Producing while Consuming:
Social Interaction around Photos shared within Private Group

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Abstract. User-generated content plays a pivotal role in the current social media. The main focus, however, has been on the explicitly generated user content such as photos, videos and status updates on different social networking sites. In this paper, we explore the potential of implicitly generated user content, based on users' online consumption behaviors. It is technically feasible to record users' consumption behaviors on mobile devices and share that with relevant people. Mobile devices with such capabilities could enrich social interactions around the consumed content, but it may also threaten users' privacy. To understand the potentials of this design direction we created and evaluated a low-fidelity prototype intended for photo sharing within private groups. Our prototype incorporates two design concepts, namely, FingerPrint and Mood-Photos that leverage users' consumption history and emotional responses. In this paper, we report user values and user acceptance of this prototype from three participatory design workshops.

Keywords: Social networks, Photo Sharing, Consumption, Personal content

1   Introduction

The amount of personal content in the online world is growing exponentially. People can easily capture and share personal content such as photos, videos, audio tracks and textual data on social media platforms such as Facebook, Google+ and MySpace. The meaningfulness and emotional attachments to such user-generated content make it important, rather than its ownership [21]. The main focus, however, has been on the explicitly created content. In this paper, we are interested in exploring the use of implicitly created personal content, in particular, users' browsing history, usage, log data and access patterns that are not made visible and explicit, in the current research. The way people consume others' and their own content can provide some useful insights about this invisible social interactions. By capturing people's consumption-related information inferences about very simple social interaction such as "who has seen my profile" to more complex social interactions such as "what type of connections (family, friends or colleagues) are interested in my activity X" can be made. Additionally, we believe that us-

ers' consumption patterns can be used to design new social features and better recommendation mechanisms.

In fact, studies have shown that consumption activities, such as browsing a friend's profile page, status updates or photos, account for the majority of all user activities on Social Networking Services (SNS) such as Facebook, MySpace, Hi5 and Orkut [11, 25]. Recent research has shown that consuming or browsing, accounts for 92% of all user activities [11]. Clearly, people spend much more time in consuming content as compared to explicitly reacting to it (e.g. by commenting) or actively publishing. Such studies drew our attention to an unexplored design space where we as designers and developers of social media services can leverage consumption related information for supporting new social interactions. We term this particular design direction as *producing while consuming*. The phenomenon itself is explored in a few projects [25, 12, 29, 30]. It is, however, largely overlooked in the user study literature. Some of the popular SNS, such as Orkut and Friendster have used features such as "Recent Visitors" to provide a history of profile views. Flickr also includes statistics that show the interaction and viewing history on users' photos. Facebook recently also introduced the "seen by" feature which informs a user that his or her post or message has been read by the recipient. Moreover, advanced approaches are used [28] to collect a broader set of "interaction metadata" that can convey information about who saw it, who said what when they saw it, what was pointed at when they said it, who did they see it with and for how long, how many times and so on.

In this paper, we explore 'producing while consuming' as a new research topic for always-connected smart mobile devices. The current generation of smartphones, equipped with the state-of-the-art sensing technologies and their ever so present nature in people's everyday lives make them a potential source for capturing users' consumption-related behaviors. For the purpose of exploring the design direction of 'producing while consuming', we studied the use of a low-fidelity prototype - PhotoBook that focused on photo sharing within private groups, such as close friends and families. In addition to basic photo browsing features, we incorporate two design concepts in PhotoBook: FingerPrint and MoodPhotos. The FingerPrint concept allows users to view *consumption patterns* (frequency, and recentness of visitors) related to their photos and represents this by a set of layered fingerprints on the top of the photo. The MoodPhotos concept reveals how the visitors reacted to an owner's photos by capturing visitor's facial expressions associated with photos. On a photo sharing gallery, these two concepts enable relevant people to view how visitors have been consuming photos with a representation of fingerprints and emotional responses.

Revealing people's consumption-related activities has strong privacy concerns. For example, people may not want others to know their current activities or their high interest in certain shared content. Realizing this, we first decided to apply a participatory design approach to verify general user value of the 'producing while consuming' research theme and evaluate privacy risks at an early stage of design. We organized three participatory design workshops involving three different situations and user groups. Our results provided reflections on the design direction of 'producing while consuming'. Our participants viewed the two design concepts as a means for lightweight feedback, which provided reassurance and a sense of connectedness. We also observed that our participants found that revealing their consumption patterns did not greatly compromise their privacy, as the photo sharing was within their private group. Overall, we lay stepping stones for further development in the 'producing while consuming' design direction.

2   Related Work

From the literature, we will discuss some related work on photo sharing activities and current studies that leverage users' consumption patterns.

2.1 Photo sharing

There is a rich body of literature on personal photos and practices related to photo sharing. We will limit the scope of our literature review to only photo sharing using technology. For a much broader review on photo sharing, we refer you to Sarvas and Frohlich's [24] recent text book.

Social networking services are by definition computer-mediated services that allow users to share their own content, integrate content and interact with others [9]. Olsson [20] emphasizes that when people share photos online with relatives and close friends the main motivator is also to strengthen the existing relationships, as an addition to reminiscing and reliving certain events and storytelling [26, 27]. Self-presentation and expressional needs also play a big role in photo sharing regardless of the size of the target audience [22]. Putting ones' photos visible for others online seems to include a motivational aspect of collecting others' comments and also to follow the interaction, discussion and history around the photos and even archiving it [18, 19]. Photos that are commented by other users seem to found a new content object that is valuable for the owner as an entity including all the interaction history from other viewers.

The storytelling aspect of digital photos is well emphasized in Balabanovic et al. [2], where in a study the authors explored two categories of methods people used in telling stories from digital photos: photo-driven and story-driven. Using semi-structured interviews, Miller and Edwards [16] studied digital photo sharing practices of 10 participants on Flickr. They explored two categories of users: people who were still following the Kodak Culture and 'Snaprs'. Snaprs are the ones who shared their photos even outside of their social network with fewer concerns for privacy. Their immediate focus was on taking photos then sharing them to relevant people. Ahern et al. [1] identified four factors that could affect people's privacy while sharing digital photos: security, identity, social disclosure, convenience. Bentley et al. [4] compared personally captured photos to commercially purchased music and found several similarities. From this comparative study, they found out that 1) users search with fuzzy concepts and settle for an "okay" option, and 2) users change their mind during the search process and end up with something completely different.

Photo sharing via camera phones is also a well-researched area. Kindelberg et al.'s [14] study of camera phone users led to a taxonomy of six affective and functional reasons for image capture on a camera phone: individual personal reflection, individual personal task, social mutual experience, social absent friend or family, social mutual task, and social remote task. Van House et al. [26, 27] studied kinds of images taken and patterns of sharing with cameraphones and the MMM upload software among a graduate student cohort at UC Berkeley, and among more general cameraphone and Flickr users. Olsson et al. [22] studied users' needs for sharing the digital representations of their life memories. They identified three main motivations: personal growth and identity (no sharing), strengthening social ties (sharing with family and friends) and expressing/getting attention (sharing with anyone). In a field study, Jacucci et al. [10] explored how people actively construct experiences using mobile devices capable of sharing multimedia content. In particular, the authors suggest that continuity, reflexivity with regard to the self and the group, maintaining and re-creating group identity, protagonism and active spectatorship were important social aspects of the experience. Another such event sharing study that comes close to our research interests was done by Esbjörnsson et al. [7]. From an ethnographic study at car racing venues in the UK and Sweden, the authors describe three interesting findings that can be useful for supporting event sharing at car racing venues: viewing paradox of spectating, active spectating and role of sociability.

2.2 Leveraging Consumption

In [11], authors explore user activities in four popular social networks: Orkut, MySpace, Hi5, and LinkedIn. In a 12-day period, an average user interacted with 3.2 contacts in total, but these

users interacted visibly (e.g. using comments) with only 0.2 friends. The study shows that the amount of all interaction is 16 times greater than the amount of visible interaction. In [5], the authors explore user activities on Facebook, Twitter, and Flickr with their mobile devices. Their result reveals that the users only attend to a small proportion of a full content set, such as content recently published and content from selected contacts. Both studies indicate to the potential of users' consumption behaviors.

The following studies attempt to leverage users' consumption data by revealing visitors. A study [3] shows that feedback mechanisms (on consumption activities) made people feel comfortable to share their location information with friends and strangers. It also reduced their privacy concerns. In this study, a mobile location-based application was deployed in Facebook. One group of users received feedback, i.e. they could check who viewed their locations. The other group of users did not receive this feedback information. As a result, the study found the first user group was more positive about sharing their locations than the second group. Orkut and Friendster have added a "Recent Visitors" feature, with an assumption that this will increase the level of interactions among users. However, existing studies do not agree with the value of such designs. One study [25] suggests that the design did not typically lead to reciprocity. The authors investigated the impact of the "who've viewed you" feature in China's RenRen, one of the biggest regional social networks. From more than 93% of users, less than 10% of latent relationships are reciprocal.

Some early systems explored the feasibility of 'producing while consuming'. For example, the PhotoLoop [29] is a system that automatically captures users' activities while watching slideshows. It uses video/audio recordings and integrates this data (slideshows and video narrations) to create attractive content. The concept provides functions similar to our MoodPhotos feature, where they allow recording videos of users who look at photos. PhotoLoop is aimed for a stationary context, which differs from the present study about mobile scenarios. Mobile devices tend to be used pervasively in different time, locations, and social contexts. A combination of such information can lead to more sensitive situations.

The concepts addressed in this paper all deal with automated content capturing and sharing. There are many earlier studies in this general direction. The WillCam [30] proposed a digital camera that helps users to add visual annotation while taking pictures. The annotation includes facial expressions of the photographers that are taken by another camera attached at the back. CenceMe [17] is a system that infers the presence of individuals using sensor-enabled commercial mobile phones and shares this information through Facebook, MySpace and other online SNS. As for image sharing, CenceMe supports a feature to automatically take and share random photos without any control from users. All of these concepts promote automation in terms of content sharing. However, these systems are seldom systematically verified from a user experience perspective.

3   Exploring Consumption with Photos

We are exploring mobile services for users to share their photos within their inner circles, i.e., closest friends and family. In our current setup, users can directly upload photos to a shared album which is accessible to relevant users. Additionally, we are using face recognition tools to identify people in photos and provide them access rights. The private group setting is the key differentiator here, compared to the existing photo sharing tools such as Facebook or Flickr.

To explore the 'producing while consuming' design direction, we introduce two features to this photo sharing setup: FingerPrint and MoodPhotos. Both the features are meant to capture user' consumption behaviors and utilize this information to enrich social interactions around the consumed content.

3.1   FingerPrint

The FingerPrint concept uses the metaphor of physical photo sharing where viewers unintentionally leave their fingerprints on photos. The concept allows users to view consumption patterns about their photos and represents this by a set of layered fingerprints on the top of the photo. Figure 1 shows two screens of the FingerPrint concept, where Figure 2A depicts a normal photo gallery visible to everyone and Figure 2B shows a view where all visitors' consumption patterns are represented with different fingerprints laid on the top of the photos. This view is visible to only specific people. These fingerprints are shown in different colors, sizes and intensity to represent type of friends (e.g. colleague, family), frequency and recency; respectively.

On the technical side, the concept uses the front camera of mobile phones to detect the face of the viewer (to verify that somebody is looking at a photo). It calculates the amount of time spent on photos and also takes into account the number of finger gestures (e.g. zoom-in with two fingers). Additionally, it records the eye-gaze using front camera, to place a fingerprint in a particular portion of the photo.

(A)   **(B)**

Figure 1: The FingerPrint concept. (A) the default view, and (B) consumption patterns with fingerprints.

3.2   MoodPhotos

MoodPhotos gathers a user's facial expressions when he/she browses a shared photo album and shares these facial expressions to other users when they browse the same photo. This design feature relies on the front camera of mobile phones to capture users' mood photos.

Figure 2 illustrates how the design concept MoodPhotos works in a shared photo album. When a user browses a photo from a shared album for a prolonged time, an emoticon appears in the corner of the photo. The emoticon is equipped with a counter that indicates how many mood photos other people have left on the image (in Figure 2A). The user can check out the mood photos in detail by pressing the emoticon button (in Figure 2B), and add his/her mood photo from a sequence of photos that the device has automatically captured while he/she was viewing the image (in Figure 2C). These photos are meant to reflect natural responses of the user. Consequently, user can choose an appropriate mood reaction from these photos or pose for new ones.

Figure 2. The MoodPhotos Concept. (A) the default view to browse photo; (B) the view to check mood photos in detail. (C) the view to add own mood photos.

As a general UI concept, MoodPhotos embodies many alternatives. The above-mentioned example details the use case where users exchange concrete portrait photos as emotional response to a photo. Alternatively, these impressions can be abstracted into emoticons on the basis of the facial expressions of the viewers. As Figure 2 shows, a user must initiate the operation to share a mood photo. Alternatively, the system can be more proactive when it detects "dramatic" expressions from the viewers. Given the privacy risks, the system needs to ensure users immediately awareness of mood photos to be shared.

4   User Studies

Given the stringent privacy concerns with both of our design concepts, we took the first step by exploring users' reactions using a paper-based low-fidelity prototype. In this study, we intended to explore users' 'realistic' behaviors hence it was important to use real photos in our prototype [8]. We recruited two student groups and one elderly women's group for our user studies. Each group consisted of 4 close friends. Our user studies consisted of two stages:

1. Each participating group was asked to organize a common social event, where individuals were asked to capture at least 20 photos at the event. In order to gain real emotional responses, the participants were instructed not to reveal or share the photos before the participatory design workshop. After the event, all these photos were sent to us so that we could use them in our PhotoBook prototype (Figure 3A).

2. Each group was invited to a participatory design workshop. They were asked to individually browse through the PhotoBook and leave fingerprints and mood reactions. In the PhotoBook, all the photos had a layer of transparency (Figure 3B) for the participants to annotate their consumption-related data. A real-time, photo sharing simulation was created where participants were provided with an opportunity to capture their own photos to leave facial reactions (Figure 3C).
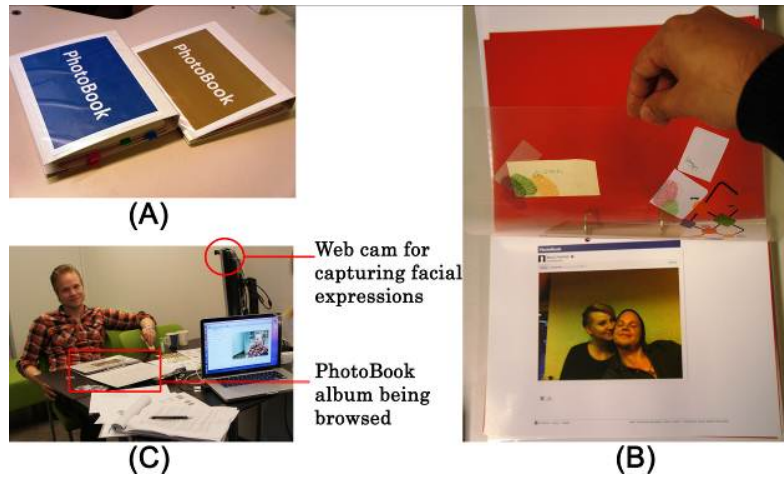
Figure 3: The PhotoBook prototype (A), photos with a layer of transparency (B), and the setup of our photo browsing sessions (C).

4.1 Participants

Three group of users participated in this study. Group A consisted of students (2 males, 2 females, ages 27-30), who organized a bowling event and had a dinner together. Group B consisted of younger students (3 males, 1 female, ages 22-26), who went to a music concert called "Lost in Music 2011" – an indoor festival in Tampere. Group C was a photography club that consisted of four pensioners (all females, ages 67-72). They arranged a party together at one of the group members' home in Tampere. The first group captured 223 photos, the second group had 378 photos and the third group captured 181 photos, hence the total of 782 photos.

4.2 Participatory Design Workshops & Photo sharing Simulation

From the photos we collected from our participants, we created a physical album out of them. Since all participants were familiar with web-based photo sharing, our PhotoBook layout had similarities with existing photo sharing tools. In addition to making the photo album, we added a transparency on the top of each photos. This transparency was meant to store all the consumption related information. We made three version of the PhotoBook album with different photos in each version.

To simulate photo sharing act, we positioned our participants in three separate rooms of a large user experience facility in our company. One room had two participants and; the other two rooms had one participant each. Each room had a version of PhotoBook album, a web camera for taking pictures, a set of fingerprint stickers in different colors and sizes and relevant stationary. A researcher was responsible to explain the procedure of the workshop and acted as a helper to the participants (Figure 4A). The researcher began with explaining the two design features of the PhotoBook (FingerPrint and MoodPhotos). The participants were asked to browse through the PhotoBook album and use the available material to convey their consumption patterns. The researchers helped participants in capturing their facial expressions while browsing through the photos and prompted them to stick the appropriate ones on the transparencies. We also arranged a color printer, from which we gave them prints of their photos during ongoing sessions. In each room, a user was given 30 minutes to browse through the photos.

Figure 4: Participant being helped by a researcher (A) and a group interview session (B).

At the end of the browsing, researchers would carry the PhotoBook album and to the next room. All the three versions of PhotoBook were circulated to different rooms along with the researchers. During the individual sessions they added comments and communicated with each other through the photo book. This way the PhotoBook versions brought information related to consumption data to the next participants and allowing sharing of photos and the information about the way they are consumed. During the procedure, each researcher talked to all participants in turn. In a way, researchers pretended to be the "technology" that shares photos between all participants, adding the functionality of the service and supporting the interaction.

At the end of the whole simulation, we collected all photos annotated with different consumption behavior and invited our participants to a group interview (Figure 4B). In the interview, we discussed their experience of using such a prototype in their real life, especially focusing on the FingerPrint and MoodPhotos concepts. The most commented photos were scattered around the table so the users were able to see the collection they had created together in the events, by additional content and comments from the simulation sessions.

We transcribed both the individual and group sessions and analyzed our results using an affinity diagram technique. We also used the photo collections from PhotoBook to associate their comments with their photos.

5   Results

Our PhotoBook prototype and the participatory setup were intended to explore how people's consumption related behaviors can be utilized such that they could bring value to people's interaction with personal content (in this case, photos). As an overall finding, the users were positive about leaving fingerprints and mood reactions to photos so others could see them. Nearly all the photos received fingerprint marks. About one quarter of photos received mood photos during our study. In the following, we provide details of some important findings from our study.

5.1   Consumption as Content

As our participants viewed photos in the PhotoBook prototype, they indirectly contributed to the original content, by leaving fingerprints, mood reactions and in some cases comments. Figure 5 shows two examples where photos are annotated by sticking 'named' fingerprints and mood reactions to express that these photos have been 'seen' by specific participants and what kind of facial reactions the photos evoked, respectively. The prototype was designed in a way

that this consumption data is shown as an overlay of the original photos such that original photos remain as they are. However, it was observed during our participatory design workshops that participants viewed photos in terms of how they were consumed. For example, commenting on a mood reaction on her photo, a participant said: *"Mood photos could raise social interactions. When you see the reactions of others, it gives you reactions. It also works when you don't have a comment to add but want to share the feeling. If you put a smiley, it is just a smiley."* With the consumption data added on the top of photos, participants not only shared experiences from the actual event where a photo was taken but they could continue their interaction after the event was over. Similarly, our participants were also very careful about how they represented their consumption patterns. Participants intentionally left cues on photos to add meaningfulness to those photos. In cases where they found less interesting photos in the PhotoBook, they decided not to leave any cues about their consumption behaviors. Here is a comment from one of the participants: *"I think it is not that special. Maybe it is because I have seen many pictures of me like that! It doesn't give me any special memories of that night. It is not special for me, it is not even funny for me."*

(A)　　　　　　　　　　**(B)**

Figure 5: example of annotated photos.

As the consumption data were added by others the photos became collectively owned by the people who viewed them. On several occasions, the consumption patterns even became more important than the actual photos. As shown in Figure 5b, when participants saw a very provocative photo of a fellow member of their group (Group B), they reacted by adding their mood expressions. Here the mood photos were used as a means for poking fun at the person in the photo. Figure 5b is an example where different mood photo reactions led to an extended social interaction over the consumption data. A participant who left his mood reaction said: *"I'd like to add my mood here because Heikki and Päivi have given thumbs up to Matti's photo. It's like "oh, not again". There are always pictures like this from Matti (laughing). It's typical Matti!"*

In this example, the mood photos were not only a response to the shared photos, but a response to mood photos left by other group members.

This way, on several occasions participants' fingerprints and their mood reactions became an important source of social interactions. As we showed, participants poked fun at each other and extended their social interaction by adding their reactions on the original photos.

5.2　Lightweight Communication and Sense of Connectedness

FingerPrint and MoodPhotos supported lightweight interaction, which convinced the users to produce more content over shared photos. Referring to FingerPrint, a participant commented: *"Usually, I don't leave comments on my friends' photos. Since, my fingerprints are automatically taken; it seems useful to leave a mark on photos in this way."* Referring to the Mood-

Photos, a participant commented, *"Sometimes it is hard to tell about your feelings with words. This is a much better way to tell the author of the photo how you feel."*

The idea of collecting all the event photos from every photo taker into a same album was highly appreciated. Users wanted to see photos from all the members put together. They appreciated seeing the different viewpoints, to get pictures of themselves in the process and to an get idea how others experienced the event.

Enhanced social connectedness was the key user value of FingerPrint and MoodPhotos. These features made photo sharing more "personal" than conventional feedback mechanisms such as "like" button or comments. For example, Figure 6 shows a photo of Group B, where all the four participants have reacted either via a fingerprint or a mood photo. Referring to this example, one participant commented: *"This is a nice group photo I took it when we first started drinking. When I see the mood reactions of my friends, it makes me believe that this photo gave the same kind of pleasure and feeling to them as it did for me."* Several participants also suggested that with a fingerprint on a photo they are reassured that specific people have seen the photo. One participant commented: *"I like when my parents for example pay attention to my photos. Fingerprints would be a feature for paying that attention."*

Figure 6: A group photo with added consumption patterns.

The participants also agreed with utilizing the information from translucent consumption to develop new features for filtering, prioritizing and categorizing photos. For example, the number of fingerprints on a photo can be seen as a factor for making certain interpretations about the photo. One participant suggested that *"there could be statistics to tell which photos are popular and how many viewers there are, and that could even be shown without giving out viewers' information"*. Referring to the MoodPhotos, a participant commented, *"It is fun to see the pictures of others, but more value would be if we could categorize the photos by the viewer's mood. We could see the photos that have raised anger, happiness, disgust or such."*

These experiences are already possible with the lightweight mechanisms of liking a photo and leaving text comments. Features such as MoodPhotos further contributed to this possibility as it could cover photos that do not trigger any user comments or likes.

5.3   Feedback Disclosure Practice and Policies

When users left MoodPhotos or FingerPrint to shared photos, their behaviors were regulated by two types of policies. They restricted the kind of feedback they left on photos and they needed to carefully select the photos they disclosed their feedback over. This was particularly the case for MoodPhotos as the mood photos can reveal un-intended information.

The users appeared to have good consensus in selecting the photos that they choose to leave feedback on. In this study setup, all the users in each group were aware of the photographed events, therefore, they were able to quickly pick up the photos that deserved their attention. Here are some examples of photos that received intensive feedback. In Group A, one photo featured one member made a funny face when undressing himself. In the same group, another photo featured a group member hugging a girl. The featured girl was not known to the other members of the group; therefore, the photo itself stimulated intensive feedback in the user interviews. In Group C, one photo featured a collection of handcrafted artifacts in the place where the group held their event. All the handicrafts were made by the event host, who was a part of this study group. Based on our interviews, the lady was well known in her friend circles for this hobby of hers. In Group B, one photo featured a blurring figure of a member of the study group who was about to go out of a door. In the participatory design workshop, all the group members left their feedback to this photo because of the accidental special effects of the photo.

In the user interviews, we also noticed that people skillfully avoided some kinds of photos when leaving feedback. One of the most common examples was when they intentionally avoided paying attention to photos where they appeared. While acknowledging that they would closely watch these photos, they avoided leaving their finger prints. After all, nobody wanted to project a "self-centered" public image. In another case, the users avoided photos that may carry some sensitive information. In Group B, rumors went that two of the group members were secretly dating each other. So other participants avoided paying too much attention to the photos featuring the couple to avoid the potentially awkward moments.

The users explained their concerns about the kinds of feedback they gave when browsing shared content. The most common user concern was that the system could give away "inappropriate information". For FingerPrint, the users could accidently stop on a page for prolonged time, which did not necessarily communicate their interest in the photo. For MoodPhotos, one participant pointed that she did not want to share her natural mood with her friends. She commented that she usually checked photos when she was bored. Therefore, she doubted that people would share strong emotional responses when encountering with some significant photos. Another participant said that she would not always be at her best moments when she browsed a shared album, for example, in the early morning before wearing a makeup. She did not want to share any part of her face in her mood photos.

Overall, privacy did not emerge as a major concern as far as the system did not give the information away without users' consent. One main user concern was to whom the information was accessible. Since the information was shared within close groups, mainly the people who participated in the event, the users were open to sharing their consumption patterns via finger prints and mood photos.

The users suggested different disclosure policies for FingerPrints and MoodPhotos. FingerPrint should follow "opt-out" strategy. The system shares finger prints automatically and supports quick removal. All users applied FingerPrint to most photos. Some participants even suggested to add FingerPrint to all the photos they browsed by default. Opt-out policy probably serves this frequent usage best. MoodPhotos should follow "opt-in" strategy. The system takes mood images automatically but only shares them when initiated by a user . Participants mainly used MoodPhotos for the significant photos that triggered "big feelings", not for the photos that plainly documented what was going on. They did so to make mood photos more valuable. It is of note that most study participants agreed with the value of automation on the condition they could intervene. For example, some users suggest the system to proactively prompt them to share mood photos when detecting some big feelings from the users.

There were differences between the groups especially regarding to the openness of sharing and commenting. Some of these concerns seem to be related to the age and experience of SNS use,

but most habits of commenting and collaborating seemed to repeat regardless of the group all of them commented and created collaborative content to the book in a similar fashion.

6 Discussion

Digital services reflect the way people are connected to each other. For example, Facebook often reflects our offline social network. The current literature suggests that people are more often connected to their real-life connections rather than searching for new contacts [15]. What people do on these services often reflects what people do or want to do in real life. When designing social software applications, we believe in the importance of mimicking real-life events. In such events, people presented are typically engaged in rich social encounters. Some conversations occur about the photos, but more often the conversations occur with the photos. Photos are just contextual cues for the social encounters behind them. As a story listener, we always display our subtle expressions and gestures; as a storyteller, we constantly monitor how other people respond and guide our conversations accordingly. We constantly switch roles in these social encounters when together we construct shared experiences.

'Producing while consuming' is one meaningful attempt to mimic real-life situations in the context of social sharing services aimed at private groups. By allowing people to easily share their consumption activities, we essentially allow people to engage in a social encounter where people can all equally contribute to an ongoing conversation. Everybody in a private group can signal to each other and follow others' signals. This differs from existing services that emphasize the role of content producers at the expense of other group participants.

From our participatory design workshops we learned several important aspects of the 'producing while consuming' design direction. We will discuss these aspects in the following.

6.1 Blurring Boundaries: *Publisher* and *Consumer*

Current approaches to leverage users' consumption patterns [25] focus on providing feedback to content producers to improve their comfort levels and allay privacy concerns. With the 'producing by consuming' design direction, we go a step further by utilizing users' consumption behaviors to design creative ways of communicating via such behaviors, not only to the owners of the content but to others who are allowed to view such details. In FingerPrint and Mood-Photo concepts, we experiment with representing consumption behaviors of people such that they invoke possibilities for social interactions.

In 'producing by consuming', participants move between being a consumer and a publisher. As they consume content of others, they indirectly produce content (in our case, their fingerprints and facial reactions) which become associated with the original content. Interestingly, with such an arrangement, the resulting content become collectively owned.

As we saw in the participatory design workshops, the fingerprints and mood reactions encouraged further social interaction among our participants. Examples discussed in figures 4B and 5 show that such consumption behaviors motivated participants to playfully interact with others only via the consumed content. In these examples, our participants also reacted to the mood reactions by leaving fingerprints. Hence, as the consumption increases the creation of new content also go up. In some cases, reactions such as *"why did Jarno not leave a fingerprint on this photo, did he even look at this one!"* showed that by making consumption visible, our participants' expectations were raised. Hence the value and meaningfulness of the content is shared by the original content as well as the visible consumption data.

'Publishing while consuming leverage "invisible" user activities thus convert all people into active content publisher. In early studies about online communities, "lurking", or the activities of "reading posts but never posting", is typically perceived as a negative activity [23]. These people free ride the content produced by others, but they do not generate content for others. With 'publishing while consuming' designs, we can change the "lurking" phenomena. On the one hand, parts of the lurker's activities become visible for others, so it is rare to be a lurker. On the other hand, with easy mechanisms to participate, many lurkers will start to explicitly publish more often.

6.2   Increasing Social Presence

'Publishing while consuming' can make people share more content and engage in social connections. People may also end up becoming more socially aware of each other. They can effortlessly notice cues left by others even when they do not intentionally look for such content. We believe that all these factors contribute to the positive experience over social networking services because all of these factors are essential motivations for people to use these services [6].

MoodPhotos has a direct way of presenting emotional responses and feeling of people when they view photos. Whereas, FingerPrint served as a subtle, reassuring feature that informs a user that 'a close one has seen my photos'. With these different types of communication channels, a feeling of connectedness is generated. We believe that in a private group sharing (close friends or family members) such openness in sharing photos and consumption patterns of people may generate a more open atmosphere in the group and may even lead to more photos shared. The long-term impacts of these features deserve more attention in the future studies.

We foresee that with a fully functional system, 'publishing while consuming' may persuade people to give away relevant contextual information. As research has shown, when convinced by the potential values, people are willing to make some compromise [23]. In this study, we find that people gain sufficient social interaction benefits when giving away some level of private information. Purely from a technologist's perspective, this is a good direction to expand people's comfort zone in sharing their contextual information. It is of note that we do not intend to start an argument that it is beneficial to persuade people to make privacy compromises. This argumentation certainly deserves attention in a separate discussion.

6.3   Limitations: Location and Context

From the beginning of this research, we were sensitive about the issues related to people's privacy. Our participatory design approach was carefully placed to simulate realistic situations, involving natural data from our participants. As PhotoBook is not a full-fledged system, we could not explore the opportunities and hurdles added by the locational and contextual aspects. The way people consume content in the real-world may differ from what we observed in these simulated design workshops. As this was clearly an early design phase, where we wanted to collect early feedback from users and inform our future design.

In this study we gathered user stories about how they regulate their feedback sharing behavior. For example, we learn that the privacy concerns are tied directly to the type of content that is shared between users, for example, the photos revealing potentially sensitive information. The privacy issues may start to arise when a user is viewing a photo that he/she should not be viewing or is not expected to be viewing. In a short user study sessions as ours, we did not record any examples of such photos being taken and/or viewed. Without these types of critical cases, it is hard to accurately evaluate privacy concerns in these design concepts. As a general limitation of this study, users must imagine scenarios where their privacy might be at risk. What participants say and what they actually do in a realistic scenario may also differ. Therefore, we inter-

pret the result as an early sign for future study. The final privacy evaluation needs a further field study with implemented systems in our future work.

7   Summary and Future Work

Our PhotoBook prototype and the participatory setup were intended to explore the values of leveraging people's consumption related behaviors to enrich social interaction with shared personal content (in this case, photos). As a general finding, we found that 'producing while consuming' was beneficial for enriching social interactions in agreement with [25], and that it invited reciprocity. Close groups appear to be a good setting for the 'producing while consuming' designs. An early study with the "Who've Seen You" feature shows that the feature did not often lead to reciprocity in an open social network [11].

The value of FingerPrint and MoodPhotos was obvious to users as the publishers of photos. People are generally positive about obtaining the possibility to access information from others, although they do not necessarily want to publish their own information for others in return [25]. In our study, we found that this unwillingness to publish may not be an issue for close groups. We understand that people are interested in building their relationships with each other within a close group. Concepts such as FingerPrint and MoodPhotos are good channels to bond these relationships.

In summary, this user study implies that 'publishing while consuming' could be a promising design theme. In the next step, we are developing functional systems based on these concepts and deploying them in field studies to verify if the design theme of 'publishing while consuming' is as much promising as we have seen in these participatory design workshops. In an ongoing research, we are implementing and deploying a system that supports FingerPrint and MoodPhotos, and comparing the system with a baseline photo sharing system without such functions. The baseline system support lightweight feedback mechanisms, similar to 'like' or +1 buttons in Facebook and Google+. The major difference is that users currently explicitly share their consumption patterns (through likes and text comments) as opposed to the implicit sharing of fingerprint marks.

8   Acknowledgments

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