

# Of Unkempt Hair, Dirty Shirts and Smiling Faces: Capturing Behind the Mobile Camera

Florian Güldenpfennig, Wolfgang Reitberger and Geraldine Fitzpatrick

Vienna University of Technology, Argentinierstr. 8, Vienna, Austria

{florian.gueldenpfennig, wolfgang.reitberger, geraldine.fitzpatrick}@tuwien.ac.at

## ABSTRACT

What would it be like, if every photo could be turned around to reveal its photographer in the moment of image capture? In this paper we report on a new camera phone application BehindTheCamera (BTC). In contrast to traditional photography, BTC employs both front and rear cameras to capture not only the target of interest, but also the photographer or scene behind the camera. We conducted an exploratory study with 8 participants over 10 months to reveal usage patterns and possible benefits for the user. A thematic analysis of the BTC images suggested seven salient categories of use. Our findings were substantiated by in-depth interviews and later review of images with the participants to capture their experience with BTC. The findings point to the value of BTC for supporting creativity, play, and capturing the interplay of photographer and motif for later rich reflection.

## Author Keywords

Exploratory user study; front-facing camera; image use; mobile phone; photography; photos; smart phone.

## ACM Classification Keywords

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

## General Terms

Human Factors; Design; Experimentation.

## INTRODUCTION

Since its invention during the first decades of the 19<sup>th</sup> century, photography has undergone a number of major changes, whether in terms of its techniques or regarding the social practices around it. Nevertheless, periods of time can be identified that appear to be rather stable and that are distinct from each other. Sarvas and Frohlich describe three paths in the development of personal photography: the Portrait Path (~1830s-1888), the Kodak Path (~1888-1990) and the Digital Path (starting from the 1990s) [17, p.2]. We suggest that photography is currently experiencing some even larger shifts on this digital path. This is primarily due to the fact that digitalization is an enabling technology

(pictures now can be saved, deleted, edited and shared over the Internet etc. very easily) and that an exploding number of people now have mobile phone cameras that they carry with them on an every day basis. This mutual change of social practice and technology shapes and remodels the current face of photography. Young people especially employ their cameras not only as a memory aid, but also for communication purposes and identity formation [20]. However, there is one activity around personal photography, which has not changed over centuries: whenever a person wants to capture a photo he or she will focus the camera on the target or motif (we will refer to the photographer's target of interest as motif from now on) and trigger the shutter. The motif will be eternalized and in many instances the photographer will be forgotten.

In this paper we raise the question what it would be like, if we paid more attention to the often-neglected photographer and take his or her picture simultaneously as they also take a picture of a motif. We would end up with a 'two-sided' photo that could be 'turned around', so to speak, to reveal its creator. But how could we accomplish this technically and most importantly who would benefit from such a technology? One possible answer to the first question is quite trivial. Today, almost every new high quality smart phone comes with two cameras built in: one camera, which is facing to the front and the other one to the back, but only one can be used at a time. Taking advantage of the availability of both cameras though, we have built an application for smart phones called BehindTheCamera (BTC) where front and back images are triggered almost simultaneously and hence capture both motif and photographer. Nevertheless, the second question - why would people do this - remains open. Here, it might be interesting to consider a classic text on the essence of taking pictures and the relation between photographer and motif. Roland Barthes [1] based his theory of photography particularly on one single picture that has been taken by an *unknown* photographer: the picture of his mother aged five in a winter garden. In his famous book *Camera Lucida* Barthes explains how he found 'a breeze of' the very nature of photography within this single picture. For Barthes this picture was able to reveal the essence of his mother as a human being, to remind him on how she really was, even though she was only five years old in the photo. He concludes that the nature of photography or its meaning is based on its making of the statement "the thing has been

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

NordiCHI'12, October 14-17, 2012 Copenhagen, Denmark  
Copyright © 2012 ACM 978-1-4503-1482-4/12/10...\$15.00"

there” (“That-has-been”) [1, pp.76-77]. Photography reveals reality, but always at a point of time when it has already passed. On the other hand, being exposed to a photographer and having his picture taken, was a highly uncomfortable situation for him:

*Now, once I feel myself observed by the lens, everything changes: I constitute myself in the process of ‘posing’, I instantaneously make another body for myself, I transform myself in advance into an image. This transformation is an active one: I feel that the Photograph creates my body or mortifies it, according to its caprice [...] [1, pp.10-11].*

What we intend to do in our study, is to not only expose the motif (Barthes: the *referent*) to the lens, but also the photographer (the *operator*), to try to put them into a reciprocal dialogue and make the operator linked to the referent available for later reflection. We can presume at least how Barthes might have felt about such an experiment if he were the photographer, though cannot know whether he would have liked to see the photographer of his mother or not. However, we can investigate how users of mobile phones today would deal with such an application. Will the participants feel uncomfortable as well? Will they be posing for the camera or will they be self-conscious? How will they respond to seeing photos at some time after their taking? What value will they gain from having both motif and photographer?

In this paper we present the design of the BTC application and then report on a user study, which explored the possible uses of ‘two-sided’ photography, both in the field and later when reviewing the images. We draw on interview data to describe the experiences the participants had using the BTC device in the field. We also explore if and how participants used both images when given different re-visiting activities at some time after the photos were taken. In complement to the participant perspectives, we conduct our own analysis of the collective pool of image pairs to explore if and how they made deliberate use of both front and back camera and identify seven salient patterns of image relationships.

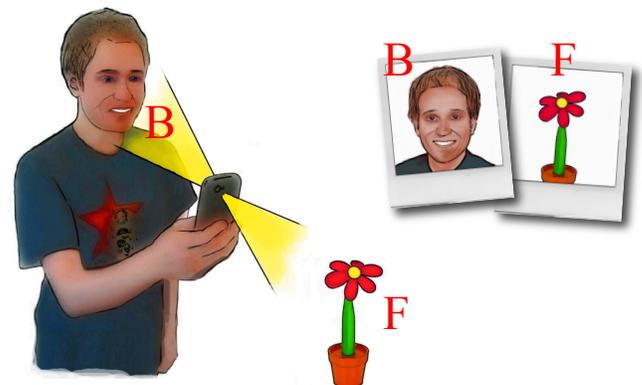
The main contributions of this paper are: a new application, BTC, which transcends the traditional notion of photography by removing the separation of photographer and motif: and, through analyzing both the image pairs and our users’ experiences, mapping use possibilities for supporting creativity and play in the taking of images, and supporting the later re-construction of the moment through the interplay of motif and the photographer/back scene. We go on here to briefly introduce the BTC software application. After this we relate our efforts to other works and finally report on the study.

#### **BehindTheCamera Picture Taking App and Viewer**

BehindTheCamera (BTC) is a picture taking application for mobile phones with two cameras: one camera facing the front and another one the back. It was implemented for the Android system and we ran it on Samsung’s Nexus S. The

special feature of BTC is that it can trigger both cameras almost simultaneously and hence has the capability to capture the photographer as well as the motif. From a user perspective, the BTC Application (App) is similar to the standard camera functionality of a smartphone. After framing his/her picture, the user presses a soft button and the App takes a picture of the motif, and with a slight latency of approximately 1 second, a picture of the user. This latency time was set as a default to deal with the front facing camera needing time to adjust to the ambient light, not just in bright daylight (when the latency can be close to 0 seconds), but also in suboptimal light conditions (such as indoor pictures in dim rooms). The user gets feedback (a short vibration of the phone and display of BTC image) as soon as both front and back image have been captured. Waiting for the back image to be completed before giving feedback avoids that the user will remove the camera from his/her target too early (during the latency time).

Figure 1 illustrates the usage of the BTC App and exemplifies which sides of the phone or camera will be referred to as front and back throughout this article. The pair of front and back images will be denoted as a BTC image. A BTC image is a photo that can metaphorically be turned around to reveal the back image (the photographer’s picture). In addition to the BTC mobile phone App, we have implemented a Java-based image viewer for desktop computers called BehindTheCamera Desktop (BTCDD). This software was used in the interview part of the study and allowed the user to flip from one side to the other as they wanted or to view both images at once. As an exploratory prototype, BTC and BTCDD feature minimalistic user interfaces and employ simple interactions, because we wanted to keep the initial focus on the concept of ‘two-sided’ photography.



**Figure 1: Usage of the BehindTheCamera (BTC) App on a mobile phone. The yellow rays illustrate the visual range of the two cameras. We denote pictures taken with the rear camera as front side images (F) and pictures taken with the front facing camera as back side images (B).**

#### **RELATED WORK**

In this section we relate the BTC prototype and study to both technical and social/cultural strands of research. First,

we consider our effort to be in line with endeavors from HCI that experiment with innovative types of photo cameras, e.g., by augmenting traditional images with additional data. Second, we do a broad review on literature that investigates the way people engage with personal photography from a social and cultural perspective.

The possibility to create new forms of digital photography has generated much interest in HCI. Frohlich et al looked into ways in which digital photography can be supported by simple means [6], for instance by recording a snippet of audio input simultaneously to image capture. They created so-called audiophotographs [7]. Other researchers addressed the question about what meta-information might be useful in conjunction with photos [10]. They summarize three categories of metadata that were thought to be interesting by their users: additional information concerning events, locations and activities. Ljungblad, et al approached the bringing of context into photography in a more playful fashion: they used a camera's built-in sensors (e.g. a microphone) to influence the resulting picture by the environment. For instance, loud noises would blur the image and hence the noise would be 'engraved' into the visual output of the camera [14].

A well-known device that differs from the modus operandi of classical cameras is SenseCam [9]. SenseCam is a wearable camera that captures images automatically at a certain time rate and/or as triggered by various on-board sensors, from a first person point of view. Researchers have looked into many aspects of this device, including issues such as its capabilities for supporting memories [16], its potential in everyday life for digital narratives and creating stories [13][8] and for assisting reflective learning in an educational setting [5].

The devices mentioned above were experimental in nature and focused on multimedia augmentations of photos or, with SenseCam, the passive capture of photos. Researchers explored the prospective uses of their new devices by giving them to people to use in everyday situations. Here we similarly explore a novel prototype application in BTC, augmented by the inclusion of both photographer and motif images, and we apply similar in-situ study methods to study what people might make of it.

There has also been a significant body of work looking at the social and cultural practices around personal photography more generally, both analogue and digital. One of the classic studies is by the visual anthropologist Chalfen who conducted a large-scale ethnographic study to examine "how ordinary people do ordinary photography" [4, p. 12]. He concluded that most people engage with it as a means of interpersonal communication and self-expression and coined the term *Kodak Culture* to emphasize that people abide by social rules when taking or looking at pictures. Another classic investigation was by the sociologist Bourdieu [2]. Together with colleagues he ran a set of empirical studies across different social classes and

their established practices around photography. More than Chalfen, he focused on photography's meaning as a social practice and how it was employed to define social classes.

More recently, researchers have investigated the processes around picture taking on mobile phones and developed various taxonomies of use. Okabe and Ito point out some differences between regular cameras and mobile phone cameras [15]. In contrast to traditional photography, pictures made by smartphones can be exchanged very easily. They describe pictures that have been captured by a mobile phone as being more personal, often times showing a mundane viewpoint of the world to be shared with close friends. They identified three prevalent camera phone usage patterns for their Japanese participants by an ethnographic study: *personal archiving*, *intimate sharing* and *peer-to-peer news and reporting*.

Kindberg et al did investigations into camera phones, which were used for personal purposes and differentiated between the reasons why images have been captured [11]. They came up with a taxonomy classifying images along social, individual, affective and functional purposes. Van House analyzed the use of camera phones as well as regular cameras and presents a list of functions of photography [19] that holds intersections with Kindberg's et.al.'s taxonomy. She describes "personal photography as, in effect, multiple, overlapping technologies: of memory; relationships; self-representation; and self expression" [19, p.125]. Lindley et al collated a number of HCI research efforts about social practices around photography into one article [12].

While the above-mentioned taxonomies provide a valuable starting point for understanding photographic processes, they all are based on the image of the motif. Because BTC captures both motif and photographer, we expect that the categories we later come up might have some intersections with these, but also differ in that they will need to capture the interplay between photographer and motif, not just the motif itself as these classifications do. We go on now to describe the study exploring the use of BTC in-situ.

## THE STUDY

The study took place in two phases: BTC trial combined with image-pair analysis, and final interview including an image review activity. In the *first phase*, we conducted a series of 3-week field trials with 8 participants, as listed in Table 1. These trials were conducted serially over the course of 10 months. While the reason for doing this was practical - we only had a limited number of phones - it also gave us the opportunity to have a pool of participants with images taken more or less recently, reflecting that people commonly review their images at varying times after the images were taken.

We targeted young users (in their 20s and 30s) who were already familiar with smart phones and shared an interest in digital photography and recruited such participants from our social networks. Participants signed consent forms and

were not remunerated. Each participant was provided with a Samsung Nexus S mobile phone with the BTC software installed. The participants were told that they could use the App as they wished, but they were given one ‘rule’: once a BTC image was saved to the phone’s storage participants were asked not to review the image before a concluding interview. Participants were also given the option of deleting any images they did not want included in the study, though none took this up. At the end of the study, the phone with the BTC images was returned to the researchers.

ID	Gender	Duration of BTC use	Number of BTC images	Time since last BTC use
P1	Female	3 weeks	55	9 months
P2	Male	3 weeks	101	8 months
P3	Male	3 weeks	51	8 months
P4	Male	3 weeks	54	7 months
P5	Female	3 weeks	47	7 months
P6	Male	3 weeks	41	4 months
P7	Male	3 weeks	51	2 months
P8	Female	3 weeks	45	2 months

**Table 1: Participants’ trial duration, number of BTC image pairs taken, and time-passed since their last use.**

To explore how the participants made apparent use of front and back camera, we collated and analyzed the data pool of BTC image pairs from all 8 trials, looking for recurrent patterns or themes. To do this, two of the paper’s authors iteratively coded the images using an inductive thematic analysis procedure [3]. The outcome was a set of seven categories (to be described in the next section). The categories or themes were then independently crosschecked by the remaining third author who had not seen any of the BTC images and, as instruction, received a description of the themes and examples. Afterwards, Cohen’s Kappa was calculated giving a satisfactory inter-rater reliability ( $\kappa = 0.56$ ).

In the *second phase*, we focused on the participants’ perspectives of BTC and the resulting images and conducted in-depth interviews with each of the participants, in a setting of their choice. In the interview, we asked them to reflect on their experiences using the camera phone and then gave them a series of their own and others’ BTC images to explore their responses to having front and back image pairs for later review. All the interviews were scheduled within the same two weeks after all the trials were concluded. This provided us with the chance to also observe whether there would be any differences regarding their reactions because of varying time lapses (ranging from several weeks to multiple months) since they had last seen their BTC images (see Table 1). The specific sequence of

BTC picture presentations during the image review activity is outlined in Table 2. We used the seven themes from Phase 1 to help us select the subsets of images and used different combinations of their own and others’ image pairs. These activities were used as diverse ways to open up a conversation about the BTC images, given that there is no established convention for how to review such image pairs.

To warm up we let the interviewees start off with a ‘jigsaw’ exercise: we printed out a small random set of BTC images from the whole data pool and the participants were asked to match front sides with back sides (see Figure 2). This gave us the opportunity to observe the participants looking at other peoples’ images in a playful way. Also, we hoped to evoke interesting reactions by contrasting our ‘novel kind of photography’ with classical printouts for presentation. Then, the person moved over to the desktop computer to review their own images with the BTCD viewer software where they were asked to talk loud about what they were thinking or remembering when they see the images. This was conducted in two rounds with two different subsets of their own data: first, the participants were presented with the front side of their images and could turn to the back side. Second, the back side was presented first and they could flip it over to the front side. Finally, the participants used BTCD to view a set of the other participants’ images. For this time they could choose, whether they wanted to see first the front side, back side or both images next to each other. Table 2 summarizes the sequence of image viewing activities. Round 2 and 3 were for studying the participants reviewing their own BTC images in two different orders. In the last round, we wanted to confront the users again with foreign material and probe their reactions.

Image presentation round	Image source
1. Jigsaw (physical printout; see Figure 2)	Everybody’s images, random selection across the categories (size: two pairs per participant)
2. Front first, then back (BTCD)	Random subset of own images (size: ~85%) across the categories
3. Back first, then front (BTCD)	Random subset of own images (size: ~15%) across the categories
4. Choice of order up to the participant (BTCD)	Radom subset of the other participants BTC images across the categories (size: ~30 pairs of front and back images)

**Table 2: Image presentation during re-visiting activity.**

The interviews lasted between 70 and 150 minutes and were audio recorded, video taped and transcribed. Once all of this qualitative material was present the researchers employed the transcripts in conjunction with the videos to analyze the participants’ view of BehindTheCamera. Again,

the attention was paid to re-occurring patterns and themes, this time within the participants' direct account.

We go on in the next section to report on how the participants used and experienced the BTC application both from the researchers' and the users' perspective. In the course of this analysis we look at the participants' accounts from the interviews through the lens of our categories to substantiate, enrich and complement our findings.



**Figure 2: Test user trying to match front side and back side of BTC images.**

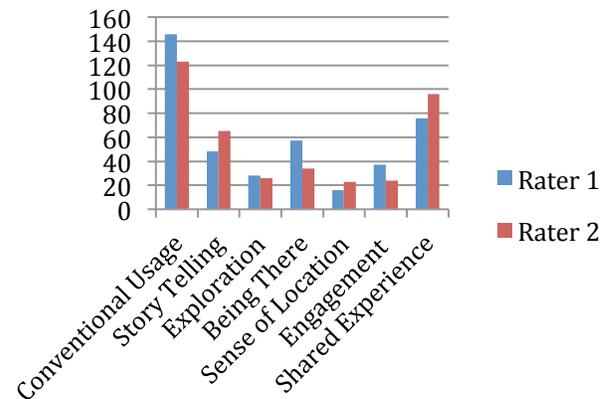
### FINDINGS

Overall 445 pairs of images were taken with the BTC App. 7 of the participants took between 41-55 pairs of images (average 49.1), and one person (P2) took many more images (101), explained by being on holidays for most of his BTC use. Our thematic analysis of the BTC images resulted in a set of salient themes or patterns of image pairs, which we have labeled as follows: *Conventional Usage*, *Story Telling*, *Exploration*, *Being There!*, *Sense of Location*, *Engagement* and *Shared Experience*. Figure 3 displays the numeric distribution of the BTC images across the categories as identified by the coders. As could be expected, we did not accomplish the highest concordance rates ( $\kappa = 0.56$ ) for the categorization of the BTC images. This is because classifying photos from everyday life can be subjective and ambiguous. The boundaries between our categories are not fixed but partially fluent. Moreover, some BTC images could also fit into more than one category. However, the coders were instructed to pick just one (the most appropriate in their opinion) category for each instance. Nonetheless we still see the same general pattern in how the overall collection has been categorized, if we follow the shape of each person's graph.

In this section, we explain the categories in detail and depict original statements of the participants that underpin the themes from the thematic analysis, together with typical instances of BTC images for each category. We will display the picture pairs side-by-side, with the left side showing the motif and the right side the photographer.

To conclude the findings section, we will report on the BTC user experience and briefly describe one aspect of our

application that cannot be captured by visual analysis, but that was also prevalent during the interviews: we will shortly report how participants employed BTC images to establish context and to reproduce memories.



**Figure 3: Distribution of BTC images across the categories for both raters/coders.**

#### *Conventional Usage*

We assigned BTC images to the 'conventional usage' category whenever it seemed that the participant used the application as if it was a regular mobile phone camera, i.e., where it appeared that there was no attention paid to the



**Figure 4: Conventional Usage. P3 takes a picture of his parking disc as a reminder (left side; motif). He confirmed in the interview that he did not pay any attention to the other camera, which depicts an image of the sky (right side).**

back camera and there is no further evidence or indicator within the picture, that would qualify the image as being part of another category. Figure 4 depicts a typical example image from this category.

#### *Story Telling*

More than any other BTC images, pictures featuring this theme appeared to be telling a story to the spectator. While almost every photo contains at least some bit of narrative, the instances assigned to this category seemed to employ BTC to unfold a story between the front and back image. The narrative context lives between both images, so to speak. Figure 5 shows two instances of BTC images that feature the theme of *Story Telling*. In Figure 5A, P3 is holding his head while taking a photo of a newspaper article about headache with a pill bottle sitting next to it. Other participants also identified these as stories. For example, P5 spontaneously commented on P3's photos: "Oh, that's a

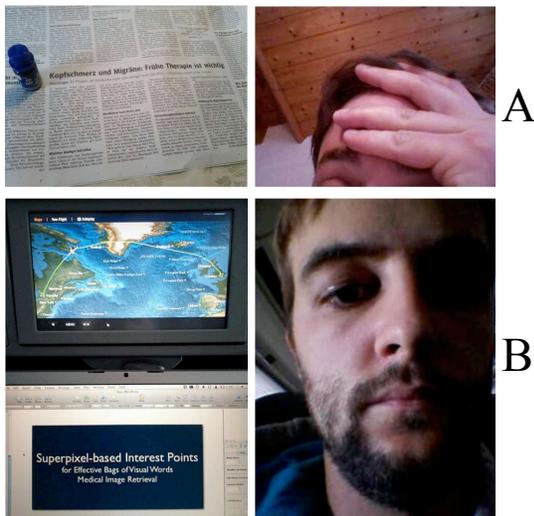
story! – Right? The photographer wants to leave us a message.” From observation and confirmed at interview, most of the images from this category had been staged.

However, Figure 5B depicts a story without the photographer deliberately staging or posing for the photo:

*Here, I am working on my presentation. We are heading towards Toronto [...]. I took the image, because it tells that we are on the plane, you can tell our approximate position and you can see that I am not nearly finished with my presentation [...]. My facial expression is just tired. (P4)*

P7 explicitly stated that the aspect of narrative was the most appealing feature of BTC to him:

*What I like best about the application is its story-telling aspect [...] when both images together form a story.*



**Figure 5: (A) P3 in right side and newspaper article with the headline “Headache and migraine demand early therapy” and pill bottle left side. (B) P4 on an airplane, looking at two screens.**

#### Exploration

According to our participants there was something about the BTC application that spurred their playfulness and fuelled creative exploration. All users but P8 created multiple instances that featured experimental or playful usages of the two cameras provided by BTC. In this context P2 mentioned:

*It is a new kind of photography. You can play with it [...]. You can try there to bring both images together.*

Similarly P6 stated on his experimentations with BTC:

*It gives you new possibilities for fooling around [...]. It is another type of photographic tool. It is a very simple extension and very easy to use. It provides you with more opportunities to express yourself with images.*

Figure 6 shows two examples of exploration images. At interview, P6 commented on P1’s picture pair in Figure 6A:

*[This is] a ‘cause and effect thingy’ – sun and shadow. This generates a nice arc of suspense between the two images. In addition, they made good use of the App, because the sun looks very luminous.*

P5 stated that at some point she began to frame the back image as well as the front image to capture more interesting images:

*That’s were I have started playing with the camera. I’ve tried to catch other people on the back image. It tried to be creative there [...]. At some point of time, it occurred to me that it would be cool to collect people with the back*



**Figure 6: (A) P1 playing with the image of her shadow. (B) P6 bringing together speaker (left side) and his ear (right side).**

*camera.*

#### Being There!

Traditionally tourist photography has been a big issue in research on picture taking in social and cultural science disciplines, e.g., [4]. This is partly due to the fact that a lot of the images available to researchers back in the analogue photography age had been made by people on their holidays. Our sample also included pictures that had been shot by some of the participants during travel, an example of which is in Figure 7. Participants reported that BTC had been a valued companion then. P5, who had to travel a lot alone lately, remarked that she liked that fact that she had pictures of trips that also included her being there:

*I am quite happy with the way I look in the images. Thanks to the back side I get to images that would never have been*

created travelling alone [...]. I think these images are great, because I have been there alone and so I can relate the things in the images to myself.

A couple of participants said that BTC was in their opinion good for capturing monuments or landmarks:

*I could imagine that something like this [(BTC)] would be great for tourist sites [...]. This could replace the classical tourist photo of a site. You take a nice image of the site and you are integrated in the back image (P2).*



**Figure 7: P4 proudly commenting on a tourist feature, stating: “I was there! [At the top of the tower.]”**

Figure 7 displays such a picture, with P4 proudly together with a tourist feature:

*I am doing this gesture for whoever will be looking at the image. Not for me. It is just a little bit of showing off. (P4)*

Not all BTC images that fit into *Being There!* necessarily have to be taken during vacation or demand the photographer to pose. We defined instances that placed the photographer into a scene as part of this category, whenever his or her ‘being there’ in the context of the location appears to be the main motif when front and back image are viewed in a bigger picture.

#### **Sense of Location**

Some of the BTC images appeared to do well in capturing the sense of the photographed location. For instance, P2 commented in the context of Figure 8:

*I intended to capture more of the location and not me. That’s why I am not in the picture. I’ve just raised the camera to capture the whole scene or to see it from a broader perspective [...].*

Thus, BTC images were assigned to this category when they helped capture the location, to get a more complete feel for the place shown in the picture by capturing in front and behind scenes. P6 thought out aloud during the interview:

*Both perspectives [of the two different cameras] adhere. This is really interesting [...] it is exactly the other way round. There we have 1/3 of ground and over here we have 2/3 of horizon. It is kind of reversed [...]. This perspective coupling creates tension. If one image faces the sky the other one faces the ground. This is reciprocal feedback, this is interesting.*



**Figure 8: P2 employed both cameras to capture the sense of a location (each row represents one BTC image).**

#### **Engagement with Motif**

BTC images of the category *Engagement with Motif* depict a visible, genuine reaction or response of the photographer to the part of reality represented in the front image. Figure 9 illustrates a typical instance of this theme. P2’s cheerful facial expression adds to the richness of the depicted moment. The back image sets the tone for the perception of the scene by conveying the spontaneous, emotional reaction of the participant. P8 remarked on one of her own BTC images, with which she was trying to capture an impressive sunset:

*The atmosphere of the sky was reflected in the expression of my face.*

This category is about the photographer engaging with objects that do not explicitly react to the photographer, whereas the next category is about social interaction and shared experience.



**Figure 9: P2 showing a genuine and spontaneous response to a children’s bouncing castle.**

#### **Shared Experience**

Instances featuring the theme of *Shared Experience* do especially well in capturing the social interaction between the photographer and his or her motif. We assigned images to this category whenever a clear response of the portrayed person(s) the photographer and vice versa was visible. The

BTC camera was employed to document the encounter of friends, families and couples. Our participants explicitly stated that BTC was good for “documenting encounters” (P7), its capability for taking “multi-portraits” (P3) was appreciated and BTC images that capture people (photographer and portrayed persons) laughing at each other were considered to be a classic use case for BTC (P5). P7 commented on the image in the first row of Figure 10:

*The situation, the dialog between the two persons in the coffee bar can be caught by means of the App.*

P1 also commented on the same images from Figure 10:

*I like that as well. If you take a picture of a group of people and you get the chance to integrate yourself into that group. That means you won't be missing in the image later on.*



**Figure 10: P5 took two BTC images of friends (each row represents a BTC image).**

#### *User Experience*

Overall, the comments made by the participants about their own and others' photos showed that the categories captured some broad sense of how participants used BTC. Analysis of the interviews also point to other aspects of the experience. The first thing that struck us was the amount of fun our participants had during the review of their own images. Participants stated their amusement mainly arose from the fact that BTC together with BTCD enabled additional information to be revealed about the images. They liked wondering what the other side of the photo would display and enjoyed being surprised. The order (back side or front side first) did not influence the affective response of the users. Also, participants valued putting both pictures (motif and photographer) right next to each other. To put it into P6's words: “*I like having the option to look behind the camera*”. Furthermore, P6 stated, that often times “*both images – front and back – are mutually gaining value*” when they are viewed together.

Regarding the user experience of the image capturing process, the existing latency between rear and front camera shutter was described critically as well as positively. The latency was appreciated when the user wanted to pose for

the images, whereas it was also described as a minor disturbance by some of the participants. Nevertheless, in summary participants preferred the latency to be as small as possible to create as authentic back images as possible.

Our users were not especially vain, yet the camera facing the user made them more self-conscious regarding their personal appearance. One participant realized:

*It seems like I am wearing the same dirty shirt for 3 days in a row, even though I only put it on for doing sports (P3).*

Nevertheless, every participant stated they wanted to continue using BTCD in any case on their mobiles, because the advantages outweighed a couple of ‘bad hair days.’ Overall, they were a lot more afraid of losing memories triggered by the back image than of having an unflattering picture of themselves taken. As the high number of images in *Conventional Usage* indicate and according to the participants, BTC can be used as a regular camera anyways.



**Figure 11: P7 photographed a young woman with baby.**

The amount of time between the point when the picture was taken and when it was presented back to the user influenced the appreciation of the images. The ‘wow effect’ increased, people were more surprised and consequently had more fun viewing the pictures. In particular the participants commented that they thought as time passed, the other side of the image became more valuable, at times even more important than the front image. For example, two participants (P2, P7) anticipated that in the distant future, the baby in Figure 11 might appreciate knowing who took her picture, an opportunity that Barthes never had with the conventional image of his mother as a child.

#### *Memory and Context*

Even though BTC was not explicitly designed as a memory aid, we could observe our participants on many occasions employing the back image to extract additional cues in order to reconstruct the memory of the captured moment. For instance, one participant (P6) estimated the amount of time passed in his changing hairstyles. Similarly P1 used her hair as an indicator to remember the weather:

*This must have been a windy day, I can tell it from the look of my hair.*

P8 used BTC to reconstruct her mood in some instances:

*What it certainly does, it enhances the reminder value. Now I can see myself too. And I wouldn't have remembered my own mood. Have I been tired, have I been animated?*

P7 appreciated BTC as “*a kind of self documentation*” in order to capture how one changes over the years.

Oftentimes non-living objects caught by the back camera have been used by the participants to contextualize the BTC images and to reconstruct memories. For instance, P4 remembered an occasion when he realized that he had been on a plane from the back image, what he was not able to tell solely by looking at the front picture.

Participants also used BTC to establish context for other peoples’ images. When reviewing a picture of P3, who took a shot out of a car, both P7 and P8 noticed that it must have been a cabriolet:

*This must have been a cabriolet. I can tell from the direct sunlight on the photographer (P8).*

Interestingly, there was no detail of the vehicle in the picture that revealed the car as a cabriolet. P7 and P8 solely concluded this from observing the light condition.

## **DISCUSSION AND CONCLUSION**

BehindTheCamera was designed to explore the photographic possibilities of simultaneous front and back images, now that many people have mobile phones with front and back cameras. We built the system without any special use cases in the back of our minds. However, during and after the study we found a couple of features of BTC quite striking, which seem to be worth highlighting.

### **Addressing Human Values**

It was clear that the participants were engaged *in* their own BTC images and found it be a fun creative application that was able to convey atmosphere, affections, emotions and hence had the capability to tell rich stories for the user. While the software provides two closely bonded pictures that can be related to each other, it still demands the viewer to invest mental work in order to bring front and back images together as a story. According to some of our participants’ responses, finding the correlate of one image in the other one is what the particular charm of BTC was all about. P3 described this from the perspective of a spectator who starts looking at an unknown BTC back image:

*If the photographer already has such a curious gaze, you ask yourself, what’s worth taking a picture of? What is he paying attention to? Tension gets built up this way.*

In the same context, it was also remarkable that the participants found interest and delight in the other users’ BTC images, even though most participants didn’t know each other. This was surprising because watching someone else’s pictures (whether family’s or friends’) has often times been reported as being utmost boring [4] and can be understood by everyone who has ever been exposed to a never-ending photo album or slideshow. When using BTC and even when playing the ‘jigsaw’ which was simply meant as a warm up, our subjects spent considerable time with the other participants’ BTC images, even though they were told that they could pick their own pace and skip

images if they wanted to. P8 captured the value of this when reflecting on the experience of viewing someone else’s BTC images:

*I think it is really cool for a stranger’s images. I like having the opportunity to see who took the picture [...]. I definitely have more fun, when the photographer laughs nicely. This infects me with joy while watching the image.*

Another key observation was that BTC fostered the creativity of the users when taking photographs. All participants but one stated that having two paired cameras at hand challenged them to make good use of them. Evidence can be found in the images in the exploration category, which hint at the new possibilities afforded by the intertwined perspectives enabled through BTC. In addition, it is not only the images from the exploration category that feature creative or playful elements. A lot more of creative engagement can also be identified in pictures from, for instance, *Story Telling* or *Sense of Location*.

In the findings section, we have reported that BTC was very suitable for capturing moods, atmospheres or affective responses (e.g. category *Engagement*). At this point, we would like to emphasize this quality of BehindTheCamera once more by a statement of P1:

*The second picture, which shows me wrapped in sunlight, depicts the temper much better, because it contains more of the atmosphere. Having the front image might be funny, but it is not as meaningful.*

We believe that the capability of depicting a moment’s particular atmosphere, the feel for a location or the affective states of the people involved is another key property of BTC that can unfold between the application’s two images.

In summary BehindTheCamera appears to support a number of human values that have already been demonstrated in usage patterns identified in the related works section. There, themes such as intimate sharing [15], social and individual affective purposes [11], establishing relationships, self-representation, and self-expression [19] have been identified in camera phone usage. Here we suggest they are able to play out in much more explicit and creative ways with BTC, because of the juxtaposition of the back and front images that provides richer perspectives. In contrast to regular photography, the observer can reconstruct the moment by mentally matching the front and back image. On the photographer’s side this opens up the possibility for creating image pairs that make use of the spatial relationship between these images.

### **Revisiting Past BTC Images**

BTC also appears to support revisiting past events in new ways, and more interestingly that this will evolve over time where the back image may take on more importance than the front. While only a relatively short time had passed since the participants captured their BTC images, even for the first participants, they still used the back image

extensively as a memory aid to reconstruct the story of the event. Moreover, as mentioned in the preceding section, our participants made statements regarding the increased value of BTC for prospective memories. Participants also explicitly noted that the future could bring a shift in the importance of the images and that in many instances the back image will be more valued than the front, e.g. (P1):

*If I take pictures of a lake during vacation, I will have a nice scenery...maybe captured a thousand times, but one will not find much of fascination in it in a couple of years. It will have no further information at all. It cannot reproduce any personal memories. - Who took the picture? In what mood? How old? Maybe therefore one day the lake will be the add-on and the back image will be the main statement. (*

We hypothesise then that in the future BTC images will be valued more because of the additional context information (generally a picture of the photographer and some background details). This is supported by Schacter [18] who argues that the affective quality of a memory cue can highly influence what we will remember. Van Dijck also states that technology can change the way people remember their past [21]. We suggest that capturing the dialogue between photographer and motif can be useful in supporting memory and recollection.

#### **Future Work**

Encouraged by the positive feedback of our participants and by the way they engaged with BTC, future research will explore the use of BTC in more specific contexts. For example, recently we began to deploy BTC in a research as well as in an educational setting to augment experience sampling and data capture. We also plan to re-visit the same images with our participants at a later point in time to explore the way engagement with both the back and front images changes with time. We will also look at minor technical iterations, e.g., to enable easy disabling of BTC when the person only wants to concentrate on the motif.

#### **ACKNOWLEDGEMENTS**

We thank our participants for their time and feedback.

#### **REFERENCES**

1. Barthes, R. *Camera Lucida. Reflections on Photography*. Vintage, London, UK, 2000.
2. Bourdieu, P. *Photography: A Middle-brow Art*. Stanford University Press, Stanford, CA, USA, 1996.
3. Braun, V. and Clarke, V. Using Thematic Analysis in Psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77-101.
4. Chalfen, R. *Snapshot Versions of Life*. Bowling Green State University Press, Bowling Green, Ohio, 1987.
5. Fleck, R., and Fitzpatrick, G. Teachers' And Tutors' Social Reflection Around SenseCam Images. In *Int Jour of Human-Computer Studies* 67, 12 (2009), 1024-1036.
6. Frohlich, D., Fennell, J. (2007) Sound, Paper And Memorabilia: Resources for a Simpler Digital Photography. *Personal and Ubiquitous Computing* 11, 2 (2007), 107-116.
7. Frohlich, D. and Tallyn, E. Audiophotography: Practice and Prospects. In *Proc. CHI 1999*, ACM Press (1999), 296-297.
8. Harper, R., Randall, D., Smyth, N., Evans, C., Heledd, L., and Moore, R. The Past is a Different Place: They Do Things Differently There. In *Proc. DIS 2008*, ACM Press (2008), 271-280.
9. Hodges, S., Williams, L., Berry, E., Izadi, S., Srinivasan, J., Butler, A., Smyth, G., Kapur, N., and Wood, K. SenseCam: A Retrospective Memory Aid. In *Proc. UbiComp '06*. Springer-Verlag (2006), 177-193.
10. Holleis, P., Krantz, M., Gall, M., and Schmidt, A. Adding Context Information to Digital Photos. 5th IWSAWC, In *Proc. of IEEE ICDCS*, 2005, 536-542.
11. Kindberg, T., Spasojevic, M., Fleck, R. and Sellen, A. The Ubiquitous Camera: An In-depth Study of Camera Phone Use. *IEEE Pervasive Comp.* 4, 2 (2005), 42-50.
12. Lindley, S. E., Durrant, A., Kirk, D., and Taylor, A.S. Collocated social practices surrounding photos. *Int. Jour of Human-Computer Studies* 67, 12 (2009), pp. 995-1004.
13. Lindley, S.E., Randall, D., Sharrock, W., Glancy, M., Smyth, N., and Harper, R. Narrative, memory and practice: Tensions and choices in the use of a digital artefact, In *Proc. BCS-HCI'09*, ACM Press (2009), 1-9.
14. Ljungblad, S., Håkansson, M., Gaye, L. and Holmquist, L. E. Context Photography: Modifying the Digital Camera Into a New Creative Tool. In *EA of CHI'04*, ACM Press (2004), 1191-1194.
15. Okabe, D. Emergent Social Practices, Situations and Relations Through Everyday Camera Phone use. *Int Conf on Mobile Comm. and Social Change*, 2004.
16. Sellen, A., Fogg, A., Aitken, M., Hodges, S., Rother, C., and Wood, K. Do life-logging technologies support memory for the past: An experimental study using SenseCam. In *Proc. CHI'07*, ACM Press (2007), 81-90.
17. Sarvas, R., and Frohlich, D.M. *From Snapshots to Social Media – The Changing Picture of Domestic Photography*. Springer, London, UK, 2011.
18. Schacter, D. *Searching for Memory. The Brain, the Mind, and the Past*. Basic Books, New York, NY, 1996.
19. Van House, Nancy A. (2011) Personal Photography, Digital Technologies and the Uses of the Visual. *Visual Studies* 26, 2 (2011), 125-134.
20. Van Dijck, J. Digital Photography: Communication, Identity, Memory. *Visual Communication* 7, 1 (2008), 57-75.
21. Van Dijck, J. *Mediated Memories in the digital Age*. Stanford University Press, Stanford, CA, USA, 2007.