every day: “*It is more interesting to know that you are in day 14 of 30 not 35 km at this speed and route. It also allows a nice visualization on a small backside display*” – (F, 36).

DISCUSSION

Summarizing the Main Findings

The awareness information on the backside display was generally considered to have the potential to act as a ticket-to-talk and to burst the mobile users’ private bubbles. After all, mobile devices are perceived as resources for social interaction [2]. Most often the mobile device users are the ones who initiate interaction with others. Here, the participants envisioned having the backside display would enable also those around the device user to also initiate social interaction.

In the outcomes of the co-design, there are three main aspects affecting the presentation of the content on the social display: context, surrounding people, and current activity. Context refers to the norms in the situation and the appropriateness of one’s activity on mobile device. The desired level of detail of presented content varied between types of audience: family, friends, colleagues, or even strangers. Furthermore, the participants approached the presentation of activity cues on the social display from two design perspectives: that of the user of the device user’s and that of the surrounding people.

For the former perspective, the mobile device user’s, the display would provide a channel for device users to present

and express themselves with the activities they do in digital services. However, the social display created an impression that information would be available to anybody in the surroundings. Presenting cues about one’s activity on the display brought concerns about conveying messages to those both intended and unintended around the users. This, thus, may create incorrect impressions to others especially with those who do not know them very well. Even though strangers were not intended as the main target group for the concept, concerns about strangers seeing the content intended to a familiar person were occasionally mentioned.

Displaying icons of the current application was a common solution when the participants were thinking from the perspective of the device user. Simple icons were considered good for generic use: they were seen to fit to a variety of possible audiences, contexts, and the user’s current activities with the device.

From the perspective of the surrounding others, different digital activities and services were perceived to have different possibilities to fulfill the initial purpose of the concept. In order to increase activity awareness with the social display, to convey a message that it is okay to interrupt, and especially to result in social interactions, the displayed content was preferred to be more detailed than just an icon. Examples of activities that could be presented with relatively much detail include music listening, watching videos, browsing photos, and other content consumption activities. Such activities involve a possibility for creating joint focus or shared experience between multiple users, hence having a strong potential to create serendipitous social interactions. Similarly, showing details about utilities like navigation applications were considered opportune to allow others in the surroundings to identify one’s activity status and thus offer a help if it seems needed. On the other end, checking email or work-related applications are activities that participants preferred not to be observable through a backside display in detail. Such activities do not encourage joint focus or shared experiences but, rather, could only provide cues that others should not disturb them. The use of mobile devices without any additional cues can already give an impression to others that they should not be disturbed [17].

Reflection with Prior Work

Balancing between respecting privacy and allowing self-presentation has always been a challenging issue. Raento and Oulasvirta have proposed design principles to manage the privacy and self-presentation in social awareness application [18], which mostly could be applied also in the future designs for social displays. The intention to increase awareness of one’s current activity on mobile devices to others in the close physical proximity, however, making the concept different from earlier social awareness applications and creating a new challenge for the design. The public visibility of the backside display does not allow controlling what information is displayed to which target groups,

unlike in remote communication where users can define different access for different groups of audiences. Interestingly, the participants tended to overlook the possibility to control the availability of the information with physical manipulation (e.g. placing a hand in front of the display). Furthermore, being present face-to-face allows for rich and expressive cues of social interaction, such as timely mutual feedback from each other's action and direction of others' attentions, and are affected by social norms [1]. For example, when a user notices that the display is viewed by unwanted people, he could hide the display which would be a simple and physical way to manage the privacy.

People are generally not particularly worried about privacy when they are publicly interacting with traditional objects: for example when reading a newspaper in a lively social context such as at a bus stop or office coffee room. Having mobile devices as a tool for the same activities seemed to make the participants more concerned about their privacy. This could result from using technology that can provide more easily processed information [1]. This explains why the participants' designs for the social display were generally with cautions. Future design should consider the ambiguity of the content, avoiding other people jumping to conclusions about the user's personality base on the content on the display. Another challenge for the concept relates to social norms and the position of the display. Mobile devices and activities on the devices are usually seen as private, even around familiar people [8]. Staring at others' mobile activities is usually not preferred or acceptable – both from the mobile device users and the surrounding others' perspective. Thus, the visual representation of the activity should be observable at a glance, without requiring starring or seeing the full view of the display.

Methodological Reflections

The study, even though still representing early research steps in the form of focus groups and co-design, surfaced a broad spectrum of important insights, perspectives, articulate the design space and design proposals that reflect potential users' needs and expectations of the concept. These help creating meaningful prototypes of the concept in the future research. In creative co-design activities and evaluative group discussions, it is important to reach a level of thinking that goes beyond the conventional. The first ideas from the participants when we mention the concept were mostly similar to social awareness applications such as [26]. The scenarios were helpful in communicating and scoping the concept we are focusing on. The co-design also revealed a variety of insightful viewpoints and alternatives and articulated their ideas further in more concrete forms. Having the backside display as a concrete form factor for the general concept of social display was found to facilitate the participants' understanding of the general purpose of making one's digital activities physically observable by collocated others.

Nevertheless, in hindsight, the gathered user insights are limited to the explanations and examples we provided. Keeping a diary in addition to this focus group would have provided more example situations of how the concept would work in real-world situations, through long-term experience, and from different perspectives. In the upcoming phases of the research, controlled experiments and trials with working prototypes will provide more reliable information about the actual acceptability and social impacts of different designs.

CONCLUSIONS AND FUTURE WORK

Mobile devices and digital services are ubiquitous and can serve for a broad range of activities. Many activities that were easily observed and allowed shared experiences have become more private after people started using mobile devices to perform them. We presented the concept of social displays as an approach to foster serendipitous interactions between collocated, familiar people.

Participants approached the display from two design perspectives: a user of the device and those around the user. In general, social displays making mobile device users' activities with their personal device more observable by those around them was seen to have a good potential to act as ticket-to-talk especially among acquaintances. It also allows others to break the social isolation that mobile devices create in collocated situation and increase possibilities for serendipitous interaction, especially among families and between friends. Furthermore, social display was seen to provide a channel for self-presentation and self-expression for mobile device users but also to be challenging concerning privacy management. Context, surrounding people, and current activity on mobile device were the main variables in participants' designs to present activity cues on the social display.

Our extensive focus groups and participatory design supported articulating and elaborating the design space and shed light on the perceived opportunities and challenges of the social displays. This serves as a user-centered basis for guiding future research activities. In the future we will continue with detailed designs of how to present activity cues on the social display from different design perspectives. We will closely consider the level of detail-ambiguity of the presentation and balancing between the sense of privacy and expressiveness of the activity cue. As a new perspective, we plan to not only consider what content the user is viewing but also present cues of the user's input interactions on the social display.

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