How Probes Inform and Influence the Design Process

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Abstract. Design and research practitioners have applied probes in their design processes to find new ways of understanding user experience, allowing them to obtain a better understanding of their users and to inspire their designs. Usually in design practice and research, project leaders and managers expect an ultimate solution emerging as a result of probing. However, in most cases such a direct connection is not evident as probes inform and influence the design process in many different ways. We provide illustrative examples of these ways based on a study related to bathroom use for a lighting system. We present a generalization of our findings on how probes can help inform other design processes.

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H.5.2: User interfaces, User-centered design
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1 Introduction

Design and research practitioners have applied probes in their design processes to find new ways of understanding user experience, allowing them to obtain a better understanding of their users and to inspire their designs. Regarding its main characteristics, probes: 1) are based on user participation by means of self-documentation, 2) look at the user's personal context and perceptions, and 3) have an exploratory character [12]. Therefore, they are also very useful for experience research in which typically possible areas for new applications of technology are explored from a user perspective [1].

Gaver, Dunne and Pacenti first introduced Cultural Probes [3] as a form of exploratory and design-oriented self-documentation method. Cultural probes are collections of evocative tasks meant to elicit inspirational responses from people – not comprehensive information about them, but fragmentary clues about their lives and thoughts [4]. A probe kit is given to volunteers representing the group that is being studied who complete the materials and send them back to researchers for interpreta-

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tion. The contents of the probe kit differ from one design or research project to another, but they always try to stimulate the mind of the participants and capture their experiences while working on the probes.

Since the original probes, several researchers have extended probes for different contexts and uses, such as in Technology probes [6], Mobile probes [5], Empathy probes [13], Photograph probes [14] and Urban probes [15]. The various applications of probes and the richness of the results have extended the reason to use the approach to understand users and obtain inspiration for new designs. The diversity and complexity of the data collected in these projects open a vast space of new opportunities for design and research. These opportunities include informing design, facilitating the process of design reflections, and the framing of the problem solution space [12].

In an industrial context the objective of using resources for probing is based on the expectation of improving the solution creation and decision-making processes. Thus, usually in design practice and in research, project leaders and managers expect to see one 'ultimate' and well-argued solution emerging as a result of probing. Apparently, when presenting the results from probing together with the final design you should be able to draw a straight line between them and verify the value of the resources used. This expectation makes sense, since often the aim is to bring a product proposition to the market as fast as possible. This is usually done for a defined target market requiring only very specific user or market research.

However, if we want to embed our solutions in social and material contexts (a design perspective) or if we want to generate more than one option for possible applications (interaction, experience and application research) the aim is to explore the broader context as well. We believe that in most cases such a direct connection is not evident as probes inform and influence the design process in many different ways. In the remainder of this paper, we plan to list those ways by presenting a probes study related to bathroom use for a lighting system. We also describe example solution ideas that included qualities of aesthetic interaction. We illustrate our views with pictures sent by the participants. The literature on probes mostly discusses how probes are designed and used. In this paper on the contrary we consider the links between the probing results and the final design solutions and demonstrate their relationships.

2 Cultural Probes Study: Bathroom Lighting

The 'Ambient Lighting System for the Bathroom' project aimed to explore how people will experience and interact with future lighting systems in their homes. The project began in November 2003 and was a joint effort between Philips Research, Philips Lighting and the Eindhoven University of Technology, and was carried out in HomeLab, Philips' research lab in Eindhoven.

We had in mind future home lighting where a variety of atmospheres could be created. Earlier studies indicated that people invest substantial effort into creating appealing ambiences in their homes especially with light, and suggested that the bathroom is one of the appropriate locations to do so [2]. From lighting experts we knew that in order to create a larger set of high quality atmospheres would require fifty or more separate light sources producing light of variable distribution, intensity and

color. This poses two questions. First, what kind of ambiences would fulfill functional and aesthetic needs as well as enrich daily rituals people have in their bathrooms? Second, how can people deal with such complex lighting systems in an easy manner?

To be able to gather data from the private bathroom uses we decided to apply the probes and complementing interviews. We were motivated to study how people use their bathrooms and identify any needs that people may have concerning lighting in this context. Furthermore, we wanted the study to inspire our design solutions.

2.1 Challenges Presented by the Bathroom

Studying bathroom use presented several challenges for the research team. First of all, we were trying to enter and study a very private place in one's home such as the bathroom. How much would participants open up and share with us? Would they report superficially or would they go into detail? Within our team we had discussions as to whether we would include toileting activities in our study. We ultimately decided to include toileting and let participants share with us whatever they felt comfortable with. Second, we had to study bathroom use over a period of one week. By doing this, we were hoping to spot both routines and rituals that people perform on a daily basis, but also more unexpected situations. The probes study thus aimed at sensitizing the participants to reflect their daily routines and dreams beyond the superficial and evident level. Third, a priori we wanted to study sharing situations as we thought these would occur from time to time in a family set-up and pose interesting challenges to the lighting system. How would the system react in presence of different people? How do people handle these situations right now? Moreover, we needed to figure out how sharing would affect the interaction with the system since light settings typically influence the entire bathroom (even if only a light in the corner is used). Fourth, we wanted to identify user requirements for lighting in the context of the bathroom. Can we identify activity-related areas within the bathroom? And how different would requirements for lighting in those areas be? Fifth and final, we were hoping the probes would allow us to avoid embarrassing face-to-face situations that could arise from discussing some activities performed in the bathroom with our participants, which could be the case if we instead would use interviews. Our challenge was to design and introduce the probe kit in such a way that participants would feel comfortable with sharing information regarding bathroom use with us.

2.2 The Probes Study

As was mentioned earlier, at the start of the project we thought that it would be important to identify needs resulting from bathroom sharing by the household members. Therefore, we recruited five couples for this study. We decided to ask our ten participants to work on the probes simultaneously as couples. Our participants varied in occupation (professional, student, homemaker), in age (between 28 and 40), and in gender (5 women, 5 men). Although we initially wanted to study Dutch bathrooms, we realized very quickly that middle-class bathrooms in the Netherlands are quite small and would not be suited for the type of lighting system we have in mind. There-

fore, we had to look for participants who had larger bathrooms as well. In this way, we were able to obtain a richer variety of contexts.

Participants worked on the probes in their homes for seven consecutive days and they could freely choose the starting day. Participants were given the probe kit with a brief personal explanation and instruction. After one week, we picked up the probe kits in the participants' homes. We then invited participants to HomeLab where we had semi-structured interviews in which the probe results were discussed with them.

The probes tasks typically aim at on one hand describing today's contexts and practices and on the other hand exploring design opportunities for the future [12]. The probes kit in this study had two main tasks: First, the 'Bathroom diary' allowed probing several different aspects. The diary included 1) a 'Timeline' to probe the daily thoughts and activities of our participants, 2) closed questions covering different aspects of routines, sharing, and lighting, 3) open questions to make people tell stories and express their opinions, 4) a map to allow self-expression, and 5) an 'Ideal Bathroom' drawing exercise to probe the dreams and aspirations of our participants. Second, the kit included a disposable camera to probe the environment and take pictures to visually support some of the experiences they had while working on the probes. Participants 'shared' the camera and thus were asked to keep track of the pictures they made in a 'Picture Record Table' found in the diary. The first pictures we proposed were connected to capturing the bathroom environment but we then intentionally left the rest of the pictures unassigned so they could share different aspects of their environment or activities with us.

3 Findings

The final design concept and evaluation of the system are reported elsewhere [8, 9]. We will now focus on the main challenges and lessons learnt from using probes for this project. To guide the discussion we will use some pictures our participants sent us illustrating the different ways in which probing informed and influenced our design process. Through the information our participants shared with us we discovered a diverse and in some aspects unexpected view of how people use their bathrooms.

3.1 Entering an Intimate Space

Finding participants for a probes study can be challenging. Finding the right contact person, organizing a personal meeting with the participants, offering a reward or mentioning the name of the company that the study is for, are all factors that can influence people's motivation to participate in the study [12].

For this project we had some extra challenges that were connected to studying bathroom use. First, we were asking our participants to allow us to enter one of the most private spaces in their homes and report on their use of it with the help of probes. Second, we had made many assumptions regarding bathroom use, activities, sharing and routines that were based on our previous knowledge. One of these assumptions was connected to the size of Dutch middle-class bathrooms which, as was mentioned earlier, would not fully serve our purpose since they are quite small. Fortunately, we found participants who lived in a Dutch middle-class home and had

accommodated larger American-sized bathrooms (Fig. 1) by either tearing down walls or using the space originally intended for a bedroom.

Despite these challenges, the probes finally allowed us to enter these intimate spaces within our participants' homes and then go in depth to discuss different aspects of bathroom use with them. This might very well be one of the main advantages of probes: they allow presenting private and emotional topics so that people after having reflected about these topics can actually talk about them with the project team.

3.2 Discovering Unexpected Uses

During the first meeting in the participants' homes they briefly showed us their bathrooms to check the type of bathroom they had. Usually participants would describe their normal bathroom use. However, based on the result of the probes and the interviews afterwards we can see that once they started working with the probes they became sensitized to various details of their daily routines. They started to think consciously about different aspects behind bathroom use that they had not previously stopped to think about. Some of these insights supported what we knew based on our previous studies but also new phenomena that were not considered earlier were found.

During our first visit to their household (Fig. 2) one couple walked us through their bathroom and briefly mentioned they had a mirror in their bedroom. At first, we thought there was nothing special about this situation. However, after a few days working with the probes and by looking at their pictures, we realized that they also had installed a sink in there. When we asked them during the meeting to discuss the probe results, they shared a very special and unique situation with us. In their household of four, the two parents and their son shared the bathroom with a teenage daughter who used to spend a significant amount of time in the morning getting ready to go out. As a solution, the parents installed a mirror and sink in their own bedroom to avoid potential conflicts in the mornings due to an overcrowded bathroom.

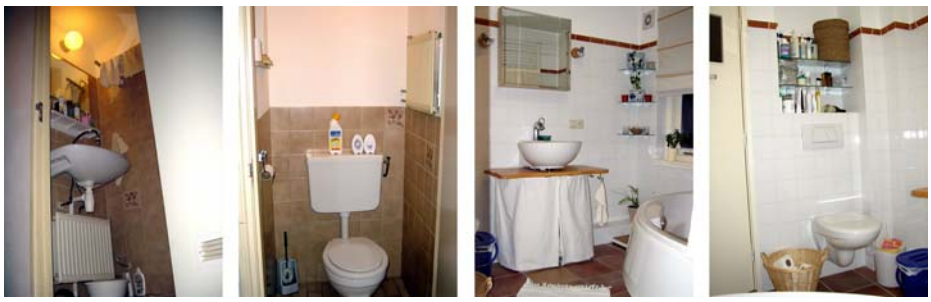

Fig. 1 These pictures made by our participants with their disposable cameras allowed us get rich contextual information about a diversity of bathrooms in Dutch households. Usually, a middle-class Dutch bathroom consists of a separate sink-mirror-shower area on the first floor and a toilet on the ground floor (two pictures on the left). We also had larger American-sized bathrooms where everything can be located in the same space, including a large bathtub with a Jacuzzi (two pictures on the right).

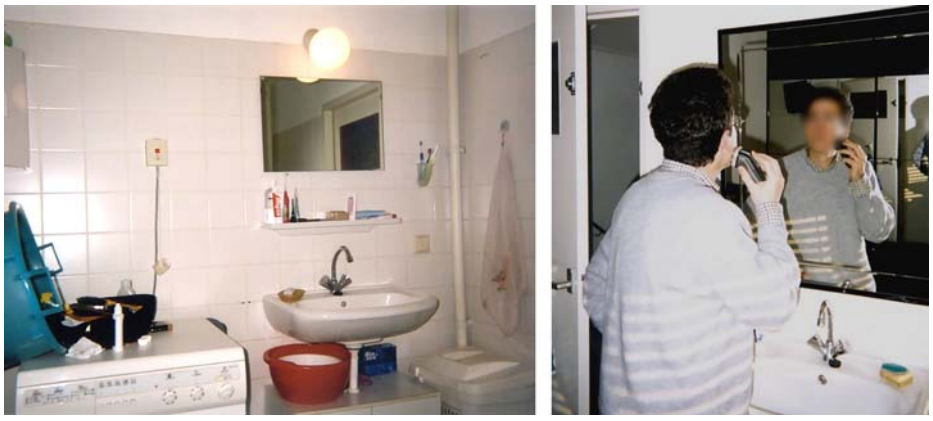

Fig. 2 Working with probes over an extended period of time allowed us to discover unexpected uses of the bathroom. In this household of four, two parents and their son share the bathroom (left) with a teenage daughter who spends a significant amount of time in the morning getting ready to go out. As a solution, the parents installed a mirror and sink in their own bedroom (right) to avoid conflicts in the mornings due to an overcrowded bathroom.

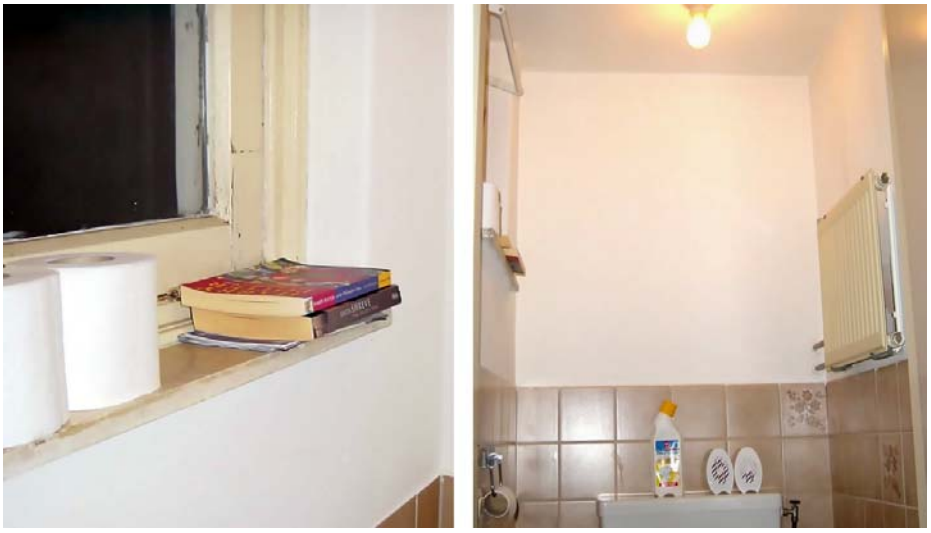

Fig. 3 Participants shared information regarding bathroom use that they may have avoided to share during a face-to-face interview. This participant was asked to share his favorite bathroom object. He mentioned his books and magazines that he keeps by the windowsill (left) are a must-have object for him. By sharing this favorite bathroom object with us, he realized how important it is for him to have a good reading light directly above the toilet seat (right) such as the one he has now.

We found another unexpected use of the bathroom in another household. When asked to share with us and make a picture of his 'favorite object in the bathroom' the male participant from this couple made a picture of some books by a windowsill (Fig.

3). We later asked him in the meeting to discuss the probe results about what was so important to him about this object. We then discovered that having something to read such as books or magazines are must-have objects for him in the bathroom. We then were able to ask him if this desire to read in the bathroom should somehow be supported by lighting in the bathroom to which he replied, *"I need a good reading light above the toilet seat, something like a halogen lamp or like the one I have now."*

The examples above illustrate how participants shared information with us regarding bathroom use that they may have avoided to share during a face-to-face interview. Both researchers and participants somehow know about these common and humane situations and the probes help participants become consciously aware of them, which facilitates openly discussing them as general phenomena.

3.3 Gathering Requirements for Design

Due to the fragmented and unclear nature of probe results, Gaver et al. [4] wonder how the results from probes can be analyzed, let alone allow user requirements to be derived from them. The large amount of data resulting from the probes may be perceived as fragmented, too detailed, or even sometimes irrelevant. This aspect can be intimidating and discourage designers and researchers alike to use the probes. However, in our study we were able to look into the probes material and find several commonalities that were fruitful for our design process: specific activity-associated areas in the bathrooms, specific types of activities and repeated daily and seasonal routines.

First, we identified separate activity-related areas within the bathroom such as the mirror-sink, toilet, and bathtub (or shower) areas. The mirror-sink area accommodates many several activities while the toilet and bathtub (or shower) areas are mostly devoted to one activity. Thus we confirmed most of our literature findings and assumptions concerning different activities performed in the bathroom and associated areas.

Second, we identified different types of activities that require the support of both functional and atmospheric lighting (Fig. 4). Functional lighting is required for short functional activities that occur frequently and demand good visibility conditions, namely, hygiene, quasi-medical and grooming activities by the mirror-sink area. Atmospheric lighting is required for creating a pleasant ambiance, where hedonic qualities are more important than just visibility. This is the case for Relaxation activities, for example when taking a relaxing bath after work [9].

Third, we were able to identify in detail the morning and evening routines or activities that they perform following a sequence on a daily basis. One interesting aspect of routines was a seasonal effect in which participants would take a shower at night during winter to avoid feeling cold in the morning and have a shower in the morning during summer. In relation to routines, probes allowed us to capture a very intimate routine. Every Friday after work when their baby was asleep a couple would take a relaxing bath (Fig. 5). Through the pictures they shared with us, they placed some requirements for atmospheric lighting to support a romantic moment.

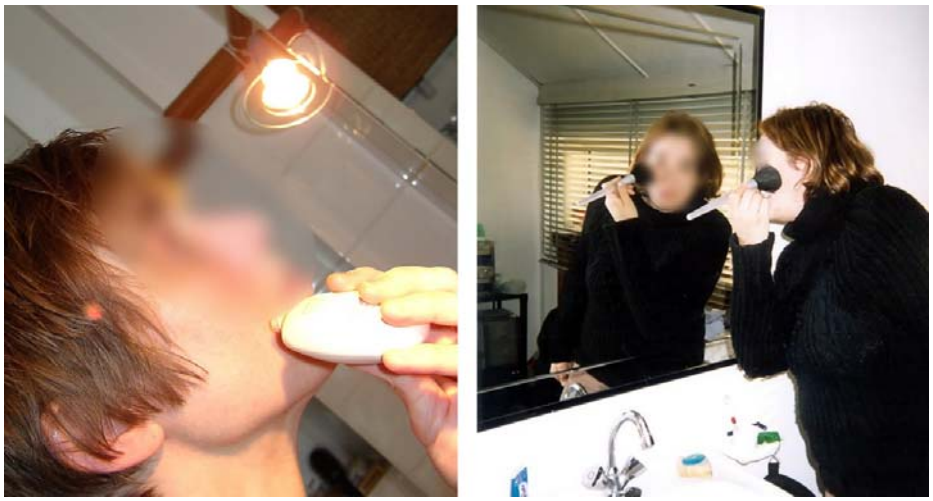

Fig. 4 By discussing with our participants some of the pictures they made during our study, they started to define functional requirements for lighting in the bathroom. Having good artificial lighting by the mirror area was often mentioned as important by our participants especially for detailed activities such as shaving and putting on make-up (left). Participants also placed a high level of importance on having a source of natural light (i.e. a window) nearby to check how their makeup looks under different lighting conditions (right).

Fig. 5 Our participants also shared with us some routines that would be very difficult for us to capture during a regular interview. Every Friday after work when their baby was asleep this couple would take a relaxing bath thus placing some requirements for atmospheric lighting to support a romantic moment.

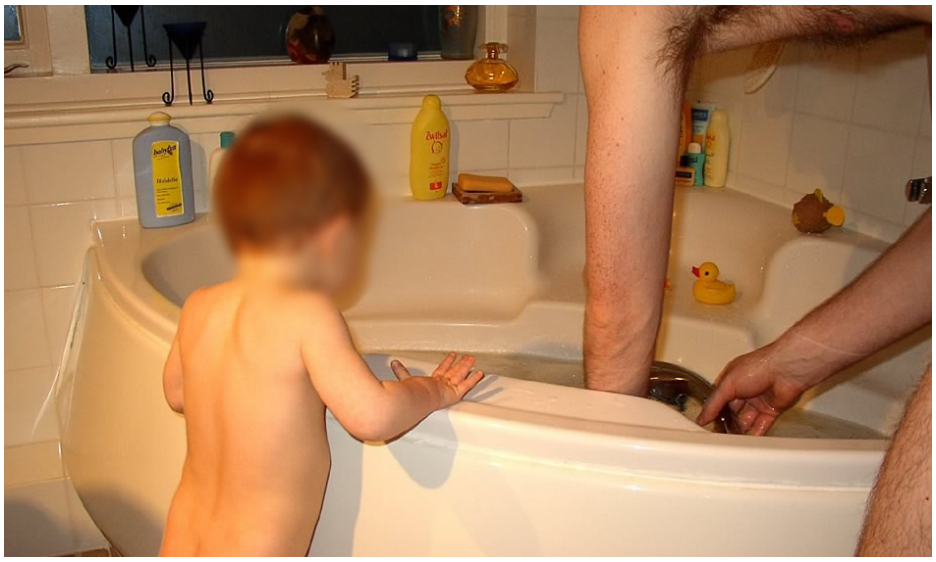

Fig. 6 Some participants really opened up to us and shared rich information on their activities. This participant is preparing a bath for their baby. In this way we were able to look into our participants' lives.

3.4 Looking into Participants' Lives

By using the probes some participants really opened up to us and we were thus able to look into their lives and learn from them. Motivating participants to share details about their lives, dreams and feelings is what probes were initially created for. Gaver et al. created probes to obtain an empathic view into the life of people they were designing for. Mattelmäki reflects on some of the questions that could lead to this empathic understanding [10]. Who are the participants, what do they value, what are they interested in, what can they do, what would motivate them? What people do they share their lives with, and how do they interact?

There is a familiar proverb saying, "a picture is worth a thousand words", which in the case shown below (Fig. 6), seems to hold true. There are several ways in which this picture can inspire designers and researchers alike. First, it depicts a real-life situation (preparing a bath) in the real context and in the exact time that it is happening. Such observations of people performing activities would be difficult to capture if one would be present there. This also holds true for the previous example (Fig. 5) where we would have had to be inside that bathroom at nighttime in order to really appreciate the true effect of a candle-lit bathroom. Second, the picture below includes people in it performing an activity, which can inspire and spark the imagination of designers and researchers to create an empathic sense of what it might be like for this family to have a bath together.

3.5 Shifting Focus

As was previously mentioned, we a priori thought one crucial aspect of this system would be to identify associated needs for bathroom lighting in a multi-user setting. Since this lighting system for the bathroom could store presets with differences in intensity, color temperature, color and spatial distribution, we were wondering how users would share the bathroom and thus also the lighting system. When we discussed our probe results with our participants, we realized that simultaneous use of the bathroom was rare and participants had far simpler ways of dealing with this issue than we thought.

We asked our participants in couples what would happen if one person would be taking a relax bath with low intensity of light and warm colors in the bathroom and the other partner would go in and need full intensity of light by the mirror-sink area. What should the system do? Consider the new request for lighting or keep the existing one? Should the intensities of light be averaged? The responses from our participants surprised us. These are two examples from different couples:

- *"We should define that in this family the woman dominates so if we are sharing, the man's influence doesn't matter. In this family we compromise"*, the husband said.
- *"We don't share that much. If I am in the bathroom and he comes in, I don't want the lights to change"*, his wife replied.
- *"You see, it depends on the family."*

- *"I don't think we would share the bathroom"*, she said.
- *"What if I need full light?"*, he replied.
- *"Why would you need light immediately? You can wait five minutes outside… I would just lock the door."*
- *"We cannot share the bathroom…"*

After these two examples it was clear to us that people have different ways to deal with these actually very humane problems. We felt there no longer was a need to focus on the 'sharing' situations in a multi-user setting as we were trying to find the perfect solution to solve social interaction. Couples told us the system should not sort the problem for them and that the solution would depend on the circumstances of the encounter (activity, mood, duration, level of disruption) [7].

Not only did the probes allow us to realize that these 'sharing' situations were not as crucial for our design as we had initially thought, the probes also allowed us to identify and shift our focus to another potential problem area for our design: reducing the complexity of interaction.

Participants were concerned about the potential complexity of the interaction with such a system. The idea of controlling fifty separate light sources was an overwhelming prospect. Moreover, due to professional jargon used in lighting design such as the 'color temperature of white light' (when light changes from a bluish white light to a more yellowish white light) which users find conceptually difficult, we realized it was important to refer to light in a way that would make sense to users.

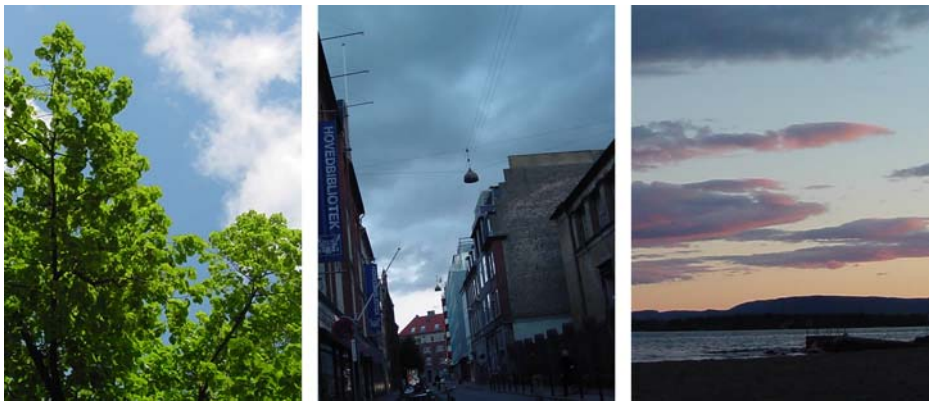

Fig. 7 Probing allowed us to shift our focus to helping participants experience the lighting system in the bathroom as a pleasurable experience. We went out to capture different natural phenomena that affect our perception of light. We discovered that changes in 'color temperature' of white light could be presented as a sunny (left) and cloudy (middle) sky. Similarly, the metaphor for applying colored lighting was inspired by a sunset that dyes the sky and the surrounding objects in an orange light (right). We looked for other phenomena for the other colors.

These observations allowed us to create a 'Natural Light' metaphor (Fig. 7), focusing on how different natural phenomena affect our perception of light. We also tried to appeal to the emotional skills of our users, trying to create a pleasurable experience for them when they interact with the bathroom lighting system.

The final interaction concept was created through a user-centric research approach [1]. It comprised a user interface with an abstract representation of the bathroom and ambience elements (represented by natural phenomena metaphors such as a sunset, a cloudy sky, a lavender field, an ocean, and so on) that could be combined to create different ambiences, for example a sunset over a lavender field.

3.6 Finding Inspiration for New Concepts

Based on the stories participants shared with us and on the various insights that emerged from the probe data, we were able to generate several ideas. These insights included the overall social context of homes and families, associated bathroom areas, routines, revealed values and attitudes concerning lightning. Some of the findings we identified as most relevant were used in the concept design, but there was a much broader space remaining with many new topics of interest leading to other solutions. Although many of these ideas did not ultimately make it to the final concept and design, they are living proof of the kind of inspiration designers and researchers can find in probes.

One notable example emerged when participants shared their experiences behind taking a bath and the elements used for that activity. Participants sent pictures of toys, soap and shampoo bottles that inspired novel playful interaction concepts such as throwing rubber ducks, toys or marbles into the tub to trigger lighting for relaxation (Fig. 8).

Fig. 8 Some of the activities such as taking a bath and the elements connected to them served as inspiration for new interaction concepts. In this case, taking a bath (left) inspired a new interaction concept where lighting for relaxation could be triggered by throwing rubber ducks, toys or marbles into the bathtub. Although the final concept did not ultimately include these alternatives due to safety reasons, the idea of using marbles was kept in the final concept.

Another idea with aesthetic and tactile features consisted of having colored shampoo bottles that would activate lighting when they were picked up or when their cap was opened. Although some of these ideas did not make it to the final concept in some cases due to safety reasons, some of them such as for the use of marbles were kept in the final concept (Fig. 9).

Another area that triggered several ideas was connected to how lighting could be triggered in the morning. Several participants suggested a gradual increase in intensity of light that could be triggered in the bedroom when the alarm clock goes off. In another example, male participants told us they either shave or brush their teeth before going into the shower or bath with their eyes (almost) closed. These activities are performed routinely which gave us an idea to trigger a slow transition in intensity of light for as long as the shaving or brushing would last thus also determining duration.

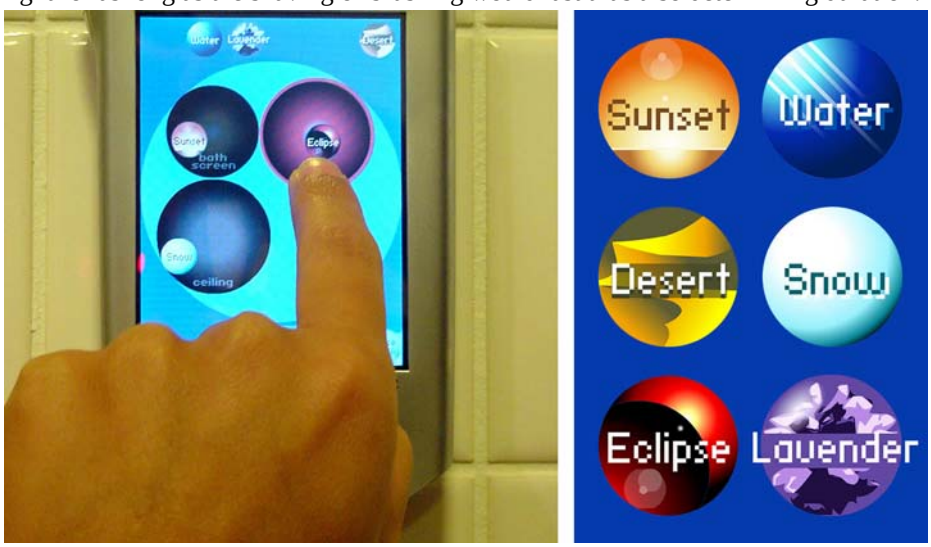

Fig. 9 The final interaction concept (left) uses the 'natural light' metaphor to reduce the complexity of interaction. Users control fifty separate light sources through a simple interface. Colors are associated to natural phenomena that affect our perception of light. Colored lighting is controlled through marbles (right) that were inspired by the toys found in the bathtub (Fig.8).

4 Lessons Learnt

So far we have illustrated some of the findings from applying probes in the context of the bathroom for a bathroom lighting system. Based on our process we summarize findings that may prove useful for other design projects considering the use of probes.

Entering an Intimate Space. Probes allow design and research teams to enter intimate spaces within the participants' home or workplace. By providing tasks including private and emotional topics for documenting and reflections they first open the door and then to go in depth with discussing different aspects to understand the wider context. This way information about private contexts and practices can be obtained.

Discovering Unexpected Uses. Probes tasks aim at inspiring and motivating users to look at their experiences with new eyes and reflecting on them. Thus, probes provide the conditions to spark participants to share fresh, unique and surprising information with the project team. Capturing information over time makes participants think consciously about different aspects in relation to their activities and context that they previously may not have stopped to think about. Meeting to discuss the probe results with the participants inspires new opportunities for novel discoveries.

Gathering Requirements for Design. Probes allow finding commonalities in the data and deriving user requirements, in spite of the large amount of fragmented or unclear data that usually results from probing. Designers and researchers should not be intimidated or feel discouraged to use the probes, as they are helpful in identifying activities, locations, and routines in relation to the context that is being studied and the focus of the project. The data enables creating an overall map with rich and detailed illustrations of the phenomena that is under investigation. This helps the designers to place their ideas and relate them to the possible users and the already existing world.

Looking into Participants' Lives. The probing process creates possibilities for interaction and dialogues with the participants. Probes as such can facilitate the right wavelength between the project team and the participants. Participants will open up, allowing the team to look into their lives and learn from them. Probes can help motivate participants to share details about their lives, dreams and feelings. Apart from that, the data and the process support the process of relating the insights and ideas with designers' own experiences and obtaining an empathic understanding of the users.

Shifting focus. Probes allow early on in the design process to test some of the topics or design solution opportunities that may a priori be interesting for the project team. What may be interesting for the team may not be a real issue for the participants. Probes allow the team to prioritize, reconsider and address the topics and issues that are somewhat meaningful and of real importance to the participants. The process can also include participatory design or activities that enable participants' own idea creations or early design solutions evaluations.

Finding Inspiration for New Concepts. Probes allow the project team to be inspired and triggered to generate possible solutions from multiple (unforeseen) directions. There is no single perfect solution emerging from applying probes. Probes usually provide a wide range of potential ideas leading to many possible solutions.

5 Discussion

Earlier we have illustrated through examples that the connection between the final design solution and the probes findings can be identified. We have also pointed out how the probes process influences the design process in many ways. Based on case studies, interviews and literature Mattelmäki [11] sees four reasons for applying probes in early design phases in company context: for gathering information to frame the design space, for amplifying design inspiration, for facilitation of dialogues between users and designers and within the design team, and finally, for enhancing users' participation in the creation of design solutions by allowing them to express their ideas and needs. These reasons are in line with the findings presented in this paper. The findings from the lighting study, however, illustrate in more detail the process of the exploring the solution, such as mapping the context, looking for solution direction and alternatives.

The design solutions are built through understanding the present users and the context, and moreover, by reflecting this understanding into the future. Design ideation includes also considering the technical, aesthetic, material aspects and interactive solutions and is also influenced by the individual designers and their personal skills and interests. In a company context inspiration is often not enough for decision-making. One should be able to argue the reasons behind the solution. For argumentation the probes findings, the insight, and the probes data with rich, narrative and illustrated examples from everyday life can be useful. This is especially valuable if the probes process has affected in the shift of the focus.

The aim of this paper has been in illustrating how probes process can inform, inspire and influence the process of finding the focus for design and exploring the alternative design solutions. In the lighting case the line between the study and the solutions has been recognisable. However we see that to broaden the use of designerly, empathic, individual-oriented and innovative approaches such as probes in companies we need more similar reflections on case studies to strengthen these connections.

6 Conclusions

In this paper we report on the rich and diverse ways in which probes can inform the design process. We presented the results of a study related to bathroom use for a lighting system to provide illustrative examples of the ways probes can shape the design process. After making generalizations of our findings, our study shows that probes can facilitate 1) entering an intimate space, 2) discovering unexpected uses, 3) gathering requirements, 4) looking into participants' lives, 5) shifting focus, and 6)

finding inspiration for new concepts. Based on these generalizations we would like to emphasize the idea that design and research teams should not be expecting a single or ultimate result emerging from probes. Instead, probes usually provide a wide range of potential ideas leading to other possible solutions. The final chosen solution will depend on the skilfulness of the design team to translate the findings into a final concept.

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