Mobile Media in the Social Fabric of a Kindergarten

Jaana Näsänen, Antti Oulasvirta, Asko Lehmuskallio
Helsinki Institute for Information Technology
Helsinki University of Technology TKK and University of Helsinki
Finland
{jaana.nasanen; antti.oulasvirta; asko.lehmuskallio}@hiit.fi

ABSTRACT
At first blush, mobile media may appear a promising solution to the problem arising from the fact that parents in the present-day kindergarten institution rely almost solely on teachers' retrospective reports on their child's daily activities. However, a kindergarten is a delicate social fabric that mixes professional roles (the teachers') with socio-emotional relationships (parenting and caring) and involves stakeholders who are dependent on adults in the use of technology (the children). To date, no studies have been reported that critically examine the boundary conditions for successful mobile media applications in such settings. We present a study of Meaning, a one-button capture-and-push-to-Web solution that was used by a Finnish kindergarten for a month. Interviews and the amount of media sent suggest that the intervention was a success, and we report on seven uses of media. However, all uses were critically affected by the users' social fabric, in which the teachers were the nexus. We conclude by discussing various ways in which the heterogeneity of the user group affected mobile media use.

Author Keywords
Mobile media, intervention, kindergarten, power.

ACM Classification Keywords
H.5.3 Group and Organization Interfaces: Miscellaneous.

INTRODUCTION
Previous research on design and evaluation of media-sharing services on cell phones have conveyed mainly positive findings, showing various benefits in the way the content shared supports, for example, discussion and gossiping, coordination of common activities, fun and joking, and companionship [5, 7, 9, 12, 13, 14]. Interestingly, a common denominator for these previous studies is that the user population has involved very simple social structures, such that they can be classified as primarily heterarchic (i.e., "flat," as opposed to hierarchical), good examples being rally enthusiasts [5], schoolmates [9], and student groups [13, 14]. Consequently, much less is understood about the possibilities of mobile media in other social settings than those involving heterarchic structures. Mobile applications are losing their novelty as an application genre and spreading to different use environments. Here social factors determine the extent to which mobile media will be adopted in our society. What do we really understand of the *social boundary conditions* for the use and adoption of mobile media?

This paper studies the potential of mobile media for strengthening the connection among different stakeholders in a kindergarten. We also aim to contribute to a more *general* academic debate: Classic works in CSCW, especially in workplace studies (e.g., [1,10]), demonstrated clearly that complex relationships among users affect technology use. There is too much literature to cite here, but CSCW has generally pointed out that different organizational factors—among them the number of contributing members and the organizational structure—may have unprecedented implications for the adoption of IT [3]. Different organizations, subunits, and groups may react differently to the same technology. We rediscovered some longstanding problems of CSCW that have not yet reached the technology-driven enterprise of mobile media studies.

However, we do not claim that lessons from CSCW are directly applicable here. Otherwise we would not need to conduct a study. A kindergarten cannot be properly characterized as an organization, and, accordingly, we have opted to use the term "social fabric" instead. Let us explain what we mean. Kindergartens are an institutionalized method of child care in Western societies. They generally involve three groups of stakeholders—children, parents, and kindergarten teachers. Additionally they require a kindergarten supervisor, teachers, educated assistants, kitchen staff, janitors, and cleaners. A kindergarten is also teachers' workplace, where they educate and care of *other people's children* and are responsible for them. Children are among their peers in kindergartens, and they have restricted contact with the world outside the kindergarten. However, the kindergarten is more than the sum of its parts. The aims of a kindergarten are to support the educational task of the parents and to promote the balanced development of a child's personality. In practice, this means continuous interaction

CHI 2009, April 4–9, 2009, Boston, MA, USA.

between the kindergarten teachers and parents. This is complicated by the difficulty young children have in explaining to their parents verbally about their daily activities. Thus, teachers are important mediating figures in distribution of information. The promise of mobile media in this context lies in adding to the information that parents receive about their child's day in kindergarten, which is almost without exception 1) verbal and 2) retrospective. The way mobile media can empower users to objectify their everyday experiences and relate them "across the distance" is the *raison d'être* of mobile media in this context. By contrast, commercial applications like KinderCam and WatchMeGrow—based on Web feeds from cameras installed on the premises—embody a unilateral-surveillance-like concept that is fundamentally different from that implemented via mobile media applications wherein users, including children, produce media.

To study whether mobile media can strengthen the connection between parent and child and of parent and teacher in a kindergarten environment, we conducted an intervention study in a Finnish kindergarten. Although similar types of settings can be found in other fields, our study is an unusual setting *where user-created mobile media* are concerned in the field of HCI.

The system called *Meaning* [11] enabled both the teachers and children to share media with parents in a near-real-time fashion (see Figure 1). The system automatically attaches metadata to the media captured and transfers content from the mobile client to a Web-based service for parents to view and comment on. The key idea in the design was to couple media capture with transfer: as the user presses the capture button, the content is transferred to a Web album unless this default action is overridden. More sophisticated control of tags, comments, and metadata is provided and the system suggests the most recently made choices as the defaults.

From the traditional perspective, the study was a success. We found that the stakeholders perceived the application as useful, and a great deal of media content was sent. The main benefit stemmed from mobile media enabling reorganization of flow of information between the temporally and spatially disparate caregivers, exactly as we had hoped at the outset. However, we were surprised that all of the stakeholders perceived and used the system differently and found different features of the application useful. All uses were affected by the users' social fabric. We will return to the issue of heterogeneity in the "Discussion" section of the paper.

RELATED WORK

Hayes and Abowd [4] in their work on automated capture technologies in an evidence-based care community context emphasized the need for community-based risk and reward analyses in design of socially appropriate technologies. Their findings pointed toward the importance of taking social dynamics into account also in study of mobile media-sharing. However, we found that existing mobile media studies were not addressing these issues.

Figure 1. After the target is shot in normal camera mode, a dialog box automatically opens that allows the user to choose the tags (a) and comments (b) to be included with the picture.

To our knowledge, studies of mobile media-sharing have involved without exception groups with a "flat" social structures—peer groups, interest groups, or primary groups wherein social distance is small, such as families. These studies have begun to chart the possible benefits of mobile media and in this realm are very valuable. For example, Van House et al. [17] identified the following functions of image-sharing: creating and maintaining relationships, reminding of and recording personal and group memories, self-expression, self-presentation, and personal uses such as using pictures as deadline reminders. Salovaara [13] studied the appropriation of a media annotation and sharing system among high-school students. He found that the students used the system to maintain relationships, send greetings, thank others for social occasions, and arrange practicalities. Sellen et al. [15] report one of the only studies of mobile media used for instrumental purposes (as distinct from "leisure" use). Their system, called Sensecam, is a wearable device combining a digital camera with sensors for elements such as motion and light level. They found that Sensecam images were instrumental in supporting people's ability to connect to their personal past.

However, there are also studies that convey signals of differences starting to emerge within apparently homogeneous groups. Mäkelä et al. [9] studied how children and their social network communicate through digital images in their free time, employing two user groups: a group of four young boys and a family. The authors reported that images were used for telling stories, joking, expressing emotions, and creating art. Interestingly, the parents often refused to use images when making sure that everything was going well for their children; they preferred to make phone calls then. Salovaara et al. [12], in a trial with rally spectators, concluded that collective and participative practices included in the creation and sense-making of mobile media challenge the perspective of an individual author in the field of media-sharing. Jacucci et al. [5], also studying rally spectators, noted that some uses of their system were divided between co-present and remote users. Sarvas et al. [14] studied the sharing of mobile images in a group of five friends. They noticed that the selection of recipients did not reflect the stable group structure but depended on who par-

ticipated in the event at which the images were captured. At the same time, some contacts, such as spouses and best friends, tended to be sent more photos than others.

Jørgensen [6] studied the impact of real-time web feeds from cameras installed in a Danish kindergarten and noted that parents used them for different needs, including feeling secure, maintaining social contact (although one-sided) and getting information. She concluded that parents' interest for the feeds is coupled with trying to find ways for coping with the complexities of handling everyday roles, mainly parenting and work.

In summary, previous studies of mobile media-sharing have not been conducted with an eye to analyzing how heterogeneity of user group affects use, although the question is of importance for mobile media. Moreover, almost all earlier studies have focused on leisure activities, whereas our study was set in a mixed environment involving work and home.

AN INTERVENTION STUDY

By using the term "intervention"—instead of the conventional "user trial," "user test," or "user evaluation"—we attempt to frame the study as an evaluation not of how "good" the *technology* is but of the *change* it may cause to the lives and practices of the stakeholders.

An intervention study lasting a month was carried out at a kindergarten in Finland. The children and teachers were given smartphones with a pre-installed version of Meaning. Web access was permitted to the teachers and parents as well as to the researchers. A mixed-methodology approach to data collection was followed, combining qualitative (interviews, content analysis) and quantitative (logs, content) methods.

The setting

Kindergartens in the Nordic countries are places where children younger than school-age are usually cared for during the parents' working hours [16]. In addition, some kindergartens prepare the children for school and teach them basic skills. Kindergartens are part of public or private school or daycare systems. In the Nordic countries, the institution of kindergartens is based on the needs of working parents; therefore, children might start their kindergarten life as infants. While methods of carrying out child care may vary by country, common features are that the children are among their peers, reared by adults (teachers), and outside their homes and immediate families.

The official aims of Finnish kindergartens are stated in Finnish law [8]: parents and kindergartens have a shared responsibility for the rearing of children. In the Finnish system, a kindergarten supervisor is responsible for all teachers and the planning and day-to-day management of the whole kindergarten while the teachers typically have academic degrees and are assigned some control over nurses.

We conducted the study in a private, English-speaking kindergarten in the Helsinki capital region (hereafter "the kindergarten"). We chose this kindergarten since it is easier and faster to elicit permission to carry out a study in a private kindergarten than in a public one in Finland. In addition, since the language of the application was English, an English-speaking kindergarten was a natural choice. The kindergarten typically has 25–30 children, aged three to six years, and five employees, but for the trial, spanning one month in summer, there were 10 children (six girls and four boys) and three full-time teachers, who always worked two at a time. Because of underpopulation in kindergartens in the summer months, half of the children being cared for there were from other international kindergartens, so not all of the children knew each other. Daily activities at the kindergarten include free play, indoor and outdoor activities spread throughout the day, meals, as well as quiet time after lunch for sleeping or resting.

Since the kindergarten we studied is a private one, there are probably more teachers per child than at public kindergartens. Under Finnish law, for example, a teacher is allowed to take care of no more than seven children in a kindergarten, which is two children more per teacher than in our setting. It follows that it might be difficult to annotate photos in a kindergarten with many more children, since doing so was not always possible in our study either.

The Meaning application

When considering the context, we saw certain favorable features in Meaning as the mobile media application. First, since parents may be interested in following their children during working hours, it is useful to have the flow of media close to real-time. Second, to get two very distinct groups—teachers and children—to utilize the application, the act of sharing needed to be very easy and closely intertwined with the act of capturing media. Third, we believed that children too should be able to submit photos to the Web album. In Meaning, transfer of photos occurs with one button press as a background process. Also, metadata should be automatic since most children cannot write, let alone type by phone. Fifth, because of the sensitive nature of kindergartens, media published in the Web album should be accessible only to the adults involved. Finally, the Web user interface was inspired by Flickr and YouTube. Similarly to Flickr's, this interface shows media in chronological order and allows access via user-created and automatic metatags. A slideshow of the media is possible, as in Flickr. As in YouTube, the videos are directly playable from the browser window.

Running on the ContextPhone platform, which was designed for Nokia S60 phones [11], Meaning enables publishing, tagging, and automatic metadata enrichment of media immediately after capture. The user can publish a photo with one keypress or store the media only in the phone's Media Gallery. Before publication, the automatically associated metadata can be deleted and/or edited; the application remembers the last choices and updates location and other data automatically from sensor-derived information. For our study, the default publishing audience included parents and teachers. The content is then trans-

ferred, in the background while the phone is fully usable, to the Web album, which can be accessed and commented on. Typical transfer time is 15 seconds to two minutes, depending on the quality of the wireless connection.

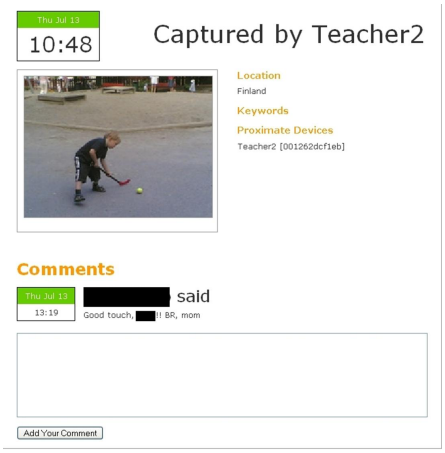

Figure 2. The main view of the Web page's media, with one page accommodating 10 clips and metadata shown on the right. The user can enter slideshow mode by clicking on the image.

Figure 3. Overview picture collage, an alternative way to browse the media on the Web client.

The mobile client overrides the native camera application. When the camera application is opened and a picture is shot, the user can decide to either withhold or publish a picture, with metadata that can be specified in a pop-up dialog box (see Figure 1). If the picture is to be published, the "Publish" button is pressed, triggering background transfer to the server and the Web client. Tags and comments can be added as well. Video capture operates similarly.

A Web album interface was custom-created for purposes of the study. It can be conceived of as a unidirectional publishing and discussion space. Media content was saved to a researcher-provided server. When logging in to the system, the user first sees a screen titled "most recent photos taken"; an example is shown in Figure 2. The Web client also provided a thumbnail overview of pictures (see Figure 3).

Procedure

Before the study, we sought permission for the study from the director of the kindergarten, the workers, and the parents of all 10 children. We also asked about the parents' interest in participating in an interview after the study. Three Nokia 6630 cell phones were handed out to the employees and one to the children. Each phone was named, and the name was propagated with the metadata (see the next subsection). The teachers' phones were named "teacher1," "teacher2," and "teacher3," and the children's was "kids." These names were included in the metadata as "tags." When introducing the application, we avoided specifying how and why to use the system; instead we described its functions and interface.

Taking photos and videos from the kindergarten and sharing them with the stakeholders is a delicate matter. All shared media were transferred to our institution's fileserver. When providing the phones, we also gave the parents and workers instructions for logging in to the picture-sharing system. The information also addressed how to use the Web album in technical terms in case the users wanted to do so. All parents created usernames for the server and chose passwords for themselves. This media content was not accessible to others without a login to the system validated with a login ID and password, again available only to members of the aforementioned groups.

The study period itself was four weeks. Only one of the four phones was working at the end of the study, since a setting for the Meaning application was switched from "send the pictures taken" to the "no" option unintentionally by users. Both teachers and children wondered why the cell phones had not sent the photos to the server, since they did not know what had happened. The first such problem occurred after two weeks, leaving the group with two functional phones until almost the end of the study. Nevertheless, media was being sent throughout the four-week study.

Data collection

We conducted interviews after the study period. At the end of the study, the media created and logs were collected from the Web client. Our analysis builds on three data sources:

1. *Complete logs* of interactions with the Web client were registered with Google Analytics. The logs allowed breakdowns according to time of day and user.
2. *The media* consisted of the images and videos shot, associated metadata, and textual comments attached to these. In total, 209 videos and 483 photographs were submitted to the Web client during the study.
3. *Interviews* of two teachers and three parents were carried out after the study. All volunteers among the parents and teachers were interviewed. We did not talk with the children; while our methodology allowed doing so, we decided during the study not to, since it seemed difficult to gather comparable data. Nonetheless, we believe that we have a good overview of the children's use of the devices, not only because of the interviews with the teachers and parents but also via the authentic photo and video material created by the children themselves.

Each interview took approximately one hour. Questions were open-ended and concerned how, when, and why the user used the system, as well as the user's perceptions of the system. The qualitative analysis of data followed the constructivist ideas of a data-driven approach wherein we

identified themes related to the use of the media and communication from each stakeholder's point of view. By letting the data lead us instead of following a set theoretical framework, we believe we do justice to the experiences of the people studied and point to salient phenomena in the data.

In the material that follows, all names have been changed.

FINDINGS

We identified seven key uses: obtaining information about a child, expressing experiences, playing with peers, educating children, supporting a child's development, reporting on children's activities, and learning about the kindergarten. We wish to note that we are aware that the uses of our observations rest at different levels—we feared that forcing the observations to the same level, as it were, would obscure key insights. Even so, we can see that the uses are in line with the tasks of each stakeholder as described (e.g., the teacher's is education while the child's "task" involves play and enjoyment). Below, we discuss these uses by clustering them into four groups: children–parents, children–children, children–teachers, and teachers–parents interactions. In addition, we discuss concerns that surfaced in the interviews. We begin with quantitative analysis of the media produced, to provide background for the observations.

The media produced

Photographs. During the four-week study, 209 videos and 483 photographs were captured and shared, which amounts to an average of 6.2 pieces of media shared per phone per day. This figure indicates that the application was reasonably popular. The first half of the study was clearly the more successful in terms of the number of pictures taken: 78.5% of all videos and 85.9% of all photos were shot in this time. The majority, almost 75%, of the photos and videos were captured with the teachers' devices, and the rest were taken with the children's device. In our system of categorization, more than 90% of all pictures taken with the teachers' devices concerned the lives of the children. If teachers appear in these pictures, they are mostly acting in the background. This indicates that teachers used the system mainly in order to communicate about children's actions to parents. The children took pictures of each other in 62.5% of the cases, and 26.3% of the pictorial material involved a teacher, which is only slightly above the average amount of pictorial attention that the average participant received (22.2%). Thus, teachers were portrayed through their own phones but also from the children's perspective.

Videos accounted for about 30.2% of the material shared, and even children, who were regarded in interviews as having been especially fond of this form of media, captured 29.2% of their material as videos. About 70.8% of the videos were between 30 and 35 seconds long, with no intervention after pressing of the record button (recording stops automatically after around 35 seconds).

Commenting took place in about one fourth of sharings: 23.9% of videos and 28.6% of photos were accompanied by comments entered via the mobile client. This relatively low proportion can be explained by two facts: teachers were often busy with other tasks and most children could not type.

Children and parents

In a kindergarten setting, parents are spatially and temporally separated from their children. It must be noted that parents retain principal responsibility for their children despite the shared nature of parenting responsibility [8].

Following the child's life

The parents were interested in following their children's undertakings via the Web album: 76 logins to the Web album were made during the use period, the clear majority by parents, and the average on-site time was 6 min 47 s. The average visitor accessed seven media content pages. The visits ranged from quick visits of about two minutes to longer sessions of about half an hour. As confirmed in the interviews, most logins were made in the evening on working days, particularly on Mondays, Tuesdays, and Wednesdays, and some on Sundays.

The focus on one's own child was made explicit, as seen in one parent's statement, *"It's interesting to see other photographs, but, to be honest with you; you focus on your own child."* All parents said that they had looked mainly at the photos 1) of their own children, 2) that their children had taken, or 3) that their children had shown to them.

One parent mentioned that the whole family looked at the photos and videos almost every night since they wanted to see what had happened in the course of the day and the photos provided a lot of information about that: *"We got a much better picture of the day by going through the photos and videos."* In one case, the parents were especially interested in seeing what their daughter was doing because the kindergarten was not their child's usual daycare facility. Moreover, a parent mentioned that his child is young and could not yet express her experiences fluently, especially if the children had been doing something special. The presence of an image taken by the child provided material for the parent to ask about and for elaboration on the happenings. Such use often took place in face-to-face situations where the parent and the child had the possibility of discussing the information that the images transmitted.

The parents also were interested in those with whom their children played. When looking at the photos, they asked about the people pictured—for example, who a particular boy and girl were. This added value gained through pictorial communication was evaluated as follows: "*I can see them only first thing in the morning when I drop her off there. I don't see the other kids. Perhaps occasionally when there is an event I might see them, but usually I talk with parents and teachers and we don't know all the kids. But when looking at this Web service, looking through the pictures, from my point of view it is good to see with whom she plays. If she says, 'I played with Harri,' I don't know who Harri is. I don't know until there is a photo. That way, this is useful. It is good to see faces. That was good."* The ap-

plication thus provided a sense of the day-to-day life of the child, making the previously inaccessible arena of the kindergarten more familiar and transparent for the parents.

Expressing experiences to parents

The system helped the children in expressing themselves through visual media, since the young children in the kindergarten were not fully able to explain and speak to their parents verbally about their daily activities. In the evenings, when the parents and the child were looking at the images together on a computer, the parents were able to ask the child more specific questions about the child's day—for example, "Did you visit a park today?" or "Were there horses in the park?" To this end, the system aided young children in distributing information from the kindergarten to the parents through visual artifacts created via the system.

Second, also for the children who were able to vocalize well and explain their days, mobile media provided a different way to tell their parents about their experiences. The older children had the necessary skills to shoot communicative photos and videos and, thus, were able to express themselves actively through visual media by choosing what they captured. The parents also found it good that the children were allowed to take photos and that they were not just the objects of photography; as one of the parents put it, *"It gave them a touch and they felt they are part of it."*

Figure 4. Three typical photos taken by the children. The comment "Spiderman by Nils" was added to the last photo.

The children's photography practices focused on personally important motifs, subjects to which they already had formed an attachment. The children took pictures of each other, and they focused on their personal activities and did not seem overly concerned with documenting the background or contexts (see examples in Figure 4). One child who was very eager to shoot photos and videos enjoyed describing verbally to her parents the stories behind the photos. This indicates that the system encouraged face-to-face contacts since the parents were able to use the system in order to talk in a more detailed way about life in the kindergarten.

A peer group: children

Children are among their peers at kindergarten, and they are expected to play and carry out their daily activities together, though subject to teachers' authority. Although all children at the kindergarten were below school age, their competencies and age varied significantly.

"Goofing around"

The children's attitude towards multimedia material was twofold: some of the children were enthusiastic about the technology and photography in its own right, whereas others found it obtrusive to be photographed. According to the teachers, most but not all of the children were eager to use the cell phone.

The older children (six-year-old girls) were the most eager to shoot photos and videos and they also created most of the media. However, almost all of the children tried to take photos, and all could do so, at least with the teachers' assistance. Only the oldest children were able to send photos to the server without continual assistance. Indicating the eagerness of the children to use the application, the teachers told of having to "wean" children from the camera at times.

The children liked to "goof around" in front of the cameras when other children photographed them—making faces, posing, and even acting and staging funny situations. Often the children viewed media collectively from the phone display immediately after capture, gathering around the phone. The children's interest in photography is visible also in the way they posed. The favored poses range from looking at the camera while being photographed to smiling, saluting, and performing special dances. It seems that the cell phone was similar to a new and fascinating toy for the children. All in all, face-to-face interaction in the situations wherein the images were taken was emphasized.

Not every child wanted to participate, though. One of them did not want to be photographed by the teachers but did allow it when another child did the photography, though usually making a face. The children's "goofing around" also manifested that the device might have been seen as intrusive. Interestingly, while the subject of intrusion did not come up in the interviews, the video content shows that some children posed for the camera unsympathetically. These poses were seen when the people pictured clearly felt uncomfortable with the presence of the device and at times were trying to hide or run away from the camera. In Figure 5, one of the girls is seen approaching three other children, who, after noticing the device, fled, saying: *"She's camering us; let's leave quickly."* At this point, the girl behind the camera corrected them, stating: *"I'm not camering you."* This confused one of the persons pictured for a moment, but after a while the girl added, in order not to be lying, *"I'm taking a video."* This incident shows that in some cases the introduction of the camera seemed to be annoying.

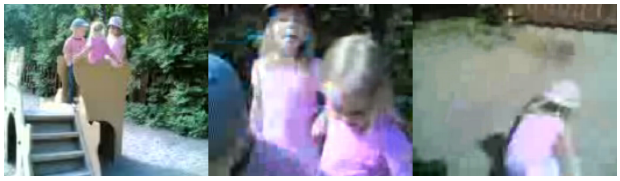

Figure 5. Children fled from the camera when another child was capturing a video of them.

Also *power relations related to use of the camera* become visible, since the person behind the camera has an advantage over the pictured who are escaping the camera. The girl was clearly more acquainted with the practices associated with the device, which can be seen in her effort to correct the language used. This also came up in the inter-

views, in which the teachers noted that the younger children in particular did not have the necessary skills to use the cell phones. Hiding or running away from the camera and taking photos back were the ways in which those captured responded to uncomfortable situations.

Children and teachers

The children spend most of the day outside their immediate families, during which time the kindergarten teachers are responsible for care and teaching. However, teachers might become significant adults for children and the children do not necessarily recognize that teachers are doing a job when caring for the children.

Figure 6. A collage exemplifying typical photos with the native tags (in parenthesis) taken by teachers. From left to right, top to bottom: 1) playing games (Hugo playing football), 2) playing without a formal structure, 3) using different skills (Hugo and trampoline), 4) educating the children, 5) showing the results of different common achievements, 6) reporting day-to-day routines, 7) documenting outdoor excursions (Eva and Lea on the bus), 8) addressing the agency of the mobile device itself, and 9) taking miscellaneous, pictures that were hard to categorize—such as extreme close-ups.

Educating children

The promise of mobile multimedia for teachers is that it can be used as an educational tool for teaching children ways of communication and other skills. The teachers in our study not only encouraged the children to capture media but also encouraged them to explain the content to parents. While it was possible to annotate photos when sending them, a male teacher mentioned that he sent many photos and videos without writing much under them. He explained that *"the children can also explain."* He saw videos as self-explanatory.

Supporting a child's development

The photos and videos were used to support the children's understanding of their physical self-concept. One of the teachers shot more videos since he found it educational for the children to see themselves move. Perhaps because of the system being embraced by the teachers and the positive feedback involved, some children wanted to pose whenever the teachers had their phone visible. When the children noticed that they had been photographed, they wanted to see the photos or videos on the phone screen again and again; as a teacher put it, *"Children wanted to see [the photos] from the phone. 'Look at me; I am dancing or singing!'"* This indicates that, although the teachers had the parents in mind when they took photographs, they also maintained their own relationship with the children by capturing media and providing feedback to the children about their activities.

Teachers and parents

The communication events between teachers and parents are key in the parents' efforts to understand what is going on in the life of their child. The teachers supposed that the parents would be interested in everything concerning their children's everyday life, and this motivated the teachers to take and share photos.

In the kindergarten, the teachers and parents communicated with each other in the following ways: when the parents were picking up their children at the end of the day, they talked with the teachers about the children's day if they had extra time, and if something special happened or was going to happen, the parents were informed orally or textually. The teachers also held brief meetings with the parents. When the system was introduced, it provided many opportunities for clarifying things that had been practically inaccessible to the parents, and the teachers took advantage of this.

Reporting children's activities

The teachers emphasized that mobile media captured at the kindergarten aided reporting about children's activities. Not just special events were reported on; mundane daily activities were documented. Almost 75% of all pictorial material was obtained with the teachers' devices—which they also lent to the children, particularly near the end of the study—and over 90% of it was of children. This figure may imply that the teachers' devices were used in a function-focused manner to inform the parents about life in the kindergarten.

Many facets of life at the kindergarten were photographed (see Figure 6). Important motifs and situations captured included focus on 1) playing various games, such as hide-and-seek, or playing football or completing a puzzle; 2) playing without a formal structure, like sliding, dancing, and jumping around; 3) exercising various skills, such as cycling, drawing, and cleaning up; 4) the teachers actually educating the kindergarten children in geography, telling the time, and learning how to use the cell phones; 5) showing the results of achievements, especially completed drawings; and 6) carrying out day-to-day routines such as eating, sitting, waiting, and occupying oneself with other everyday activities. Also, 7) outings, travel away from the kindergarten for a time, were important events to capture. Going to a Winnie the Pooh exhibition, sitting on a bus, looking at animals, going to the beach, and viewing special sights were photographed, as were 8) pictures that somehow address the agency of the mobile device itself and 9) pictures that were hard to categorize, such as extreme close-ups of a face, hands, and a ball. The pictures taken show

that the teachers tried to provide parents with a well-rounded depiction of children's time at kindergarten. Even though the teachers told us that their intention was to photograph everyday situations at the kindergarten, it is interesting that sorrow, anger, and crying children seemed to go non-photographed by the teachers, although they are obviously part of everyday life in kindergarten. Since primarily positive aspects were photographed, this might indicate that the system led teachers to focus on showing how well they *performed* their role in parenting.

The teachers also said that they intentionally photographed situations that would be difficult to explain by other means. They shot many videos not only because the children liked them but because video was more "self-explanatory," with less needing to be explained textually. In general, these circumstances were described by the teachers as authentic situations in the children's plays and games. The teachers were happy if they managed to capture candid shots of children in those activities. *"There were also some children who were singing spontaneously by themselves, some kind of a dance–song show for nobody, not even for a camera. The children didn't notice they were captured,"* said a teacher. This points to a communicational advantage introduced by the system: the parents could become bystanders of a sort and follow what kinds of games their children were playing.

Learning about the kindergarten

A second pursuit that we discerned considers the whole kindergarten as a service provider. Teachers put effort into describing the kindergarten and its surroundings to the parents via media. This came up explicitly in the interviews: the teachers supposed that the parents are interested in the surroundings of the kindergarten, because not all parents lived nearby and, therefore, some would not necessarily be familiar with the surroundings. Teachers mentioned taking photos of outings so that the parents could see the places their children visited. This phenomenon is also visible in the photos taken: the teachers often tried to include in their pictures people in the background so that key people and also surroundings were captured in the same image. An example of this is a photo from a visit to a park the group visited regularly. For the parents this meant an opportunity to get to know the places where their children spend their time while the parents are at work.

The commenting tool was used exclusively by teachers in trying to help parents to 1) find content and 2) understand it. In the first week, commenting was relatively popular, amounting to 68% of all comments on videos and 73.9% of comments on photos made during the research period. Of all media shot in the first week, about 32% had textual comments. Later on, the amount of textual notes halved for the videos to 15.4% and dropped for the photos as well, to 22%. The typical comment described the activity or location: "snack time," "playing the snow white game," "central park in the afternoon." These descriptions anchored interpretation to a specific level, highlighted details that seemed important, and relayed additional information. All comments were short, ranging from one word (e.g., "Paparazi") to the seven-word "Mari and Jane hide from the camera." The brevity emphasized the role of the pictorial communication. For the sake of completeness, it should be noted that the children, lacking writing skills, did not write textual comments, except once when exploring the interface: "Ajncädmdbdkajamdmejedaädbkädc.Dagqkpgk." However, the teachers had added some comments to the photos captured by the children. Commenting was performed by the teachers at the beginning of the study also because they believed that comments supported the parents' understanding of the content.

Concerns about privacy

All of the stakeholders had privacy concerns. According to the teachers, some of the parents had asked them what the application is for and who has access to the pictorial material. The teachers also found that some parents had prejudices against the application since they were worried about their children's privacy, although they had permitted the researchers to carry out the study. In the end, they seemed to find the application acceptable when they became convinced that external parties did not have access to the materials. This indicates that limited access to the photos taken from a kindergarten may be the only appropriate way to share multimedia content in this setting.

Contents of photos may be seen as a record of how the teachers are doing their work, because the children as an object of photography were also the object of the teacher's work. The teachers also oriented their interaction with the system introduced toward the children's parents. As has been mentioned above, negative events in the kindergarten were rarely, if ever, photographed—the teachers may have wanted to portray a positive image of themselves. When asked directly, the teachers did not express having been concerned about the media being used for evaluating them, although they *felt* that threat "in the background." They were not aware of any concrete motives for monitoring either. The teachers were able to handle this privacy concern since they had relatively high control over what was being photographed and the parents focused mainly on their own children when looking at the media produced. In addition, the teachers were always able to deny the children the use of the cameras by citing educational concerns.

There was also a privacy issue of a kind not anticipated. One parent mentioned this explicitly: *"I felt there were some concerns in being photographed while at work,"* referring to the children's media. The children shot 26.5% of all media, and of this 26% featured the teachers, typically in the background rather than the foreground. When asked, the teachers admitted that they would have wanted to delete some photos, which was not possible in the application. These kinds of photos did not concern the teachers performing their work but were simply close-ups of them.

The children's privacy challenge was that not every child wanted to be photographed. Children expressing this con-

cern fled or hid from the camera and took photos in return in order to respond to uncomfortable situations.

DISCUSSION

Each stakeholder approached the system differently. The children were eager to express their experiences to the parents via mobile media. They looked at the photos alongside their parents in the evenings and discussed their time at the kindergarten. Moreover, the children used photography as a type of tool to interact with their peers in face-to-face situations. They "goofed around" in front of the camera when other children took the pictures. However, some of the children found it intrusive to be photographed.

Via the application, the parents obtained information about the children's mundane activities and special events at the kindergarten as well as about the places their children visited. Although the parents could have followed the life of the kindergarten during the work day, they found it better to look at the photos in the evenings with their children. They were especially interested in what their own children were doing and with whom they were playing. Interestingly, the sharing of information was clearly asymmetrical: the parents obtained a lot of information from the kindergarten via the media contents, and, because only a few comments were added through the Web client by the parents, the teachers gained feedback mediated orally by the children.

The teachers addressed the media to the parents; thus, they reported on the children's life at the kindergarten. Furthermore, they utilized the system to encourage children to explain to their parents the contents of the photos taken. In this way, the children's verbal expression was encouraged. Moreover, the teachers shot videos of children so that the children could see themselves moving and, consequently, learn about their appearance. Some privacy concerns emerged at the beginning of the study, but these were not fully realized and did not discourage use.

The overarching benefit of Meaning was therefore its *support for mutual understanding of life in a kindergarten in spite of differing spatial distances, competencies, strategies, and activities "separating" the stakeholders.* The study seemed to be a success, with a reasonable amount of media sent and all groups finding the system useful. We identified the design choices that facilitated the acceptance of the Meaning system as follows:

- All stakeholders had an opportunity to participate actively in the media use and creation. The system was positioned as a contrast to the surveillance model that underlies some one-way webcam systems.
- As its default option, Meaning transferred the captured media to the Web client. Thus, the system supported all users' capacities. The children were unable to follow textual interfaces, and the teachers were too busy to devote a great deal of their time to use of the system.
- The physical, tangible object of the cell phone and also the image display, around which the children gathered for viewing, were central. Therefore, the system made it possible to interact with it in face-to-face situations Mobility of the phone enabled capturing information concerning the children's mundane activities and about the special events at the kindergarten.
- The simple chronological ordering of media in Meaning made it easy to follow the daily tasks of participants, although there could have been more sophisticated ways to search, such as via tags and queries.
- The commenting feature was used for the purpose of making some media content understandable to the parents. However, the lack of parent interest in viewing the media in real time is a factor contributing to the decline in teacher comments. When the teachers heard that the parents were looking at the photos with the children they wanted the children to talk about the photos and, therefore, they no longer annotated them so much.
- The media published on the Web album were accessible only to the adults involved.
- The slideshow view made looking at the media comfortable together with children.

Despite the study proving a success, the data reveal that all uses were shaped by the users' social fabric, in which the users were an important boundary condition for this success of the intervention. The teachers constituted the most important boundary condition because without them the whole system would have been useless. If another group (the children or parents) were missing, the two remaining groups would still reap benefits. For example, if the parents had not been interested in viewing the media, the teachers and the children would have used the system for "goofing around" and "supporting the children's development," respectively. Without the children taking pictures or posing in front of cameras, the teachers and parents would have been able to communicate via the system. In addition, the teachers were the only group interested in satisfying the mixed interests. The teachers had to teach the children to use the devices and had to let them take photos, even though it might expose too much information about their daily duties. It was the teachers' responsibility to encourage the children to distribute information in pictures and verbally.

This observation echoes a topic discussed in the context of CSCW, namely *"the discrepancy between those who do the work and those who reap the benefit"* [1]. The teachers acted as a sort of nexus, similar to the moderators who promote IT use, help and support users, and establish conventions of IT use in organizations [1].

Another aspect of heterogeneity we saw, also familiar in CSCW, was that the system *disrupted the existing power balance* [1] by enabling the children to distribute sensible data about the kindergarten and that, thus, the teachers were no longer the "gatekeepers" in the flow of information.

In addition to these two aspects of heterogeneity known from CSCW, we saw two other types emerging that may be more characteristic of non-professional social structures.

First, any kindergarten *mixes work interests with socio-emotional interests (those of parents)*. It was the teachers who had to impose a balance to satisfy the mixed interests. For example, they addressed the reporting and performance goals but at the same time had to keep in mind the fun and educational goals when guiding the children. In their use of Meaning, we see them navigating between these two orientations. Second, we saw *radically differing levels of ability to use the camera*—between adults and children but also among the children. Not only did it create a need for the teachers to be sensitive in their manner of teaching and supervising use of the camera; it also introduced power imbalances among the children as a peer group: when children had opposing interests, the more skilled had an advantage that at times was exploited with negative consequences.

We started the paper with a critique of studies that have taken for granted "flat" or heterarchic social structures and thus avoided questions that arise with more pluralistic settings. Our intervention highlighted four aspects of heterogeneity that were accentuated—effort, power, interests, and levels of skill. Had we looked at only user acceptance or the media produced, we would have concluded that the intervention was a success, missing the "elephant in the corner"—that is, that the success of the whole intervention relied critically on user groups. We hope that these findings help understanding conditions for media use in complex social settings by bringing existing vocabulary into the discussion as well as by charting new phenomena that arise.

ACKNOWLEDGEMENTS

We thank Mika Raento, John Evans, and Sauli Tiitta for support in organizing the study and Airi Lampinen, Antti Salovaara, Risto Sarvas, and anonymous reviewers for comments on the manuscript. This work has been funded by the Academy of Finland project ContextCues.

REFERENCES

1. Bansler, J. P., and Havn, E. Sensemaking in technology-use mediation: adapting groupware technology in organizations. *Computer Supported Cooperative Work*, 15, 1 (2006), 55 – 91.
2. Grudin, J. Groupware and social dynamics: eight challenges for developers. *Communications of the ACM*, *3*, 1(1994), 92–105.
3. Grudin, J. and Markus, M.L. Organizational Issues in Development and Implementation of Interactive Systems. G. M. Helander, T. K. Landauer, and P. V. Prabhu (eds.): *Handbook of Human–Computer Interaction*. Elsevier, (1997), 1457–1474.
4. Hayes, G. R. and Abowd, G. D. Tension in Designing Capture Technologies for an Evidence-Based Care Community. *Proc. CHI 2006.* ACM Press (2006), 937–946.
5. Jacucci, G., Oulasvirta, A., Ilmonen T., Evans, J. and Salovaara, A. CoMedia: Mobile group media for active spectatorship. *Proc. CHI 2007*, ACM Press (2007), 1273–1282.
6. Jørgensen, V. The Apple of the Eye. Parents' Use of Webcams in a Danish Day Nursery. *Surveillance & Society* 2, 2-3 (2004), 446-463.
7. Kindberg, T., Spasojevic, M., Fleck, R. and Sellen, A. The ubiquitous camera: an in-depth study of cell phone Use. *IEEE Pervasive Computing 4,* 2 (2005), 42-50.
8. Laki lasten päivähoidosta. Suomen säädöskokoelma [Law of Child Care, Statutes of Finland] (1973), §36.
9. Mäkelä, A., Giller, V., Tschelig, M. and Sefelin, R. Joking, Storytelling, Artsharing, Expressing affection: a field trial of how children and their social network communicate with digital images in leisure time. *Proc. CHI 2000*. ACM Press, 548–555.
10. Orlikowski, W. J. The duality of technology: rethinking the concept of technology in organizations. *Organization Science*, 3, 3 (1992), 398-427.
11. Raento, M., A. Oulasvirta, R. Petit, and H.Toivonen: ContextPhone: A prototyping platform for context-aware mobile applications. *IEEE Pervasive Computing 4*, 2 (2005), 51-59.
12. Salovaara, A., Jacucci, G., Oulasvirta, A., Saari, T., Kanerva, P., Kurvinen, E., and Tiitta, S. Collective creation and sense-making of mobile media. *Proc. CHI 2006* ACM Press (2006) 1211–1220.
13. Salovaara, A. Appropriation of a mms-based comic creator. *Proc. CHI 2007*. ACM Press (2007), 1117–1126.
14. Sarvas, R., Oulasvirta, A. and Jacucci, G. Building social discourse around mobile photos–a systemic perspective. *Proc. MobileHCI 2005*. ACM Press (2005), 31–38.
15. 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. *Proc. CHI 2007*. ACM Press (2007), 81-90.
16. Tietze, W., Hundertmark-Mayser, J. and Rossbach, H.-G. European child care and education study group: school-age assessment of child development: long-term impact of pre-school experiences on school success, and family–school relationships. European Union DG XII: Science, Research and Development (1999).
17. Van House, N., Davis, M., Ames, M., Finn, M. and Viswanathan, V. The uses of personal networked digital imaging: an empirical study of cameraphone photos and sharing. *Ext. Abstracts CHI 2005*, ACM Press (2005), 1853–1856.