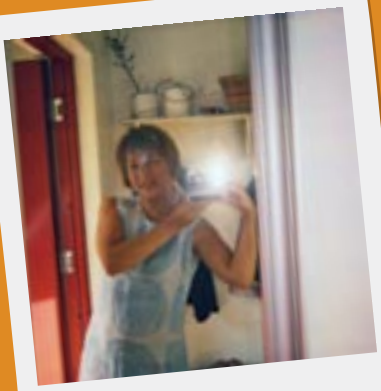
DESIGN PROBES

Tuuli Mattelmäki



Tuuli Mattelmäki (1965) works as a researcher and project manager at the University of Art and Design Helsinki. During her research she has worked in several projects for developing tools and processes for user-centred product concept design. Being educated as an industrial designer she has applied her design thinking skills in enhancing innovative approaches that are inspired by the richness of human experiences and everyday practices. Her research with design probes has inspired students and organisations to apply the approach in various projects. She has been actively involved in several user study cases and collaborations with the partner companies. Her publications include articles about probes, empathic design and design for user experience.

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Curiosity and interest in design, people and stories were the drivers of this research. I have gathered clues, I have looked for insights, created stories and imagined real and virtual worlds. To be honest, becoming a researcher and making a doctoral dissertation was not a career I had envisioned. It only started to tickle my thoughts as I got a job as a research assistant and entered the small but stimulating Smart products research group in the Department of Product and Strategic Design at the University of Art and Design Helsinki. This, almost an accidental event, started a growing interest in interaction, experience and user centred design.

This research was carried out mainly in eDesign and Luotain projects. I am grateful to the Academy of Finland and Tekes, Finnish Funding Agency for Technology and Innovation, Design2005 programme as well as the participating companies for enabling my work. I also want to thank the EU European Social Fund Article 6 and Innovative Measures for being able to continue the work in Active@work project.

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1

Instructions: "Apply!"

The mental image conjured up by the word probe may take our thoughts into space, the depths of the oceans, or into the human body, to places not accessible to researchers. These probes are equipped with instruments selected to help answer research questions. This book will deal with probes that are based on self-documentation and among the approaches applied to user-centred design. These probes investigate the phenomena to be studied and the individual users, at the same time picking up signals useful for future work.

The design community has been inspired about probes, applying them both to experimental studies and business projects. Their use has been discussed in several publications, but a detailed consideration of the subject has not yet appeared. This book describes what the probes are, as well as for what purpose and in what way they can be employed. One of their developers, William Gaver (2001), writes that he is sceptical about a formal definition of the method, fearing that it will lose its profundity, heart and authenticity. This book will demonstrate the use of probes by illustrative examples, while attempting to maintain the authenticity of the original idea. The book sums up the probing experience, describing several case studies in which probes have been applied. Since the probes are an ap-

OPPOSITE. Toys allow playful exploring: In mobile clinical collaboration case the workshop participants applied toys for creating scenarios. (Battarbee et al. 2005)

proach to be applied in an experimental spirit, the instruction for using this book is ”Apply it!”

The University of Art and Design Helsinki started probing in connection with the eDesign project of 1999, financed by the Academy of Finland. This project considered emotions and user experience in terms of interaction and product design. One of its objectives was to investigate what the holistic methods for examination of the interaction between the user and the product could be like which would incorporate the needs of the designer as well. In this context, the designer meant someone involved in creative design. The employment of probes and the inquiry into them has continued in the four-year Luotain Project, financed by the Finnish Funding Agency for Technology and Innovation TEKES Design2005 programme and the participating companies. In this project, considerations have been directed further by the topics of user-centred concept design and of formulating the user experience, as well as close collaboration with companies.

The research looking into probes has dealt with several domains. Firstly, the work started from the supposition that user study reports by other experts do not necessarily meet the designer’s creative thinking. How should interaction and product design through empathic approaches be supported? Secondly, the expansion of user-centred design from usability towards user experience has presented new challenges. Will probes facilitate investigating people’s daily experience, as well as their emotions and incentives, in order to back up the concept design? Thirdly, the probe procedure was originally artistic and design-oriented, and was developed in an experimental research project. How can probes be applied to the R&D environment and an industrial context? Fourthly, it has also been necessary to sort out what probes really are and how to go about them in order to teach, develop and evaluate the approach.

This book has two objectives. Firstly, it is addressed to researchers, students and professionals interested in user-centred design who would like more information on probes and their applications. This book is meant to offer both research findings, and descriptions and illustrations to inspire the reader. Secondly, this is an introduction of the doctoral dissertation, summing up observations and analyses from the author’s academic publications, as well as experience gained during the research. The process of writing this book, like any planning work intended to meet various requirements, has demanded compromises. In spite of the progress to a finished book not having been quite straightforward, the reader will hopefully have a clear and practical map of the ways of probing.

As for the disposition of this book, Chapter 2 offers a rough outline of the field of design in general, and user-centred design in particular, where the probes have been developed. Chapter 3 deals with the probes, their development and uses.

Chapter 4 is a gradual exposition of the process, with the aim of instructing the reader in applying probes through the best practices and illustrative examples. The concluding chapter is a summation of the issues discussed, and an outline of the trend in probing.

2

Changes in the field of design

The idea and practice of design are changing. Products have changed and assumed new meanings. These changes have been caused by aspects such as experiential views of the products to be designed. The objects of design are not merely products applying modern technologies, but experiences and industrial strategies as well.

Richard Buchanan (2001) establishes four places of exploring a product and its significance. Firstly, the range of products of graphic design traditionally consists of symbols and communication. Secondly, the object of product design has traditionally been material things. Up to the middle of the 20th century, the design of objects was restricted to the external factors of form, function, material, production and use. Next, objects as an element of people's social and cultural environment attracted attention. The design is addressed to action, the products to be designed no longer being tangible. The third, the interaction design, as a new domain of design in Buchanan's outline, is focused on the interaction between people and technology, regarded as something broader than the product–user relation. Products are not merely physical objects, but experiences, functions and services as well. Furthermore, they will have to be useful, usable

OPPOSITE. Workshop participant, usability specialist-industrial designer, is visualising a design idea and its relationships with various aspects of mobile clinical collaboration. (Battarbee et al 2005)

and desirable. The fourth area, new as well, is environmental design dealing with models of thought and human systems. These systems are not necessarily material solutions either, but bodies of integrated knowledge and physical objects, as well as living, working, playing and learning environments. Although people understand the influence these have on their lives, they find it hard to see these systems as wholes, which is why design is employed to create ideas or thoughts to make them understand it and help them act. Precisely these ideas and thoughts are the product of environmental design in Buchanan's view.

Alain Findeli and Rabah Bousbaki (2005) discuss the same field with respect to design theories and their evolution. The first half of the 20th century, the subject of discussion and theory has been a material object or product. Design was then regarded and will be regarded as applied aesthetics. Design applied theories of both art and science. After World War II, it was increasingly regarded as rational data processing, which was to be understood and analysed by means of scientific models. A new trend has recently been observed, a growing interest in the actors of the design process and user experience as a holistic phenomenon.

As the concept of product broadens and the demands on understanding the context rise, more knowledge of various fields is called for, to be associated with the object of design and to be worked out further. Buchanan (2001) regards the mission of design in this situation as binding a comprehensive network with the elements of producer, product, community of users, goals and expectations, as well as the scientific, social and cultural environment. This situation results from the detachment of conventional science from practice through theory, fragmentation and specialisation. Design has been given the role of linking and integrating research findings for new solutions – explaining practice and working as a social agent in other words (Findeli & Bousbaki 2005). Buchanan's vision invites the practice of design to join forces with theoretical knowledge. Competence in practice cannot necessarily be associated with books and words, as in conventional theoretical knowledge, and it is not required either, because daily working life appreciates "designerly ways of knowing, thinking and acting" (p. 55 Cross 2001).

The following is an examination of aspects of the changes in design from four perspectives: the designer and the thing to be designed on the one hand, and the practices of concept design and user-centred design on the other.

2.1 DESIGNERLY WAYS OF THINKING

One of the roles of industrial design has traditionally been consideration for the users' perspective, and their protection in the design process (see Ahola 1978,

Dreyfuss 1974). Beside aesthetic quality, feasibility and usability, we expect the designer to understand the whole of the user experience. (Buchanan 2001, Fulton Suri 2003b, etc.). In recent years, the practice of user-centred design, education and research into it has started applying and developing approaches particularly suited to design thinking and making. The objective has been to encourage the designers' empathy, to connect knowledge and inspiration, to facilitate or support teamwork; hatching out ideas, communicating and making decisions.

There have been attempts to analyse design and designerly thinking by means of process models, but the functional quality of mechanical models has been challenged. Rational models of problem-solving do not work, because we do not come across clearly formed design problems in real life (Schön 1983). Horst Rittel and Melvin Webber (1984) talk about "wicked" problems of design, without a pre-defined shape, because the design problem and its solution are interlinked. As we try to grasp the problem, we also analyse the alternative solutions, but there is no way of ultimately knowing whether every possible solution has been discovered. It is also possible that there is no solution. The decision is made on other criteria since these ill-defined problems have no right or final solution. In some cases, the quality of the solution chosen cannot be tested, because its introduction changes the world. For the same reason, a "wicked" problem cannot be solved by experimenting with it, the introduction of a solution being an irreversible move. A badly planned motorway cannot be magicked away. It is however possible to get some feedback on the appropriateness of the idea in research and development by visualisation and experimentation with a prototype. The problem can be explained from various angles, and the choice of these influences the solution. Buchanan (1992) adds that the explanation is also affected by the designers' personal view of the substance of the solution.

The design procedure is solution-oriented. Although designers analyse the world in order to shape it, they also wish to understand the present situation, but this understanding is an instrument of change. In looking for solutions, designers examine the situation and the range of solutions, which adds to understanding. The designers explore in three ways (p. 145 Schön 1983): Firstly, "exploratory experiment is the probing, the playful activity by which we get a feel for things. It succeeds when it leads to the discovery of something there." Secondly, the designers can act in a more determined manner because they want to have something happen. It actually happening is however not certain. Thirdly, designers can offer hypotheses through which the presented solutions are assessed, and the number of alternatives is reduced.

Various alternative answers are tried in the design process by asking "what if?" (Schön 1983). The design work moves back and forth between detail and the whole.

FIG. 1. When planning a new kind of bathroom, the designers collected pictures of water. These pictures opened an interesting world of shapes, colours and materials that had hardly anything to do with bathrooms that they knew. The model for their design solutions was the diversity of the surfaces shaped by water, such as rocks with soft shapes, sandy shores and shapely pieces of wood worn out by water (Aromaa & Suomela 2003).

The situation is worked out, it responds, it is considered again, and new moves are made. Typically, the possible solutions are reduced by external constraints such as laws (Lawson 1990). The self-imposed constraints also affect the area of solutions. These constraints can be practical and flexible for problem-solving (Gedenryd 1998). Self-imposed constraints can be changed and circumvented, which is why a skilled designers should know how to look for new ways to circumvent and moderate the constraints.

Kees Dorst and Nigel Cross (2001) write about the problem space and solution space between which the design work moves, bridging the gap between them. Framing the problem and solution spaces seems to be crucial for creative design. Cross's findings (2004) also suggest that skilled designers move rapidly to early guesses about solutions, using these as a means of examining and defining the problem-solution area as a whole. Designers who use a lot of time for information gathering and problem definition did not do so well in producing solutions.

Creativity and intuition are important in design work (Cross 1995). Typical characteristics of creativity are flexibility, avoidance of routine solutions, and the requirement of personal interpretation. Designers accept that their knowledge is not complete or sufficient. It must be interpreted and new things have to be add-

ed to it in order to achieve the desired result (Cross 1995). The creative process is typically about looking for something not known before it is found. "Design is the ability to imagine *that-which-does-not-yet-exist*, to make it appear in a concrete form as a new, purposeful addition to the real world" (p. 10 Nelson and Stolterman 2003). "Design draws on rational thinking, but is not merely a rationalized, logical process. It is a process that includes imagination, intuition, feeling and emotion as well" (p. 124 Nelson and Stolterman 2003). Creativity is the ability to see and associate familiar things in a new way. Design moves flexibly from one subject sphere to another, shaping old things by relating them to something new *(*de Bono 1970*)*. Research and experiment extract examples, pictures, objects and action from previous experience. While looking for similarities, differences are also sought. Something familiar can act as a metaphor and help understand or describe what is not known yet (Schön 1983). In creative thinking, information is used because of the movement of thought caused by it, not necessarily for its own sake. Designers often use various visual techniques such as collages (Fig. 1) to help in hatching out ideas. Beside drawing, visual inspiration is found in illustrated magazines, cartoons and films (Strickfaden & Rogers 2004).

The designers' reflections usually happen in thoughts and visions created on the drawing board. Henrik Gedenryd (1998) claims that thinking and drawing are not separate cognitive processes. The thinking is simultaneous with the drawing. Designers do not simply print out the ideas conceived in their heads, the visual feedback from the drawing supporting the ideas simultaneously hatched. While thinking, designers transform the abstract principles requiring logical analysis into narrative or visual representations of the situations of use (Gedenryd 1998). Such stories are memorable, subjective and rich with details that are easy to identify with (Erickson 1996). Designers need tools to assist their reflection (Bødker et al. 2000) (Fig. 2). Devices such as mockups and prototypes help understand the constraints and opportunities of the experience to be designed.

A great deal of design work is not associated with solving identified problems, but rather discovering new opportunities and ideas. Bo Westerlund (2005) mentions the Sony Walkman as an instance of this, the development of which cannot be called problem-solving but rather an idea utilising the opportunities offered by new technology. He suggests that we should talk about a design space containing all possible products or solutions not yet designed. An outline of alternatives and constraints then helps get a better idea of this space and its limits. The constraints in the solution field can illustrate the aesthetic, attitudinal and technical factors before the solution is found.

The subject of designerly thinking is thus the ill-defined problems the solutions to which are not necessarily produced by rational analysis. Designerly ac-

tion is interpretative and reflective, playing with potentialities. Designers examine the solution field in order to find alternative solutions and constraints on design, and in order to understand the nature of the problem. Coming up with a problem or a potentiality are associated with finding a solution. The creative process combines the designers' experience, their self-imposed constraints, their knowledge and information, as well the chains of thought created by the process. The information is not perfect, so that the pursuit of new solutions and models of thought requires that the designer gets a grip on his or her data, interpreting it and working it through. Furthermore, the practical and visual tools, along with various ideation materials, supports designerly work. The new trend of user-orientation which started from the traditional, often rational thought, towards designerly creative, generative and visual approaches, offers inspiration for interpretation and investigation. The understanding gleaned from user information helps designers to examine situations of use beyond themselves and their experience.

2.2 TOWARDS DESIGN FOR USER EXPERIENCE

A discussion about users, understanding user experience as well as the relation between design and emotions has emerged among researchers in design and practising designers in the last ten years. The way of thinking of the user has assumed new shades of meaning. In areas such as usability they have discovered that decision-making is not based on rational and logical reasoning, emotions having a vital significance (Norman 2004). At the same time, attention has turned from functionality, effective and faultless performance and satisfaction to a broader human understanding and mapping-out of pleasure factors (Jordan 1996). This revision of perspective has started particularly because of the spread of interactive technology from the workplace to home and leisure in the 1990s. Patrick Jordan evoked the usability discussion by suggesting that things giving pleasure should be looked for, not just problems. The pleasure factors mentioned by Jordan are a) pleasure through physical sensations (physio pleasure); b) pleasure through communication and time together (socio pleasure); c) pleasure through achievement and challenges (psycho pleasure), and d) pleasure through an aesthetic product and the values it contains (ideo pleasure). As for understanding the users, attention to emotions and pleasure has increased the range of phenomena to be looked at. Beside performance, play and pleasure along with the significances associated with products to be designed have also been considered. The rationally acting user has been transformed into a complex, emotional experiencer.

According to Elizabeth Sanders (2002), design is interested in the user's new role not merely as a passive experiencer, but an active influencer as well. This role in-

FIG. 2. Ideation, tinkering, material from students of IT product design in University of Southern Denmark Sønderborg.

cludes elements such as the desire for and power of self-realisation, successful pursuit of one's plans, and finding pleasure in experiences. Sanders establishes further that consumers can become creative producers and express their views with some help from design experts. Sanders outlines a new field of design, the idea of which would seem to be interlinked with the visions of Joseph Pine and James Gilmore (1999), who think that products become virtually unique and suited to anyone, when he or she can participate personally and select the desired experience. This calls for mass customisation, a procedure matching the buyer's needs and the company's means, along with an interaction channel for the company to present the options offered, and for the customer to choose the wished-for experience. Pine and Gilmore (1998) started a boom by launching the concept of the experience economy. According to them, companies must produce experiences. People are prepared to pay more for these than for mere consumer goods. The price of the experience depends on what environment it is enjoyed in. According to Pine and Gilmore (1999), the goods bought are tangible, but experiences had are memorable.

The experience economy designs food adventures, washing experiences and driving sensations, not simply restaurants, washing machines or cars. Although

these events are personal, and the details cannot be finalised, the design can affect parts of the experience, such as sensory and functional factors. We should thus talk about planning environments that encourage and enrich experiences of the kind desired. Pine and Gilmore (1999) give examples such as exciting jungle restaurants, birthday adventure farms and shopping paradises looking like amusement parks. However, even daily things, services and environments can be experiential, sensual and memorable in a more tranquil way. The car door locks with a well-designed click, train doors are closed with a happy jingle, or the toilet of the fish restaurant is filled with the sound of mewing seagulls.

The user experience and its design have been a much-canvassed topic for a couple of years, and have assumed a variety of meanings (see the proceedings from international conferences such as Design and Emotion 1999 and 2002, Designing pleasurable products and interfaces 2000 and 2003, Designing interactive systems 2000, where this subject has been discussed comprehensively). These discussions include the content of the experience and the best approaches to it from the design point of view. The following will look at the experiential aspects from the standpoint of the discussion about product development and design research.

Sanders (2001b) describes the user experience as a momentary flash taking place in time, triggered by previous experiences and future dreams. Anu Kankainen (née Mäkelä) and Jane Fulton-Suri (Mäkelä & Fulton-Suri 2001) operate on a very similar principle in their description: the present experience along with its context, actions and motivations is included in a time chain affected by history or past experiences and expectations of future events. Jodi Forlizzi and Shanon Ford (2000) offer an outline where experiences can vary from a subconscious or routine experience to cognitive, and to a story containing individual meanings.

Donald Norman (2004), who has looked into the experiential aspect after having dealt with usability, gives an outline of the user experience by means of three levels. The visceral level considers the outer appearance, shape and physical feel of the product. The behavioural level involves its use, function, comprehensibility and usability. The reflective level is committed to rational thinking, self-image and memories. The diverse ways of dealing with the experience often only consider one of these levels. For instance, Pieter Desmet (2002) has specifically looked at the appearance factors by means of the PrEmo system, which can measure the emotions evoked by the appearance of the product by means of the five emotions in his classification.

The eDesign project examined the reflective experience by considering stories of meaningful objects. The stories were supposed to help us understand what

the hooks or contacting surfaces are like that emotional ties are attached to, and map out the design opportunities offered by them (Mattelmäki & Battarbee 2000, Battarbee & Mattelmäki 2002). The framework emerging from these stories has focused to user experience which is linked with a physical object. It also includes the gradually evolving significances and experiences. In this outline, an object can be meaningful because

- It offers a link or prompts a recollection of a person, experience, story, place, feeling or atmosphere. It can be a particular item of memorabilia, or memory associated with it through a meaningful experience. The object can be a present from the last Christmas of childhood, when Santa's beard was still real (cf. memorabilia, Pine & Gilmore 1999).
- Its design touches one. Its aesthetic and sensory quality evokes memories, or it ages in dignity and wears well. A piece of metal jewellery gets a patina from touch, the elbow rest of a wooden rocking chair become silky with good wear (cf. sensuality, Pine & Gilmore 1999, and Jordan 2000).
- It presents a challenge to its user. This challenge can evoke both positive and negative feelings, and may involve an ambivalent love-hate relationship. The thing, such as a car, has taken money, time, work and commitment. Learning to play guitar is painful, but getting the idea of it is rewarding. (Cf. Jordan 2000, psycho pleasure)
- It has become a companion with time. The companionship involves loyalty, appreciation and confidence. The VW beetle has been with one all over the country, there has been crying and laughter in it. It is almost a living soul. It is a member of the family, which has been cared for, and which is spared, even if it is not in use any longer, and which is mourned when it passes away. A companion cannot be replaced. Things such as a pair of shoes, a hat or a tool have been worn out, shaped and tuned with their user, and can be almost an extension of their user's body.
- It is a symbol of what the user is or what he or she would like to be, what kind of image is desired. A wrist computer does not make a diver, but it can produce an image of one. Owning a guitar is the first step towards a rocker image. A monthly bus ticket may be an ideological statement in favour of ecological thinking. (Cf. Jordan 2000, ideo pleasure)
- It works as a means of achieving a goal. It works when required; it is creditable and necessary. The goal may also be social interaction, socialising and having fun. A record player collects young people to listen to music together; a phone is a means of communication between people. (Cf. Jordan 2000, socio pleasure)

Katja Battarbee (2004) emphasises the role of social interaction for the significance of an experience. Clinking champagne glasses alone, with someone, or in a group feels certainly different. Taking a photo, developing it, talking about it or listening to other people's comment affect the relationship between the photo and the photographer. Thus the human and continuously changing social system surrounding the experience should be considered as well since it is not enough to understand the feelings and sensations of the user when designing an experience.

The practical approach from an industrial and interaction design point of view favours a more experiential interaction (see studies such as Hummels 1999, Djadadininingrat et al. 2000, Wensveen et al. 2000). When the interaction between electronic equipment and its users is often restricted to pressing the usual buttons on the side of a box, the key to experiential interaction is consideration of aesthetic user movements, as well as an increase in haptic and sensory pleasure. This is the starting point for Stephan Wensveen (2005) in his study of emotional interaction by means of tangible user interfaces. Design is the vehicle of natural, multi-sensory, aesthetic and experiential interaction.

This book approaches user experience from the perspective of user-centred concept design. The frameworks of user experience help to make sense of the phenomena. One of these frameworks emerged in the Luotain project, where things had been looked at particularly from the point of view of the procedure of user-centred concept design. The purpose is to help understand what the elements of the user experience are, and the methods which can be employed to approach them (Jääskö & Mattelmäki 2003, Jääskö et al. 2003). This experience is divided into five areas, which are looked at from the user's perspective, looking for features that delineate, direct and inspire the concept design. These five areas partly overlap, and can only be separated in theory. This division is meant as a practical memorandum to support user-centred design and the use of the probes described later in this book.

- The object of the world of humans is about people, users or potential users, their lifestyle, attitudes, values, goals and motivation. What inspires them at work? Why do they play sport, for the group or their health, or in order to outdo themselves? What is their attitude to their hobby? Is it a passionate pleasure, a means of distributing knowledge and experience to others, or a casual habit? Are they sociable, sentimental, frightened or rational? Furthermore, you have to consider the users as a community that shapes its members' experiences and ways of doing things.
- We look at work and purposeful action through the world of action. What do people do, and how? What stages form part of the action? Is it most natural to lift, press or turn the switches?

- The world of the products deals with the products, novelty values and trends on the market and in use, through which people evaluate the properties of new products. Could the design of a smart device make use of characteristics that someone interested in exercise appreciates in a bicycle? What kinds of smart device is a nurse used to using?
- We take a stand on subjective matters such as historical context, attachment, stories and memories through the product significances. What images do earlier experiences and the significances produced project onto the product to be designed?
- Consideration of the physical world creates the framework into which to fit the products to be designed. This world consists of the physical and the aesthetic context. How do the conditions of the freeride skiers affect the properties of the product? What is the visual appearance of a nurse's environment? How big is everything really in America?

The user experience is a comprehensive and ambiguous term, which we have tried to understand and analyse in various ways. There is no ultimate understanding of it. The definitions and frameworks of experience help us to grasp indefinite things, they name them and point out things to be considered, and thus make us look in the right direction.

2.3 RECOGNISING OPPORTUNITIES

Companies face new challenges as design and technology change. They used to compete for progress or quality, but now almost all have access to the same technological components. One must keep up with development. Companies must find new ways to differentiate their product from a competitor's invention, and commit their customers. Furthermore, the awareness of people's experiences and the increasingly multicultural market have imposed new demands on design. The user perspective is desirable at the very beginning of the process. The user material is a source for product opportunities, needs and new ways to act or think. An understanding of user attitudes, needs, wishes and dreams is called for (Cagan & Vogel 2002). The early phases of design are particularly actively considered when working on new methods for user studies (Fulton Suri 2003b, Kankainen 2002, Sanders 2005, etc.).

New solutions and methods do not necessarily get the time to develop in a hectic R & D schedule, so they have often been separated from product development activities. The purpose of concept design ventures is to allow conditions for innovation. In seeking innovation, the key words are flexibility, openness

and free scope. Turkka Keinonen et al. (2003) define concept design as action in which new ways of doing things and new ideas are sought, detached from the strict, technical or temporal preconditions, and the short-term goal of sales returns. Product concept design is often regarded as the first stage of product development, but it can also define the product without this definition directly aiming at production. The concept design can deal with aspects such as design, user-orientation, technology or commerce. User-oriented considerations can concentrate on a single phenomenon, such as weight control or a limited group of users, such as novice kiteboarders.

Concept design can take place in research projects. William Gaver and Heather Martin (2000) have envisaged alternative directions for future technology and its design. Such projects can play with future potential and prompt reactions without pressures for economic productivity, and can map out the interaction between concepts and people for the benefit of the academic community and companies.

Companies use concept design for the following reasons (Keinonen et al. 2003):

1 In preparing the implementation phase of product development. Concept design is meant to shorten and direct the process itself. Alternative solutions are then considered, and one is chosen for creating a new product.
2 For development of essentially new solutions. The concept design projects ask what could be planned in the future. They can develop inventions to be patented, collect ideas, or build up collaborative networks for the future.
3 For outlining of the future and for concretising alternatives in support of the company's strategic decision-making. The future is unpredictable, but guesses can be made about it. The concepts sketch alternative possibilities, and make decisions for the future more tangible.
4 For learning and creativity in the company. The concept design projects leave room for experiment and error. Groups such as the usability team of GE Healthcare participated in a project looking at clinical collaboration (Battarbee et al. 2005). This project did not aim at product development directly, but it taught the team new ways of working and opened up fresh perspectives.
5 For influence on the expectations and for a favourable future for the company. This strategy is employed in such areas as the motor industry (Karjalainen 2004). Exhibitions show concept cars suggesting what cars might be like in the future. Comments from the public can influence the future trend of car design meanwhile customers start expecting new kinds of car models.

The emphasis in the first phases of the design process, and in concept design in particular, is typically on collecting and interpreting the knowledge required for design, such as user information. The user study is then specifically adapted to identification of new opportunities (Rhea 2003). The first thing to be considered is the initial position in the design prospect, trying to understand what the challenge is all about, and what the limitations are (Cagan & Vogel 2001, Kelley 2001). These determine the procedure and the direction of further considerations. Sound delineation of the area to be looked at intensifies the work, but since the exploration can bring the unexpected, the process must tolerate openness. At the beginning of the innovation process, as in designerly creative thinking, it can be productive to take wrong turns from the point of view of the end result, because this produces new lines of thought, and the designer gets a grip on the idea and new insight into solutions. A broad perspective can challenge old ways of thinking, and concept design typically aims at breaking conventions. A user study is then conducted by means of qualitative research (Cagan & Vogel 2001), observing people in real-life situations (Kelley 2001) and using experimental, creative methods (Sanders 2001a). These user observations are followed by interpretation and new ideas. The emergence of good, innovative ideas is guaranteed by thinking of as many ideas as possible (Kelley 2001), so that even the limitations of the initial position can be challenged. The initially broad perspective is restricted when options are given priority, and decisions are made about the focus of the process (Rhea 2003). The process continues in realising, visualising and modelling the concept ideas, and concludes with constructing and assessing prototypes, and possibly implementing the concept for commercial production.

Concept design, like design in general, has to tolerate things which are indefinite and open. The design mission and the research problems are not known to start with. The design and exploration process is thus open, flexible and iterative. Rhea (2003) believes that the ”fuzziness” of the concept design process clears up efficiently and credibly in a user-centred procedure in particular. Although it is essential to map out the background, even designerly creative thinking plays an important role in the emergence of ideas. The user information typically describes the existing situation, while the amount of work on the ”wicked” problems of design concentrates on identifying future experiences and solving any related problems. The concept ideas and the direction of the design are directed by assimilation of knowledge and the lure of potential to be considered, not simply the result of logical analysis (Keinonen et al. 2003). The user information helps the designer to adapt the design thinking to the user context and thus delineate the number and area of scenarios to be considered. The viability of the ideas can be ensured by various evaluations, with user acceptance and accordance with the

initial commission as vital criteria. Cagan and Vogel (2001) emphasise the relation of the ideas to the views shared by a multidisciplinary design team.

The designers have traditionally been in charge of the experiential properties of the product solutions, having to resort to their personal competence in dealing with them. In concept design, looking into potential solutions is teamwork, and supporting it is crucial (Cagan & Vogel 2001). Teamwork demands sharing of insights and interpretation of experiences, discussions, conceptions and assumptions. The team consists of people with diverse specialties, typically engineers, designers and marketing professionals, but other experts and user representatives as well. The teamwork attitude to concept design is curiosity, experiment, surprise and learning, which is why the team members have to be open to new ideas. The conditions for cooperation in the team are improved by means such as workshops and team-building exercises. The importance of teamwork is also important in user-centred design. A shared view and commitment by the parties should be ensured from the start, so that the message of the user information does not change on the way (Cagan & Vogel 2001). Procedures enriching the interaction and supporting the teamwork, such as user descriptions, scenarios and visions delineating the design field help to take the team to the goal that its members share (Keinonen et al. 2003, Rhea 2003, Tuikka 2001).

2.4 METHODS IN USER-CENTRED DESIGN

I described above how an industrial designer has traditionally tried to bring a human and experiential perspective into R & D. As for interactive devices and the development of ICT, new kinds of competence were required to humanise the technology, and this was no longer simply the designer's responsibility. As early as World War II, there were attempts to ensure that performance was as efficient and impeccable as possible by paying attention to ergonomics. When technology moved on to workplaces and to everyday life and leisure, new skills were demanded from design. Usability became an important issue. The spread of ICT and smart products in the 1980s and 1990s presented new challenges both at physical user interfaces and the inner logic of their function. Ways of improving usability were standards, instructions, and tests. User-centred methods started to appear both in professional design literature and the design of interaction and information systems and applications in particular.

User-centred design has become generally accepted procedure (Cagan & Vogel 2001). At the same time, user orientation has needed further development, and new methods have had to be employed to support it. These methods are there to supply knowledge of ergonomics and usability, as well as the experience of aes-

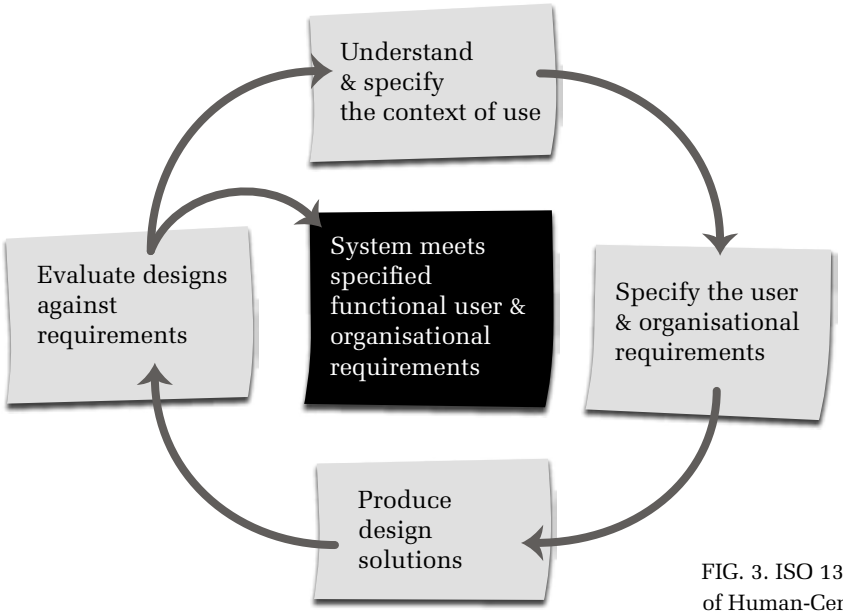


FIG. 3. ISO 13407 Standard of Human-Centred Design

thetics and form, the appropriateness of the object of design for the user's way of life, and integration into daily work (Jääskö & Keinonen 2004).

User-centred design creates an interaction with the users from the start, and it is maintained all through the iterative process (Gould & Lewis 1985). The goal is to introduce an understanding of the user's needs into design work, and transfer it into the product specifications. The user's view is also utilised in the evaluation of the design solutions. Standards such as ISO 13407 (Fig. 3), define the process of human-centred design. Firstly, it identifies the need for design, secondly it determines the context of use and produces the user requirements, and then start designing solutions. The work concludes with evaluation and iteration of the solutions until they meet the requirements. However, creative iterative design enables the integration of the user study activities into all the stages of the process in a more dialogical way than the ISO standard. The research can initially resemble journey of exploration: what is over the ocean, India, America, or Ultima Thule, or some other end of the world? The direction is taken first, and the destination is adjusted on the way there.

User-centred design can be approached in various ways. Elizabeth Sanders and Ulay Dandavate (1999) instruct their readers to look into the user experience in three ways: listen to what people say, look at what they do, and let them express what they think and what they dream of. People are typically heard in interviews, seen in observations, and people express themselves in various crea-

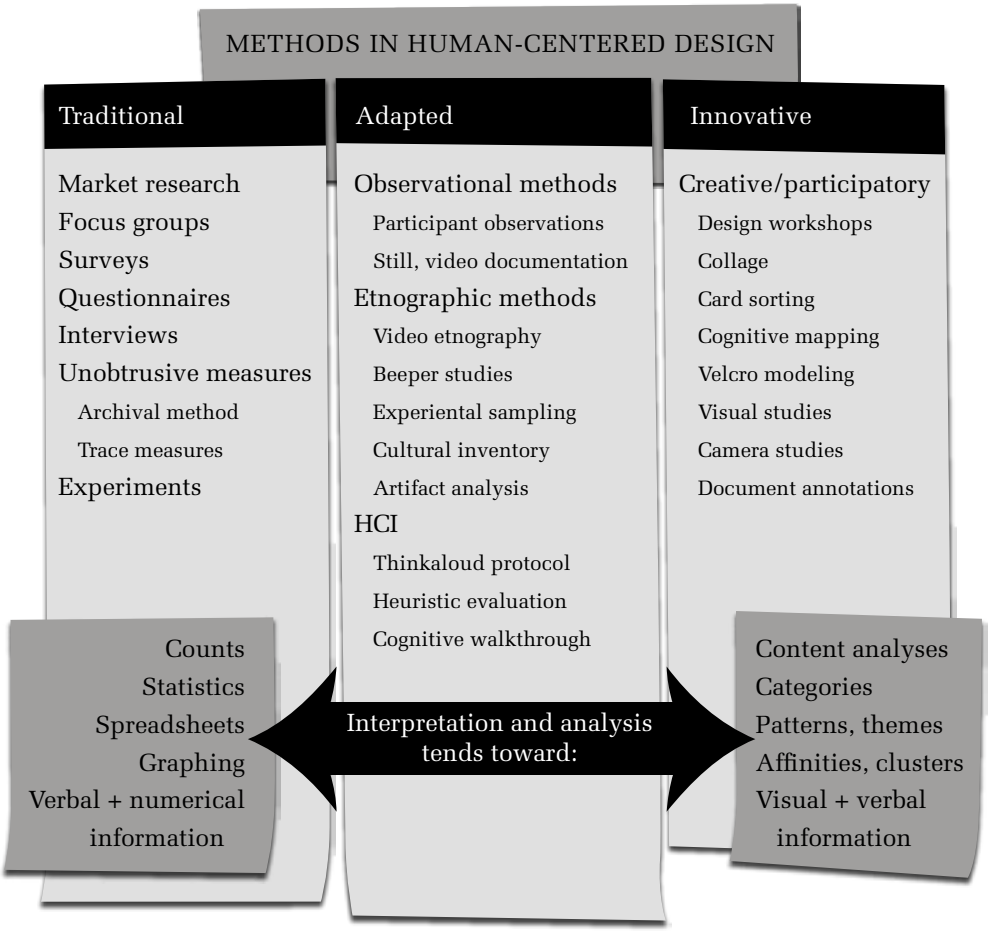


FIG. 4. Human-centred methods and the interpretation of the material in Hanington's view (2003)

tive ways. Bruce Hanington (2003) has also divided human-centred research methods according to their goals and results in three categories: traditional, applied and innovative methods (Fig. 4.).

Traditional methods include market analysis, group discussions, inquiries and interviews, which typically produce knowledge of large masses of people, and result in figures, statistics and tables. The use of these methods is often based on their value in confirming or disproving things already known, but they do not necessarily offer any new prospects (Hanington 2003). One of the known drawbacks with the traditional ways is for instance that people's account in the focus groups of their decision to buy something need not reflect their real-life conduct. Besides, the generalisable knowledge extracted from a study of the satisfaction in the market segments is not sufficient for designing mass-customised solu-

tions, because they do not disclose the needs of an individual customer (Pine & Gilmore 1998).

The applied methods are typically qualitative, borrowed from the humanities. These include observation and ethnography, as well as human–computer interaction (HCI) studies through methods such as thinking aloud and heuristic evaluation. The difference between traditional research and user study of user-centred design is to be found in the aims of the research. An evaluative and critical study aims at identification and explication of phenomena. Many methods are originally based on approaches from which confounding variables have been excluded as much as possible. Design, on the other hand inventories, defines and produces alternative (good) solutions. Design applies methods such as ethnography at the quick pace required by R & D in people's own environments, workplaces and homes. Well-established research methods such as self-documentation, used in ethnography, sociology and medicine, are used for determining user expectations and for understanding the use of technology (Adler et al. 1998, Van Vugt & Markopoulos 2003). Sanders (p.1 2002) has described the characteristics of applied ethnography in the following way:

- it takes place in a natural surroundings
- the process is open to change and refinement throughout the process as the new learning shapes future observations
- it combines a range of research methods
- it has a goal which is more likely to be exploratory rather than evaluative
- it aims at discovering the local person or "native's" point of view, where the native may be a consumer or end user.

The innovative methods in Hanington's view are creative and participatory, such as workshops in participatory design, collages and camera studies. These methods, necessary at the early stage of design in particular, are intended to understand people's feelings, pleasure, values and dreams. Sometimes the objectives are thoughts never really thought, let alone expressed in words. These questions require tools to help the users to express themselves through metaphors and associations, sometimes revealing very delicate and irrational motives. Creative and projective methods offer these ways of expression (Sanders 2001a, Shedroff 2003). Projective tests, such as the Rohrschach test or the fill-in test, were originally developed in psychology to study a patients' character, problems and subconscious, intended to disclose things through association that do not emerge unaided. These projections reveal things that people do not wish to see, or are incapable of seeing (McGrath et al. 1993). The principle of psychoanalytic inter-

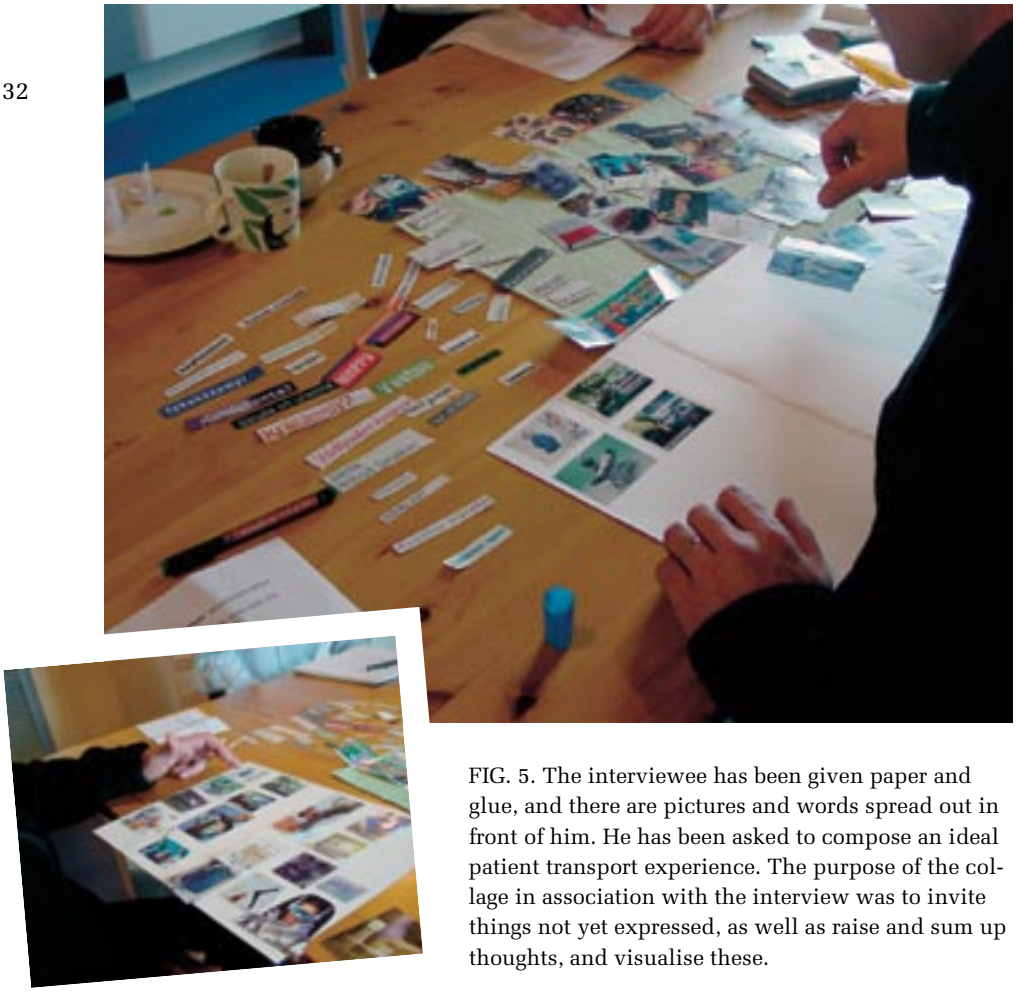


FIG. 5. The interviewee has been given paper and glue, and there are pictures and words spread out in front of him. He has been asked to compose an ideal patient transport experience. The purpose of the collage in association with the interview was to invite things not yet expressed, as well as raise and sum up thoughts, and visualise these.

pretation is that the factors affecting the emotional reactions evoked by images are subconscious, not conscious (Rose 2001). In the design environment, similar methods can be applied and interpreted more freely as vehicles of understanding and interaction (Gaver 2001). In user study, projective methods are used for collecting qualitative data about the users and their values, dreams and needs for understanding and inspiration, and for further development of design, not for finding out about psychological problems.

The innovative methods typically produce visual and verbal knowledge for delineating and discovering design opportunities, such as Fig. 5 and 6. For example in participatory design workshops the user's reflections and ideas are conveyed straight to the designers through visual methods. Hanington (2003) claims that since design work is creative and visual by nature, research aiming at de-

sign should offer the same qualities. Firstly, the methods should be creatively worked out to match any given situation. Secondly, designers can smoothly elaborate their research findings into design solutions. Jacob Buur and Kirsten Bagger (1999) also admit that the use of user-centred design methods should include an experimental attitude, and that a routine implementation should be avoided in order to maintain the fresh approach necessary for design work.

Hanington's division (2003) exhibits the trend by which traditional methods produce quantitative results and generalisations suited to large groups, while the application of innovative methods is more concerned with smaller groups and even individuals. The subjective emphasis of the innovative methods rejects stereotypes and generalisations, which, according to Gaver et al. (2004), lose the personal and divergent factors in the material which inspire the designer. An individual need or dream can provide the spark of an idea in design. People are not necessarily capable of demanding improvements, or imagining possible futures. Nevertheless, the discovered and fulfilled dream of an individual may meet the need of a larger group of people as well (Leonard & Reyport 1999). This is particularly interesting for concept design,

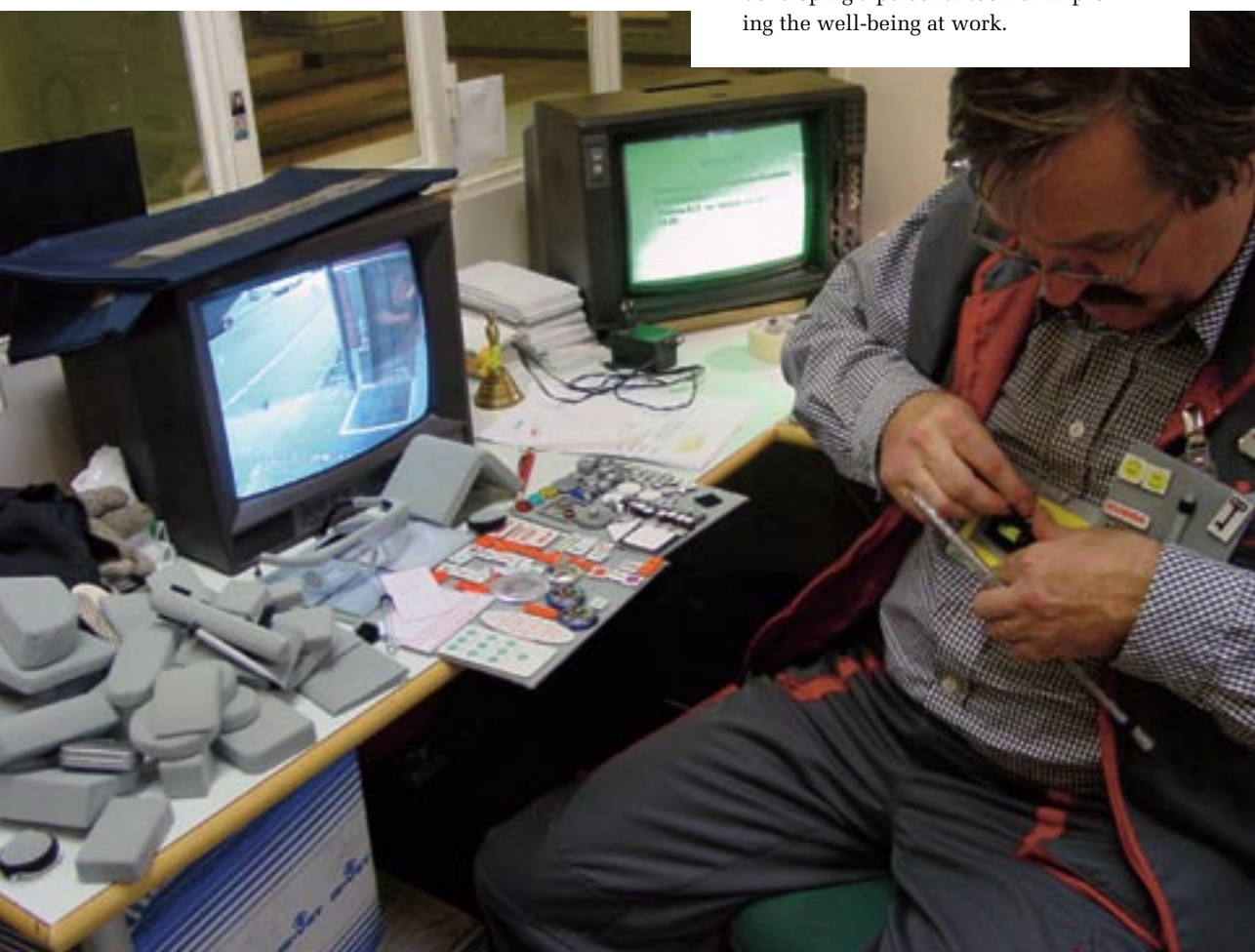


FIG. 6. In participatory design the users can be given physical materials to help work out and express their ideas. Here these kinds of creative aids are used for developing a personal tool for improving the well-being at work.

because it can experiment and play around with various possibilities for new prospects without aiming directly at product development. Product development often calls for more studies and reasoning to build production decisions on.

The user information for design can be collected by traditional, applied or innovative methods. The traditional, academic methods emphasise objectivity, which is not enough for experience design (Fulton Suri 2003a, Hanington 2003). Firstly, they often do not touch the users' individual motives and emotions, values or criteria, which are meaningful for designing experiences. Secondly, even a systematic analysis need not produce new ideas for design, since imagination plays a role in design-related research (McDaniel Johnson 2003). The benefit of experiential, non-objective methods is the insights and ideas they facilitate and the possibility of shared experiences offering the design team a common basis.

Traditionally, designers do not face potential users, the user information being reported by other experts. The design of the user experience emphasises the designers' participation in user studies (Fulton Suri 2003, Hanington 2003). The designers ought to understand the personal, cultural and social factors and interpretations as broadly as possible, because their design solutions are evaluated and assessed through these. The subjective, empathic and experiential approaches point out the designer's ability and need to empathise with the user's situation. The human approach, with as holistic understanding of the user as possible, already described in association with the user experience, is then applied to empathic design. Design empathy can be described as the ability to put oneself in someone else's position, to imagine oneself in someone else's place.

The discussion about empathic design and methods emerged in the late 1990s. Ulay Dandavate, Elizabeth Sanders and Susan Stuart (1996) regarded an expanding of the focus of user-centred design important, as well as inclusion of emotions alongside rational considerations. Empathy is needed to understand emotions. In 1997, Dorothy Leonard and Jeffrey Rayport published an article that marketed empathic design as an inspiration for innovation. Empathic design was regarded as an alternative to traditional marketing and the methods of other academic disciplines, seeking clues for ideas for new products, as similar to concept design. Market research is not seen as a producer of clues, because the consumer or the customer is typically not able to communicate needs that could be satisfied by new products (Leonard & Rayport 1997).

Fulton Suri (2003b) considers design empathy in dividing the ways of understanding the user into four, starting from the objective and finishing with the subjective. The first way, the most objective, is to learn from information from secondary sources or own material, such as the ergonomics of bus seats or the dimensions of leg room. Secondly, people are observed in their own context, such

as observing the activities of bus passengers. Thirdly, people are asked to join in, by, for example, describing what makes the atmosphere in the bus through photographs. The fourth way, the most subjective, which has not been considered as a human-centred method in Hanington's outline, is research through the designer's personal involvement, by joining in the experience, becoming a passenger and sitting with all kinds of fellow passengers, imagining and experimenting with various kinds of solutions.

Subjective is not random, however. Ilpo Koskinen (p. 7 2003) has defined principles for empathic methods. These are user-centred, and demand a contact with real user. They are visual and tangible, thus supporting designerly thinking. They are cheap and low-tech, so as to be easily adaptable. They are subject to interpretation, because designers will have to understand how the users look at themselves, and what is meaningful to them. They are playful and pleasant, in order to inspire the users to imagine future experiences. Furthermore, they typically aim at the start of the design process, the concept design.

The roles of designer and user affect the attitude with which these methods are applied. Jääskö and Keinonen (2005) have observed the following roles. The user can be the designer's patient, where the designer is an expert such as a doctor trying to analyse the problems in the user's action to be remedied by design. The role of an expert is frequently taken in studies concerning issues such as usability. The user can be the designer's teacher; the learning intended to remove the designer's preconceived ideas and understanding of the significances of the user. This kind of role is needed when designing products for a different culture or different age groups. The user takes the role of the designer in participatory design where the user is regarded as the expert in personal dreams and as a creative person (Sanders 2005, and others), who can produce suggestions for solutions together with the designers or the researcher. The user is the designer's muse when the material collected from the user is used to support the designer's inspiration, and the interpretation of the material is the designer's duty. This involves some hatching of ideas, imaginative interpretation and storytelling, without any aspiration to factual knowledge. The designer can take the user's role and empathise with the user's situations when the goal is understanding feelings and experiences. This is based on the idea that the designer's personal experience is the key to insight and empathic understanding of the user's experience. We can try to empathise with a blind person's daily life by walking through town with a blindfold.

Personal interaction with people is the best way of getting contact and building up an empathic understanding. The user can then be both a muse and a designer. The designer for his or her part is both a student and an expert. Empathic

design gives the designer the opportunity to use both creative imagination and experience, but, being committed to and associated with the knowledge of the user, it leads to solutions considering the user's perspective.

2.5 REFLECTIVE DESIGNER TRACKING EXPERIENCES

I have now described the tendencies in design, and what follows is an attempt to sum up the discussion. Firstly, the object of design, the product, has changed, extended and become more complicated. Design aims not only at beautiful, pleasant, practical and comprehensible objects, but experiences as well. New features have been introduced by smart and mobile devices, as well as ICT and its systems, where the object is not purely physical, but is connected with other objects, services and environments. The user is not a mechanical subject or a passive customer, but an active, sensitive personality, and even a designer participating in the production. Also the strategic significance of design for companies has been acknowledged. Design is a means of differentiation, competitive advantage and anticipation. New perspectives and approaches are called for.

Not only has the product changed, but the practice of design has undergone changes as well. Beside individual hero designers emerging from the masses, there are various organisations, multidisciplinary product design teams and networks. As the technology advances, design faces the new challenge of understanding what is to be done or manufactured in the future, not simply concentrating on improving the existing products. The demand for innovation and anticipation of the future require creativity and new horizons in the organisations. The user-orientation is systematically introduced into design at its early stages so that the experimental research can probe the space of design, outlining its characteristics and limitations. The maintenance of innovation in design teams requires a practice that supports cooperation and facilitates creativity.

Beside product and practice, the user centred design and the variety of objects of design along with the demand on experience add new dimensions in the design field. How should people's private and changing experiences be observed and examined? How should we motivate them to talk about their lives, values, needs and feelings? The user perspective demands a holistic understanding of the user experience, mutual understanding between the members of the design team, and promotion of this understanding in the organisation. All means are needed, from the traditional to the experiential, and from the objective to the subjective. The research methods are partly developed in a designerly manner, by avoiding routine. The practice of design research has acknowledged designerly experiment, "thinking by doing". Just as it is suggested that user study can work as an

instrument of design as pen and paper do (Säde 2001), the experimental activities can be a vehicle of a more profound understanding. New visions of interaction can be created by experiments such as trying prototypes out in practice. In the design thinking, theory and practice walk hand in hand (Buchanan 2001). The probes are also linked to this change in design practice.

3


Kipua, SÄRKYÄ ja kolotusta?
DIABETES.
Kaupassa ja pankissa JA APTEEKISSA
Minun terveyteni ja kuntoni

Probes seeking human life

The changes in the design field described above have also affected the methods of user-centred design. Ever since the late 1990s, traditional methods have been challenged by new, experimental methods, and the methods of user-centred design meant for the concept design stage in particular are being developed continuously. The probes are among the new challengers, meeting the demands of understanding potential, experimentation and designerly interaction brought by the changing situation. This chapter will deal with the common characteristics of the probes used in design, and will give examples of the various applications of them. Finally we will look into the purposes of applying probes.

3.1 CHARACTERISTICS OF DESIGN PROBES

Design probes are an approach of user-centred design for understanding human phenomena and exploring design opportunities. The literature and the experiences from several probe studies suggest three features describing the probes in this book (Mattelmäki 2005). The first emphasises the user's active role in recording the material. The second and the third show similarities with the characteristics of applied ethnography (Sanders 2002).

OPPOSITE. Probes allow personal expressions. Väinö probes included booklets in which the participants were asked to tell about themselves. (Mattelmäki 2003b)

Probes are based on *user participation* by means of *self-documentation*. The users or potential users collect and document the material, working as active participants in the user-centred design process. Probes are a collection of assignments through which or inspired by which the users can record their experiences as well as express their thoughts and ideas.

Secondly, probes look at *the user's personal context and perceptions*. The purpose is to outline human phenomena and users, as well as introduce the user's perspective to enrich design. The assignments focus the users' attention and record their daily lives including social, aesthetic and cultural environment, needs, feelings, values and attitudes.

Thirdly, *probes have an exploratory character*. They explore new opportunities rather than solve problems that are known already. This characteristic relates the probes to the "wicked" design problems (Rittel & Webber 1984) and concept design, often with an experimental goal (Keinonen et al. 2003). Probes sound out the field of design, trying to find and delineate alternative solutions as the explorative probing described by Schön (1983) does. Probes are meant to support both the designers and the users in their interpretations and creativity. They are used to ask the users to experiment, express and explicate their experiences. The open probe assignments are both descriptive and explorative. The openness and room for interpretation also involve the expectation of a surprising or unexpected result.

This book concentrates primarily to probes based on self-documentation. Probes can also appear as interactive devices or systems; experience prototypes in other words (Buchenau & Fulton Suri 2000). These collect experiences and explore new potential in including the users in experimenting, commenting, and hatching new ideas with technological potential (see Hutchinson et al. 2003, Paulos & Jenkins 2005).

The most typical forms of traditional self-documentation are diaries and camera studies. The academic purpose of self-documentation is to examine the daily factors of human lives. Firstly, it is a way of collecting data from several situations which is thought to give a more credible and reliable idea of a person than recording just one situation by means such as observation (DeLongis et al. 1992). Secondly, it is an attempt to minimise the observer's possible influence on the person observed (Carter & Mancoff 2005). Christopher Ireland (2003) establishes that the reason for using self-photography may be the desire not to include a researcher in the situation to be observed, because his or her presence would change the behaviour in situations such as young people's home parties, or because taking photographs would not be proper in other respects in situations such as getting washed, or because observing the situation would exhaust the resources because of demands such as travelling. Self-documentation can record context-related experiences as they oc-

cur, minimising retrospection (Csikszentmihailyi & Reed 1987, DeLongis et al. 1992, Brown et al. 2000). This contention is based on the perception that the experiences are recorded in a more genuine form there and then in a diary than situations such as group interviews conducted afterwards. When people look back, they do not necessarily remember the situations and sensations that they have experienced sufficiently well, or their reminiscences are contaminated or distorted.

The probes in user studies based on self-documentation are conducted by means of *probe kits* (Fig. 7). The instruments collecting signals consist of various, often physical *objects* and *tasks*. The kits can be envelopes, folders or bags holding articles such as notebooks, illustrated cards or stickers specifically designed for the purpose. Since the experimental nature of the probes encourages creativity in defining the assignments and designing the articles in the kits, articles and

FIG. 7. A probe kit from a project entitled Active@work (Mattelmäki & Lehtonen 2006). This project examines and develops ways of supporting ageing workers' well-being at work and motivation to work longer. The kit contains a workbook with assignments and questions, a timetable as a diary, a camera and descriptive exercises for recording the tasks for the day, a map exercise for accounts of daily routes, as well as postcards for the workers to send messages to their employer and the designers of the probe.

assignments vary from project to project both in content and aesthetic appearance. Activities such as taking photographs, writing diaries, answering open questions, drawing maps and making a collage of pictures are frequently used.

The following is an account of the assumptions and procedures of the cultural probes in the first probe study (Gaver et al. 1999).

3.2 CULTURAL PROBES

Cultural Probes were developed in the late 1990s in a research project entitled Presence, financed by the EU, with researchers and designers from many European countries. This project outlined new technology to support the active presence of senior citizens in local communities. The approach was characteristic of concept design in that the focus of design was open, and the challenge consisted in finding new ideas rather than dealing with present problems and their solutions.

The object of study was three communities of senior citizens in three places: the little town of Peccioli in Italy, Oslo in Norway and the suburb of Bijlmer in Amsterdam in Holland. First, background information was collected on these places and cultures by means of discussions and questionnaires, such as social and historical factors. William Gaver (2001) describes how the design team eventually developed an urge to make the fact-based material and its figures live. They wanted to get an idea of the details of people's lives in the three places. They called for an empathic understanding, which they did not achieve by traditional means.

The point of departure for the developers of the cultural probes was to create a dialogue between the designer and the user (Gaver et al. 1999). One of the goals was to get rid of the stereotyped images of ageing people, as well as to develop sensitivity in listening to other people and understanding their actions (Gaver 2001). The dialogic process emphasised the designers' need to be designers even when conducting a user study. They wanted neither to simply meet the needs of the user group, or wish to express their own views only, the validity of which was to be proved by users. They wanted to match both their own designerly imagination and the needs and wishes of future users.

The design team decided to include the senior citizens in the design work and encourage them to use their imagination. Probes were designed for the purpose, the development of which was inspired by the projective methods used in psychology, as well as the thought and practice in contemporary art. The probe kits, containing tailored material for a particular place, included illustrated question cards, map exercises, a disposable camera and a photo album (see Fig. 8). The exercises were ambiguous and open on purpose, since they were meant to encourage discussion about future possibilities (Gaver et al. 1999).

Unlike the traditional self-documentation in ethnography in which existing activities are supposed to be documented with as little disruption as possible, and without interfering in them, this was specifically an attempt to provoke people and stimulate their imagination. They were also given the opportunity either to answer or abstain. About six weeks after the distribution of the probe kits, parts of them started being returned to the designers, a postcard and a map at a time. Inspired by the material returned, the designer team visioned possible futures by creating interactive concepts such as the slogan bench in Fig. 9.

Another probe project started by Gaver (Gaver et al. 2004, Hemmings et al. 2002) examined domestic life. *Domestic probes* collected material for the designers to get inspiration for ideas for future home technologies. Encouraged by the success of the cultural probes, the exercises in the domestic probes were even more open and varied (see Fig. 10). The probing process and the accumulated material provided a source of inspiration for the designers when they worked out concepts visualising alternative futures such as Fig. 11.

The original probe process was experimental, artistic and innovative. Even the development of a user study involved planning and imagination. The probes were meant to collect beginnings to stories conceived in the designers' heads to build the concept ideas on. The material accumulated in the probes, pictures and answers, has been presented as a result of the process. It was not considered interesting to use scientific tools for analysing the data, and aspects such interpretations of user understanding, the data interpretation methods and the reasons for the concept ideas have not been reported.

The assumptions of the cultural probes suggest equality between user and designer, a notion similar to participatory design. The way of handling the material does however not support this idea, because equality was replaced by the designers' empathising and imagination at the interpretation stage. The designers did not want the participants to explain their own interpretations of the material, specifically avoiding it, building their planning on their own views as well as the issues and insights emerging from the user material and the inspiration created by the material and the process. This has attracted criticism and created discussion. Gaver (2001) however emphasises that the idea of using the probes was not to analyse the material and individual tasks, and the materials were not meant to be analysed. The results were fragmented and unclear. Gaver et al. (2004) wonders how these photographs or dreams could be analysed, let alone allow user requirements to be derived from them. Instead, they wanted to dive into the material in order to come up with their own ideas, and to develop and share stories that sparked off new ideas.

The freshness of the original probes is in their visual nature and the designerly dialogue that openly accepted the constraints imposed by the designers them-

FIG. 8. Contemporary art is mentioned as a source of inspiration for cultural probes. The probe material was visual and aesthetically well-considered, inviting, and prompted elderly people to initiate an creative interpretation process. Among the map exercises, people were asked to mark routes and residences as well as to put stickers on ready-made maps. The map exercise on this picture is "What if Peccioli were New York?" On another map, people were asked to think "What if Bijlmer were a human body…" and consider where would its eyes, ears and nerves be. (pictures William Gaver)

FIG. 9. The role of the ideas created in the cultural probe project was to inspire interactive installations and provocative visons for alternative futures (see Gaver 2001). The concept developed by the designer team, the signal bench, was used and tried out in Bijlmer. The benches projected people's messages for others to gaze at. The idea with these, as with some other concepts as well, was very similar to the probes. People were asked to slogan what they wanted to be projected for other people to read and grasp. One could ask whether these ideas were developed in the process, whether the process emerged from the ideas, or the planning took place simultaneously, overlapping with the probing. (picture William Gaver)

FIG. 10. The tasks in the domestic probes provided different spaces at home with stimuli for recording activities and reflections. The kit contained devices such as a digital recorder of dreams, where people could record 10 seconds of their memory of a dream, and a listening glass that helped people to listen to the sounds of the household if held close to their ears and pressed against the wall (Gaver et al 2004). In addition, a phone memo-pad was to be placed by the phone, and a toilet memo-pad hung near the toilet. (picture Willam Gaver)

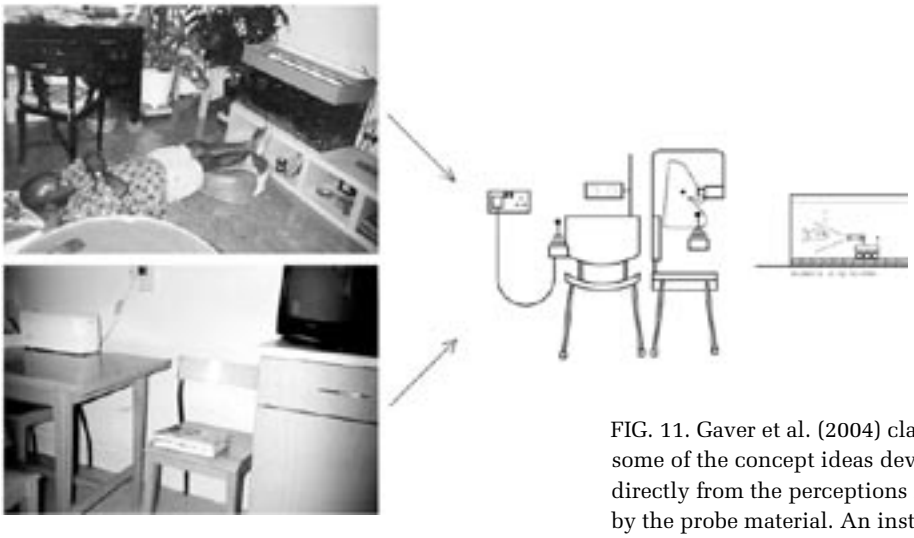


FIG. 11. Gaver et al. (2004) claim that some of the concept ideas developed directly from the perceptions invoked by the probe material. An instance of this is a photograph with one of the participants staring at an aquarium. This led to the idea of a concept for the spectator to see and control the picture of the aquarium as if inside it. Most of the ideas cannot be so clearly traced, because they were affected by the designers' personal interests, technological potential and imaginary scenarios. (picture Willam Gaver)

selves (Lawson 1990) and artistic inspirations. The designers conducted user studies to find new ideas and surprising new concepts. The probes were a way of luring the user off the familiarity of their daily lives as well. One of the pioneers of contemporary art, Marcel Duchamp, shared a similar notion, bringing ready made products to an exhibition, such as a urinal in 1917. Instead of a mere spectator experience, his act was meant to offer something to prompt new thought (Sederholm 2000). Many other projects in contemporary art aim at an experiential process containing both the author's idea and the spectator's interpretation. International situationists, whom Gaver has mentioned as an inspiration of the cultural probes, did things such as touring the German countryside with maps of the London underground (Sederholm 2000). These instances suggest a visible connection between contemporary art and cultural probes, but it is a new concept in user-centred design, and with its provocative purpose a somewhat confusing one.

3.3 PROBES TAKING ALTERNATIVE ROUTES

Inspired by cultural probes, many designers and researchers have applied the probes in their own projects. The artistic process of the original probes has assumed new emphases and nuances in various projects. The following is an account of the uses of the probes for new purposes and in new ways.

The interest in user experience and interaction design has pushed the probes in a more designerly direction. The probes of Stephan Wensveen (1999) were more clearly targeted than the previous ones, and the design had a clear goal. His intention was to design a new kind of experiential *alarm device.* Firstly, the probes were meant to collect opinions, dreams and feelings for the design of an alarm device for the future. Secondly, they were meant to record observations of individual waking-up situations when they happened. Wensveen's probe exercises were largely similar to cultural probes, but they built around the alarm device, outlining the associated design space. Wensveen's probe kit contained both documentary and personal exercises, as well as diary exercises looking into emotional states. The verbal and illustrated exercises in the manner of market research were meant to collect images and dreams associated with the style and character of a smart alarm device. Unlike the treatment of cultural probes, Wensveen (2005) has discussed the summaries of the probe material by using quantitative research methods as well. In these summaries, he tried to answer the question of the relevant emotions for a waking-up experience. The quantitative results and the more open interpretations were used to direct the planning of the alarm device (see Fig. 12).

The purpose of the cultural probes, artistic inspiration, has not convinced all who apply probes. They have wanted to use them to produce knowledge of contemporary reality. The *residential probes* emphasised the ethnographic and informative nature of probing, instead of inspiration (Hemmings et al. 2002, Crabtree et al. 2003). This project was intended to develop aids for special groups, the probes being meant to disclose the users' individual needs. The target group consisted of former mental patients. The probes were intended to create a contact with people and environments, the characteristics of which were to be looked at more carefully by other methods. The goal was sensitisation to the needs and properties that a challenging research environment and individual users demand from the designers. Besides, the probes were regarded as useful in situations where methods such as observation in people's accommodation would have been awkward in practice, and in all likelihood disturbing to the people to be observed as well.

Some of the participants in the residential probe had enthusiastically "misused" the probe exercises, photographing each other's bare bottoms. The researchers (Crabtree et al. 2003 and Hemmings et al. 2002) regarded the interesting themes and the overall understanding produced through the material as much greater than an account of individual answers or tasks given in cultural probes. As if they wished to exaggerate the contradiction with the original probes, they did not think particularly highly of investment in the aesthetic quality of the material. Instead of artistic expression, the best quality of the probes is being subjective and open,

FIG. 12. The probes helped find directions and empathy for the individual waking-up situation (Wensveen 2005). Inspired by this understanding, the designer has derived ideas of the functionality of an alarm device which is sensitive to both emotions and situations. Once the design solution is there, it is difficult to distinguish which of the alarm clock's properties have been affected by the probe findings, and which are the designer's own views. Even a systematic analysis of the material does not result in design solutions by itself (photo Stephan Wensveen).

as well as provoking discussion and supporting people's commitment to the design process.

The initial stages of the Interliving research project also made use of probes to map the research subject and its individual context as an element in the user study palette of participatory design (Westerlund et al. 2003). *Communication probes* were used to get acquainted with families volunteering for several years in a project examining and developing future home technology. Unlike cultural probes, the probe material of the Interliving project was interpreted by means of research for conclusions to direct further research (Beaudouin-Lafon et al. 2001). The diary notes were divided into five pre-determined issues, which were goals, worries, technology, place, and ideas for planning and design. People emerged as another issue, during the coding. In addition to this, mentions

of things such as the phone and computer were recorded in the diaries, which offered quantitative values of the frequency of the use of these technologies. The probe material and the understanding created by research were used as a support to workshops in participatory design. Unlike cultural probes, the interpretations for design were specifically created together with the users.

The development of the probes later took a new direction. The families were given interactive equipment, video probes and message probes for communication, recordings and play (see Fig. 13). These *technological probes* had three goals (Hutchinson et al. 2003): sociological, technological and designerly. The sociological goal was to collect material about the use of technology in a real environment, and the technological goal was to test the technology out in the field. The designerly goal was to inspire designers and users to think of new technological opportunities, as well as to consider and ideate improvements in daily activities. The technological probes were used to realise opportunities by experiment, taking interaction and interactive experiences into account.

Unlike the probes described above, the technological probes were not based on self-documentation. The activities were recorded in a database, and the experiences were gone over in interviews and workshops in participatory design together with users and designers. Research outlining interactive experiences by prototypes (cf. UE probes Kankainen 2002), similar to technological probes, has in fact already been conducted in projects such as one anticipating the use of multimedia messages (Mäkelä et al. 2000, and Kurvinen 2003). What technological and cultural probes have in common is the tendency towards experiential and designerly inspiration, as well as the open-ended search for design opportunities by means of participatory design, without commitment to products.

3.4 EMPATHY PROBES

The University of Art and Design Helsinki started applying probes in cooperation with companies (Mattelmäki & Battarbee 2002; Mattelmäki 2003a; Mattelmäki 2003b; Jääskö & Mattelmäki 2003; Jääskö, Mattelmäki & Ylirisku 2003; Virtanen, Mattelmäki & Heinonen 2004). Since one purpose of these ventures was to provide inspiration and collect information, and another was to support design empathy, it is proper to use the comprehensive name empathy probes. The goal was to record diverse human material from various areas of life, and to project images of people's experiences onto corporate design teams. In these case studies we have developed the approach further, and we have learned how to apply it to different contexts. Researchers have often been intermediaries between the users and the design organisation.

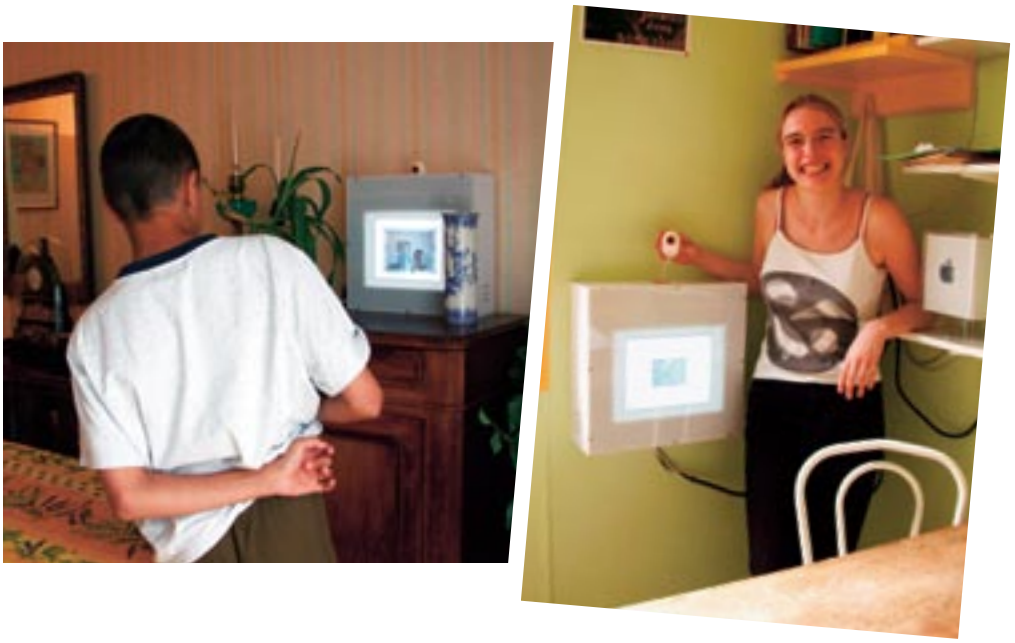


FIG. 13. An instance of technological probes is a web camera automatically taking a photograph of an immobile person in front of it and then sending it into a probe in another household. (photos Evans and Hansen)

The mixed goal, matching academic approach, collaboration with companies and user-centred empathy in design, has necessitated development and examining of the probe process. We have wished to understand how probes could be used as a practical element in user-centred design. Attention has been paid to the interaction between researchers, users and designers, handling the material, and presenting the findings. This interaction has been developed by including an interview into the probes process to complement the view of the user and the interpretations (Fig. 14). Company designers have been included in the probes process to design and comment on the tasks, to interpret the accumulated material and to participate in the interviews. This kind of inclusive approach has been a way to provide a multiple interpretation, as well as a facilitate company engagement to the process and user-inspired solutions. The probes have had their uses in marketing the user-centred perspective as well. Unused probe kits have been circulated in companies, attracting admiration and wonderment. In addition, researchers have elaborated the material from the probes by creating reports and other outcomes such as descriptions of users for the design teams.

The cultural and empathy probes share an interest in aesthetically interesting appearance and respect for people's life situations. The design of physical appearance has several significances. Firstly, the visual aspect has been designed

FIG. 14. The empathic design probes have typically contained an interview with the users after the self-documentation stage, which has supplemented the understanding extracted from the probe material, which is often fragmented, and a way of correcting possible misinterpretations.

to motivate and direct performance, and to show interest in the user. Secondly, it is meant to consider surprising perspectives by provoking and providing stimuli. Thirdly, the ideation of the probe kit and its make-up is supposed to motivate the designers to user study. Fourthly, the ideation aims at directing designerly thinking from the user's perspective when considering design details and their possible solutions. Fifthly, when the appearance of the probe is well-designed, they can be used for demonstrating and reporting the underlying research in a visually interesting way.

The probe process often creates a confidential relationship between the researcher and the participant of the study. The user-centred attitude, interest in the individual and empathic inclination in the empathy probes have partly repressed fantastic interpretation by the designers. In comparison to the cultural probe approach, this personal relation may restrict the imagination and storytelling and thus be an obstruction to wild ideas in projecting the future. When committed to people who exist and think now, and who tell us about everyday pleasure factors such as napping on Sundays or washing the dishes, it can be difficult to free oneself to imagine scenarios with high-flown concepts reaching far into the future. On the other hand, commitment may be a way of having a comprehensive mental image of the user, having emotions and values recorded, and thus supporting empathic design. Visual and genuine representations of people and their situations animate the knowledge extracted from other sources. They can make the facts live and the stereotypical image of the user fade.

The first empathy probes emerged from discussions with the researchers from Polar Electro, a manufacturer of heart rate monitors, and the eDesign research

project (Mattelmäki & Battarbee 2002). The eDesign project considered emotions and experiences from the R & D perspective in situations such as often is the case in concept design, where a product did not yet exist, and the user was not known. The discussion showed the need for experiential understanding of the potential user's emotions and motivations, which cannot be built on user feedback or usability tests. The *physical exercise and well-being study,* conducted in cooperation between Polar Electro and the eDesign project, decided to test the eligibility of the probes for an identified challenge because of their playfulness, individuality and design-orientation. The probes turned out to require supplementation with interviews and collages inspired by Sanders and Dandavate (1999).

The probe experiment conducted with Polar Electro was intended to understand sporty amateurs doing their exercise. None of them used a heart rate monitor. The study looked at what kind of activities and attitudes were part of their lives and what relation these have to their exercise and well-being. The consideration of the corporate perspective in this approach led to regular interaction between the researchers and the designers as the study advanced. The probe material was interpreted together with the researchers and the design team in order to be able to extract observations of specific interest to the company designers and product development (see Fig. 15). Apart from this, the researchers interpreted appearing themes and representations of the sporty people and their lives, exercise habits and well-being. These were used for finding new perspectives and enhancing the user-orientation in the company. The study showed that many issues resulted in new questions, and required more specifics to be dealt with, such as various factors affecting the motivation to do one's exercise.

The focus of a follow-up project undertaken with Polar Electro was sharper than the previous study. The participants were people in need of *weight control* (Auno 2003). The goal was a user-centred product concept taking people's needs,

FIG. 15. Experimental material concerning the exercise and well-being study accumulated in the probes. Some of this material was typed out in digital transcripts for a workshop organised during this project. The company partners however regarded the original, hand-written probes as more credible and experimental, it being easier to identify with the descriptions in them.

FIG. 16. The probe material was interpreted in cartoon-like scenarios with preliminary concept ideas based on the material already present, which were discussed with the user participants when they were interviewed (drawing Susanna Auno)

situations and motivations into consideration, focusing on empathy. The novelty value over earlier probes was that the users were sent a diary and a camera, as well as a key ring and a pin reading 'exercise companion'. This was a way of focusing the user on a portable or wearable smart helper and its possible properties. The users were asked to carry their exercise companions daily, imagining various situations and needs to be shared. While some of the participants found it difficult to imagine a companion, this follow-up still resulted in brilliant descriptions: the companion contacted a jogging group, screamed in somebody's pocket at the bakery counter, and commented on excess coffee-drinking. These accounts showed personality types and situations where some help with weight control could be required (Fig. 16). This project resulted in a product concept based on new considerations of both the form and content in the information given to the user, and the way of disseminating this information.

The introduction of the exercise companion was influenced by two sources. Firstly, the experiment by Giulio Iacucci, Kari Kuutti and Mervi Ranta (Iacucci et al. 2000), in which people imagined in various situations what they could do with their magic things. Secondly, a project described by Marion Buchenau and

Jane Fulton Suri (2000), in which the members of the design team had to identify with the lives and situations of arhythmia patients. The members of this group were equipped with a pager, the alarm from which detected an imaginary fit of arhythmia. They were to describe and photograph situations that they faced when the pager beeped, and describe what it felt like.

Empathic design was vital in the probe study included in a project entitled *Väinö* (Mattelmäki 2003b) (Fig. 17). The subject was senior citizens' independent housing and well-being. The parties were many, and corporate interests ranging from housing planning and furniture design to telecommunications services were considered. Wise from the experience from the physical exercise and well-being study, this project tried to provide the project team with material in a form that was as experimental as possible. Probe material was brought to the project meetings, personal characteristics were presented in the form of a narrative, and pictures and extracts from the original material were shown in a digitised form as well. The findings from the empathy probes, which tuned the understanding of ageing people's lives and homes with their accounts of person, situation and attitude, were used in the project team to help exchange experiences and opinions. The probes did not produce any solutions to the user needs that the participating companies could have utilised directly in product design, but the user descrip-

FIG. 17. The core of the Väinö probes was the workbook with tasks, diary and a photo album. The goal was to collect the material from every participant in a booklet in a uniform way. This practical goal was based on the experience of the difficulty of handling separate probe articles gained in earlier probes. The booklet worked as an introduction in the planning and design meetings.

tions and the shared understanding were the building material and the user-centred starting point for the project team when the concepts were designed.

So far the probes had been mainly applied to home and leisure environments. The subject of the *nursing and patient transport study* was the working environment, and was meant to produce a personal idea of the nurses and their situations at work (Jääskö & Mattelmäki 2003). Apart from that, we were interested in patient transport situations. The study was conducted in cooperation between the University of Art and Design Helsinki, the usability team of GE-Healthcare (formerly Datex-Ohmeda), a patient monitor manufacturer among other things, and design agency ED-design. Both the hectic pace and responsibility of the nurses' work, and the demands of hospital work were a challenging start for applying probes. In spite of these challenges, the probes managed to record views of the work community, instruments and situations from the individual nurse's point of view. Furthermore, the individual perspective detached from the company product, as well as the visuality and playfulness, were regarded as refreshing in a company where a user-centred activities are part of daily practice in the development of their product (Fig. 18).

The probes were applied among other methods in the two-month user study of *e-work and home offices* (Virtanen, Mattelmäki & Heinonen 2004). This study aimed at understanding what daily e-work is like, and how consideration of e-work could affect the design of housing and

FIG. 18. The probe kit for the nursing and patient transport study. The nurses were sent a probe folder with a practical improvement to the earlier probes, plastic pockets for cards and the diary, as well as pages for pasting photos and other comments on. The folder worked as an archive of each person's material.

FIG. 19. The weekly exercises motivated the e-workers, helped to focus the answers and also affected the content of the diary notes. Some of the assignments were projective such as describe your dream house on the right, and others rather documentary, such as tell about the things and devices you have on your desk on the left. Even this study proved that creative, open-ended exercises inspired some people, while they did not interest others at all. (pictures Katja Soini)

home offices. The corporate partners were the construction company Sato Rakennuttajat, the furniture manufacturer Lundia, and the design agency Studio Salovaarat. In this case the probes had the function of recording temporal experiences and experimental views of an e-worker's daily life. During the long documentation period, the e-workers also learned from their habits by doing their self-observation and diary writing, discovering new features in their environment and action.

Because of the nature of e-work, the self-documentation was done by e-mail (see Fig. 19), which introduced a new interactive element in the probe process since the researcher could keep informed and ask for more specific observations. The collected digital material facilitated the interpretation and sharing of the findings, which had proved laborious in the previous projects. The material worked for purposes such as background material for participatory design sessions. The designer was given a summarised version of what the researcher had collected about any given person, his or her family, housing and situations so far, which made it possible for him immediately to react to the problems with the e-work site of the particular person.

The empathic probe projects described above have utilised a personal interview as an integral part of the process. The study probing the experiences, attitudes and culture of *the freeride skiers* conducted together with the sport equipment manufacturer Suunto did not make use of individual interviews however (Jääskö et al 2003). The freeride skiers practically spend their winters on the slopes in Central Europe. In this situation, the use of probes was regarded as a practical alternative for having a glance on and getting familiar with the freeride environment, community and ideas, despite the distance. Information-gathering

FIG. 20. The freeride probes kit included several tasks. The idea of this probes was based on a character called Jaska. He was a small, novice freeride skier, meant to be sympathetic, who asked questions in the pages of the workbook. (picture Salu Ylirisku)

was a more interesting motivation in this project than the open ended designerly inspiration (Fig. 20). Although the skiers tell us about the culture, community, various situations and we see action in the pictures, a more profound understanding of the freeride experience itself was only gained later through observation. The outlines from the probe material then worked as an introduction to the subject, and they gave flow and focus to the meetings with the freeride skiers and observations of them.

Most of the probes presented above have been based on physical objects. The probes have typically been tangible, visual and multi-sensory. Our collaboration with the companies have demonstrated that the design and customising of probe kits for individual studies can be heavy on resources. The digitising of photos, cards and other materials for sharing and demonstration to the various partners in the projects demands resources as well. Also, many studies have still showed that the probes did not record the action, although they dealt with or described various situations. Retrospection in reflections and descriptions is valuable, but

FIG. 21. Test versions of the mobile probes application in a camera phone and browser-based interface with four test answers.

a new tool was called for to document changing contexts and action. Apart from this, the challenge for the probe studies is the uncertainty of the participants' motivation and their intention to utilise their probe kits.

In order to meet these challenges, a tool based on digital self-documentation called the *mobile probe* was developed in projects at the University of Art and Design Helsinki (Hulkko, Mattelmäki, Virtanen & Keinonen 2004). The users have a camera phone to send their written answers and pictures with, and the researcher has a browser-based application to send tasks and questions to the users with (Fig. 21). The answers are recorded on the server. Both the researchers and the representatives of the client companies can follow the accumulation of the material on the web site and comment on individual responses during the self-documentation stage and this feature makes interaction possible already then. The program automatically sorts the answers according to tasks and users, and the digital material is easy to print out and transfer from the server to presentations and other documents.

The visually multi-faceted probes presented above and the mobile probes differ from each other in that the latter compacts the material into photos and short texts. The material collected on mobile probes can be handled in the same way as the empathy probes, by means such as multidisciplinary interpretations and interviews based on the material (see Battarbee et al. 2005). This system, however, affects the designing and focusing of the probe tasks fundamentally. The development of mobile probes has since taken a different route from that of empathy probes and has veered towards quantitative research.

Not only have the probes been applied in collaboration with companies, but students have developed applications as well. The perspective of empathic understanding and user experience have been important, and the probes have been used in finding relevant factors of emotional states and their changes for concept design. The students have looked at things such as emotional communication (Mattelmäki & Keinonen 2001), the experience of risks and experiences in

lifts. The product concepts produced by the course have mostly reflected genuine interest in the experiences of the individual users. The probing process can

be regarded as an instrument for committing the design thinking to the user's experiences.

3.5 THE REASONS OF PROBING

The examples above demonstrate that the method of probing has been applied in many ways. Many reports characterise the purpose of the applying of probes as an enrichment of inspiration and collection of data (such as Hutchinson et al. 2003, Jönsson et al. 2002, Wensveen 1999). The cultural probes were aimed at supporting inspiration, initiating interaction between designers and users, and provoking the users into participation in the design process (Gaver et al. 1999). The residential probes aimed at collecting individual data and starting a discussion with the users (Hemmings et al. 2002). Apart from this, the user's opportunities to participate in the design process by means of probes have been discussed by Hemmings et al. (2002), Hutchinson et al. (2003), Westerlund et al. (2003), as well as Paulos and Jenkins (2005). Summing up these reports identifies four reasons to use probes (Mattelmäki 2005):

1 *Inspiration* – Probes can enrich and support the designer's or the team's inspiration
2 *Information* – Probes can collect information about the users
3 *Participation* – Probes can provide the users with an opportunity to participate in ideation
4 *Dialogue* – Probes can build up an interaction between the users and the designers, as well as within the design team, in accordance with the user-centred design principles

These four purposes will be looked at more closely in the following.

Probes as a source of inspiration

In the early design phase the designers try to get a holistic idea of the user and the environment of use. They then want to work independently and interpret the subject in order to create the surprising insights which are demanded in designerly thinking (Schön 1983). Probes are intended as a source of inspiration and support for creative thinking among the designers and in the design team. Like cultural probes, a new approach to user study and design seeking new viewpoints, the whole probe process can be inspiring. Planning the probes and interpreting the

material in particular would seem to be interesting stages of the probing process for the designer (Mattelmäki 2005).

Making up the probes offers the designers the liberty to act and apply their competence in a new situation. It also encourages them to approach the user. In planning the probes, they can start thinking of future users with creative imagination, and exploring possible directions or hypotheses concerning their solutions. The design of the content, appearance and tasks is also an interesting stage, because it is the natural thing for designers to act visually and practically, recalling design work more than the typical planning of studies. Open-ended, provocative and sometimes weird exercises, looking for new features in the familiar routines of daily life, are meant for finding new horizons. The exercises and the material thus offer an opportunity both for the designers' and the users' inspiration.

Probes provide material for empathy, impetus and enrichment for mental processes. The written research reports are not regarded as a natural source of inspiration for designers, referring here to industrial design or architects whose creative work being best supported in by openness and the opportunity to flexibly interpret information from different sources (Ahola 1978, de Bono 1990) and visual material (Hanington 2003, Sleeswijk Visser et al. 2005, etc.). Material intended for inspiration need not be handled by means of scientific analysis or require generalisations. Interesting issues, themes, patterns and their exceptions are raised, which may be elaborated further by association and storytelling concerning them. The results of probes intended for inspiration are typically presented through authentic material, physical objects and ideas, in the manner of cultural probes.

Probes for collecting information

The challenge at the early stages of product concept design is to find research problems. Neither the subject, the intended product, nor the aim is known at this point. Probes should then find signals of interesting opportunities, contributing to the adoption of the subject. They collect information about potential users, their experiences, attitudes and needs. Probes can be used for reasons such as difficulty of accessing people in any other ways, such as is the case with freeride skiers, or places where the researcher cannot be present, such as operating theatres. Probes can record detailed information about people's daily lives, such as the e-work days at a certain period of time, or physical exercise as well as the equipment and locations, along with factors affecting the experience such as family life or attitudes. Probes can also address themselves to people's actions and emotions in situations where the time and place for the events cannot be agreed

on in advance, such as patient transport. Such situations cannot be recorded there and then, but are related afterwards in diaries.

Typical probe tasks aiming at gathering information describe the present situation, and are supposed to make the users analyse and interpret their experiences. They often leave less room for creative interpretations than the inspirational probes do. The accumulated material and the understanding resulting from it are more interesting. Authors such as those in charge of Residential probes (Hemmings et al. 2002) do not regard the design of aesthetic appearance as important when looking for information.

The material collected from open-ended questions is typically fragmented and subjective, and excursions into other things cannot be controlled because of the ample room allowed for diverse readings. On the other hand, surprising readings can open up new, individual horizons. In one of the projects, a school attendant described a broom as the most pleasing tool. The reasons for this choice, lack of noise as well as the opportunity for individual ergonomic adjustments, raised personal emphases which were interesting for design. (See Fig. 26.)

The material collected in probes for information is typically interpreted for summaries and reports. The results need not produce any general or comprehensive knowledge, but form an introduction to the following stage, an instrument for determining further questions.

Probes as an incentive to participation

Participatory design aims at mapping out the users' needs and thinking of new solutions with them. The principle for generative techniques is to provide people with tools for designing and expressing their future potentialities and needs (Sleeswijk Visser et al. 2005).

Probes can support the user participation in information-gathering, expressions of needs and dreams, and design. The probe tasks can help users to observe their experiences from different angles. Active monitoring of one's own environment can make suggestions for improvement emerge. The users can be motivated to try out new equipment, prototypes, or even consider the properties of imaginary smart systems. Technological probes (Hutchinson et al. 2003) offered the users practical tools for trying out virtual interaction with their family and friends, and consider the possible properties of similar systems in the future.

Some of the probing projects are very open-ended, aiming at understanding the user and the phenomenon rather at designing. When probes are used as an aid to participatory design, the field of possible solutions is typically restricted. For concepts such as the exercise companion, it was known to be a portable or wearable, interactive and smart device. Another project was looking for a smart shop-

ping environment, and one of the design solutions was based on the notion that the customer could be identified by a smart card. The project was still not aware of the situations in which this kind of identification could be useful or pleasant for the customer. This led to the idea that the users would be given a smart card in the probe kit, so that they could imagine and record their various uses and potential for the card on their shopping trip.

Probes as agents of dialogue

User-centred design is intended to understand who the users are, what they do, and what kinds of attitudes and properties they have. User-centred design in general, and the design of user experience in particular, apply methods that measure, describe and interpret the users and their experiences as objectively as possible on the one hand, and methods leaving room for the designer's subjective interpretations and insights on the other (Fulton Suri 2003b). Probes are initially subjective, aiming at design through understanding the individual.

The probes and the probing process support the emergence of dialogue in various ways. Firstly, the process often consists of meetings and communication between researchers, users and designers in situations such as delivering the probes, or recruiting research staff. The individual design of the probe kit can be seen as an initiative from the designers to the user. The kit is like a present, and a way for the designers to say something to the users about themselves and their ideas. In doing the exercises, the users also say something about themselves to the designers. Probes also prepare the users to give an account of their experiences, direct them to interesting issues, and facilitate their communication in interviews and observations.

Designers feel an interest in their participating in user studies and interpreting of user material in a multidisciplinary team (Mattelmäki 2005). Firstly, personal meetings with users transform these from images into real people. These meetings strengthen their motivation to empathise the user perspective and apply it to product design. Furthermore, the material collected through probes helps to introduce the users to the design team discussion by means of completed probe kits and structured descriptions of users and situations. The personal, narrative and visual probe material is then the basis of user descriptions. It is worth analysing and interpreting the probes in a multidisciplinary team in order to ensure several points of view. A joint analysis makes the user material known and easier to adopt, and the design team can build up their shared view of the users and the context of use for their design.

Probes can also generate an inner dialogue when the designers use their experience in order to understand the users better and develop design empathy. The

authentic situations, personal comments and photos recorded in the probes represent the user perspective, which can enrich the empathy in design, the ability to imagine the user's situation and put oneself in his or her position.

3.6 PROBES AND USER-CENTRED DESIGN

The process in the ISO 13407 (1999) standard for human-centred design (see Fig. 4) is divided into four stages: 1) understanding and defining the context of use, 2) making up a definition of the user, 3) producing the design solutions, 4) evaluating the solutions. The process treats the understanding and definition of the context and making up a definition of the user as detached from design. The context of use is defined by human factors specialists as a rule, the ideation is handled by the designers, and the evaluation such as usability testing is done by the relevant experts.

The experience gained from the probes suggests, in line with designerly thinking, that an improved understanding of the user's context can and should go hand in hand with new designs in a parallel dialogue. The designerly reflection and the what-if process of design described by Schön (1983) can start even when only making up the probes. Fig. 22 sums up the purposes of the probe approach described above, including them in the process of human-centred design, trying to link the design thinking and the understanding of the user experience.

The probes alone cannot produce user specifications for purposes such as support for decision-making in R&D, and an analysis of the material along those lines does not serve its purpose. The authenticity, visuality and openness of the probe material are both a strength and a weakness of the approach. The strength of the material is that it projects a vivid image, offering a contact surface for designerly associations and empathies. The weakness is that the probes are subjective in their focus, and the ambiguous results this kind of qualitative method produces. In fact, practical work has rendered the words "research" and "study" somewhat misleading when applying probes. The users have wondered about the emotional nature of the playful and open exercises, and some have had expectations of the result to match a more objective approach. Also, the problem with the empathic attitude and the intricate material is that it can be difficult to distinguish the issues that are relevant for design. The fragmented outcome the probes produce has also been challenged and the difficulty of interpretation has been lamented over. The empathic attitude does not emerge out of nothing; it demands commitment and time for interpreting the material.

This chapter has described the attempts to develop and structure the probes as a method of user-centred design. The artistic and experimental process of prob-

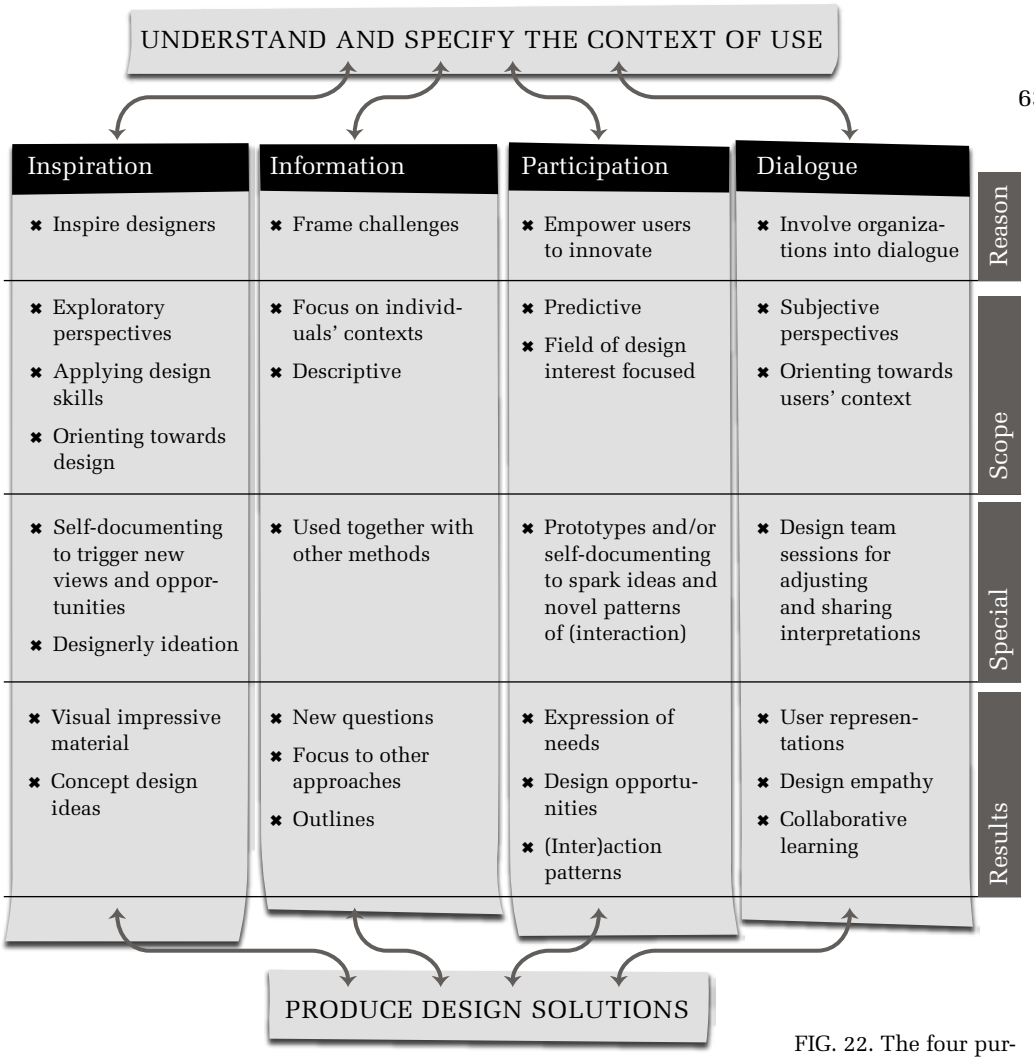


FIG. 22. The four purposes of the probes in user-centred design (Mattelmäki 2005)

ing has not been particularly discussed. Nevertheless, the designerly spirit and artistic approach of the original probes are important in user-centred probing as well. The probes can record views of the user's aesthetic environment and its individual significance. These views give the designer the opportunity to understand both people and phenomena, as well as look for alternative solutions in order to find constraints and solution possibilities for design. Depending on their handling, probes can mark out fields of design solutions in the design space before the problem is known, and produce reportable results for directing the definition of the design problem and the decision-making about it.

4

Step by step of applying probes

Probes are used for applied research and design. In a broad sense, probe tasks are open questions. Because the respondent can formulate their answers in a personally pleasing way to such questions, the material is typically miscellaneous and its reliability is questionable, which complicates its handling and classification (Hirsjärvi, Remes & Sajavaara 1997). Correspondingly, Rothstein (1999) claims that examination of culture, social interaction and human behaviour requires a researcher to navigate between intuition and intellect, imagination and logic, as well as spontaneity and method. These challenges are encountered working with probes as well. Although there is no one way of applying probes, we still need instructions and information for applying and making them in practice. This chapter discusses the well-tried, best practices of probing.

The developers of cultural probes (Gaver, Boucher, Pennington & Walker 2004) characterise the material collected through them as comprehensive and fragmented and the probing process as uncontrollable, because it involves expressing and interpreting things at many stages. They think that probes should be used non-scientifically and with a playful attitude. The University of Art and Design Helsinki has developed and applied probes in many research and design projects. These have tried to balance between the requirements of research and the play-

OPPOSITE. Workshop participants are sharing insights about the freeriders' probes material. (Jääskö et al. 2003)

fulness which is contained in the experimental nature of design, concept design and probing. The academic requirements result from the methodical point of view, and the designerly requirements from the perspective of gathering interesting user information. Systematic development of methods supporting user-centred concept design has been regarded as necessary, while the observations gained in the probes have needed elaboration into useful material for the partner companies.

The following is a gradual demonstration through practical examples of the stages of the probing process and their implementation in various projects. The first step is tuning in. The next step helps defining the principles of selecting the user group. The third step is actual probing with instructions for practical work. The fourth series of steps is the methods to be applied with probes, interviews in particular. The last step is the methods of interpreting the material and handling the results.

4.1 TUNING IN

The first stage of probing can be called tuning-in, with adaptation to creative work, and definition of the uses, purpose and subject for probes. It is possible to start probing after very little preparation, but it is sometimes appropriate to look into things more thoroughly. The subject of design and the user-centred attitude can be identified by means such as observing one's experience and preconceived ideas, ideating, discussing literature or organising group discussions and/or interviewing experts or key people.

Froukje Sleeswijk Visser, Pieter Stappers, Remko van der Lugt and Elizabeth Sanders (2005) have recorded instructions for investigating user experience, which are also suited to tuning up for a probe. The first step is carefully considering the aim of the study. These authors think that it is essential in formulating the objective that it be a question of the user in particular, his or her experience and the parts of it, not a product to be designed. The second step is a preliminary mapping. The researchers (or designers) write down their views and preconceptions of the subject, which facilitates preparing the instructions and elaborating the research findings at later stages. Sleeswijk Visser et al. (2005) warn that the new insights emerging from research after the process of learning may seem so obvious that everyone would have had them in advance. This process teaches people to see familiar things in a new light, providing analysis and awareness. When the things already known have been documented before the study, one can clearly distinguish between what was already known and what insights resulted from the research findings, and justify this distinction.

It is helpful to explain why the probes are going to be used at the tuning-in stage. The reasons include the situation and needs of research and design. It might be a question of only choosing to concentrate on some interesting subject such as physical exercise and well-being, or a question of expanding people's horizons, deepening and substantiating the present understanding, such as the nursing and patient transport study (Jääskö & Mattelmäki 2003), or the cultural probes (Gaver et al. 1999). The definition of the purpose can be extracted from the four probing purposes discussed above: is the purpose to provide inspiration for the designers, collect information about individual needs, create an interaction with the users, build up and support empathic discussion in the design team, or encourage the user in ideating and dreaming?

The tuning-in may be based on awareness and analysis of personal experience. Jane Fulton Suri (2003a) uses the wisdom of Lao Tse: "What I hear, I forget. What I see, I remember. What I do, I understand." She thinks that personal discovery and insight is vital for designerly learning. She also writes that the most subjective way to this personal discovery is experiment, helping to understand what experiences other people might have had. Personal experimentation has also been the underlying impulse of the legendary figure of industrial design, Henry Dreyfuss (p. 64 2004, first print 1955), as early as the 1950s: "I have washed clothes, cooked, driven a tractor, run a Diesel locomotive, spread manure, Vacuumed rugs, and ridden an armored tank. I have operated a sewing machine, a telephone switchboard, a corn picker, a lift truck, a turret lathe, a linotype machine." Those who studied e-work looked at their own ways of doing it and other relevant aspects at the tuning-in stage (Virtanen, Mattelmäki & Heinonen 2004). The observations went on throughout the study, comparing personal experiences, and trying to understand the users' experiences. Personal experience and knowledge through experience can be a resource contributing to an understanding of the design space. Knowing through personal experience can be regarded as a complement to user studies, rather than a challenge to them (Kotro 2005).

The tuning-in can also start by brainstorming to see what experiential issues and subjects of design can be found. These may be things such as style, specifics of material, technology or the product. One of the courses at the University of Art and Design Helsinki, User Inspired Design (see Mattelmäki & Keinonen 2000), included a video exercise before the user study, in which the students watched and analysed self-chosen scenes from films dealing with the subject of the course. The purpose of this exercise was to give the students some contact with the visual devices by which the subject of the course could be expressed. The tuning-in exercise also introduced them to the idea that they could get a grip on the subject by observing the surroundings.

Apart from ideation, the tuning-in could start with a literature review. Things incorporating visual abundance may well work similarly as an aid to tuning-in, not simply fact-based on the literature. The review helps to identify significant or interesting issues in support of starting a reflective process of thinking. This can utilise means such as searches on the Internet, as well as periodicals or TV programs on the subject. The researchers in the physical exercise and well-being study (Mattelmäki & Battarbee 2002) looked into the instructions on physical exercise and nutrition for cardiac patients. The study dealing with freeride skiers (Jääskö, Mattelmäki & Ylirisku 2003) examined the web material on freeride and the periodicals dealing with the subject. These reviews can create the first contact with the phenomenon to be looked at, such as a sport and those practising it.

Mapping-out the subject may well begin in a focus group. (On the mnemonic rules of organising such groups, see Stanton 1998 and Hackos & Redish 1998.). Not only does this help to collect data about the phenomenon to be examined, but a face-to-face meeting with researchers and other participants may also be a factor in motivation and commitment for participation in probing. The physical exercise and well-being study (Mattelmäki & Battarbee 2002) organised a focus group discussion in order to provide the researchers with a first impression of the life situations of the participants, and the subject of research. This meeting dissipated the pre-conceived ideas of the ability of cardiac patients to do physical exercise, and recorded general factors concerning well-being which were helpful for the probing.

Another efficient way of getting a grip on the subject is an interview with an expert or a key person, which can help to outline the issues raised by the study, and to get in touch with appropriate people (for more instructions, see Millen 2000). Expertise helps to get a comprehensive idea of the phenomenon, and to direct and focus attention on essential users and areas of experience. The expert observation conducted at the beginning of the e-work study identified issues that helped the brainstorming on the questions of further study. Experts however may have such a structured view of the phenomenon to be studied that finding new perspectives, which is often the goal in concept design and probing, is not very obvious. The study on kiteboarding started with interviewing experienced amateurs as experts in order to collect data about the sport and the community practising it. This helped to recruit suitable people only just starting their hobby for the probe study. Later however it turned out that the hobby and the community looked very different to an insider compared with people only just thinking of their first kiteboarding experiences.

Since the probes are about a user study aiming at design, it is necessary to tune in both on meeting the design challenge and on an empathic understanding of people. Although the ways outlined above also prepare for probing, every

step closer to the user's world, be it a question of choice of words or mapping-out of meaningful experiences, is an element of a user-centred design process and not merely preparations for research. Various tuning-in procedures can ensure comprehensive results, anticipate the significance of the assumptions and tasks in the study for the user, as well as encourage creative thinking and some rough guesses at the opportunities and constraints in the design area.

4.2 REACHING OUT TO THE TARGET GROUP

Once the wavelength is right, the next step is to reach the target group. It is not meaningful to choose a large target group for a probe study. Firstly, as little as one individual is sufficient to point out a need or a potentiality to base the solution concept on. Secondly, qualitative research including probes tries to describe and understand the phenomenon and individual people (Silverman 2000). Thirdly, it is time-consuming to make up probe kits, consider their logistics, interpret the results and conduct the interviews. The adequate size of a target group is 5–10 people. Determining the number of users is associated with recruitment opportunities and appropriateness and other factors affecting the research. Furthermore, the fact that the participants do not all provide interesting or useful material should be allowed for, because gathering it depends on people's own activeness.

The choice is not only affected by group size, but the characteristics of the people to be studied as well. Sari Kujala and Marjo Kauppinen (2004) demonstrate a variety of approaches to identifying and selecting suitable users for user-centred design. Descriptive of a person are age, sex, life-style and skills; descriptive of purpose are needs and motivation, training and experience, and descriptive of geographical and social factors are location, culture and social contacts. The iterative nature of user-centred concept design allows adjusting the criteria of the user group during the design process.

Probes looking for individual instances of lifestyles, characteristics, cultural features and stories connecting people use people's differences as a reason for recruitment – criteria such as housing type or family size. Probes seeking an understanding of a strictly defined phenomenon and its typical or possibly recurrent occurrences demand as many common features as possible associated with the study object from potential recruits. The group could consist of people such as freeride skiers living in the Alps, or young people moving around in town in their wheelchairs, or mothers practising a particular sport. The stricter the definition of the user group, the sharper the focus of the research.

As the criteria of the user group are clear, the next challenge is to find suitable participants. A short note with contact addresses is a practical start when peo-

ple are told about the study, or when they are recruited. The note deals with the idea of the study, the commitments of the participants, as well as times and deadlines, the contact address of the researcher, details of confidentiality, and possibly a reward. Sometimes people have to be persuaded (see Hirsjärvi & Hurme 2004), but sometimes the right contact person is sufficient to convince a suitable participant. The motivation of participants can be improved through a personal meeting or a pecuniary reward. A mention of the company that the study is for may increase motivation as well.

- The age range among the participants in the probe study included in the Väinö project (Mattelmäki 2003b) was 60–80 years. In this target group, both age, fitness, housing and form of family affected choice. Two of the elderly people lived in a nursing home or serviced flat. Two of the participants managed to live at home relying on help from other people. Two had a dependent relation associated with housing, because one lived in a detached house, helping another elderly person next door, and the other lived in a place of his own, attached to a place occupied by close relatives. Two married couples lived on their own, one in a block of flats and the other in a detached house. The participants were found through various contacts such as local service providers, the participating companies, and people recommending their friends. The probe study in this project aimed at supporting empathic design by providing the design team with individual representations of elderly people and their lifestyles. Here everyone represented themselves. If the goal had been a subject dealing with a more specific design issue, it would have been sensible to make the recruitment criteria more uniform.

- The e-work study (Virtanen et al. 2004) chose the residents of a building constructed by the collaborating company as contributors to the study. First they received an inquiry including a question about their interest in participating in the actual study. In addition, an information meeting was organised in the building, where more eager recruits were engaged. The recruitment met the challenge of a situation where the residents had just moved in, and finding the time for the study was not easy. Participants such as families with small children could not be persuaded.

- Age was not a determining factor for the physical exercise and well-being study (Mattelmäki & Battarbee 2002). The crucial factor was that people were sporty amateurs. Physical exercise was vital for the health of five of

the people selected. Five did their exercise for other reasons. Division into two groups from the start seemed to serve the purpose of comparisons of habits and needs for physical exercise. As for the final results, individual attitudes to life and factors motivating physical exercise were more relevant, because they were distributed according to life situation and personality, not health. The association of cardiac patients was a functional contact of recruitment for this study. Apart from this, people were persuaded to participate through friends, and by inviting people doing their jogging. Although this kind of recruitment demands a brisk attitude from the researcher, casual people who fit into the criteria of the group can be excellent candidates for a probes study.

- As for the freeride skiing studies (Jääskö et al. 2003), the criterion for inclusion was being a freeride skier. The skiers were contacted through a product manager interested in freeride skiing. The skiers knew each other and the company, and were highly motivated participants. This kind of contact is practical, but the risk with the participation of friends is that the results do not produce new perspectives, and do not encourage bold interpretations.

- The nursing and transport study (Jääskö & Mattelmäki 2003) included participants from areas such as anaesthesiology, intensive care, emergency rescue (ER) and midwifery. The nurses were recruited through the contacts of the partner company. Although this company has a well-established collaboration network, the recruitment was delayed by the unfamiliarity of the probe approach and details involved with patient confidentiality: Things such as taking photographs at the hospital are not possible without permits facilitating collaboration, and a strict code of conduct.

4.3 DESIGNING THE PROBES

Designing the probes can be started simultaneously with the steps above. For the design following issues should be considered: What are the issues we are interested in and what could the nature of the probe objects. What are the properties of various tasks, and what is their purpose? Furthermore, probing includes the steps of sending and receiving the probes.

As the topics and ideas of probing accumulate at the tuning-in stage, decisions need to be made on what kind of questions are asked. Asking open questions is regarded as a kind of art form in which no hard and fast rules apply (Hirsjärvi, Remes

& Sajavaara 1997). The same applies to probing, even where the tuning-in is done thoroughly. Gaver et al. (2004) want to emphasise that the philosophy of the probes is fundamentally associated with accepting ambiguity. It is possible and pleasant to do the probing with an open mind, asking open questions in the name of inspiration and playfulness. We will then have to tolerate the designerly ambiguity of the probing, and surrender to risk-taking. Surprising things may remain unnoticed if clear assumptions are used to focus interpretations. In the name of efficiency, it is still sensible to make some assumptions and decisions on the objective of the studies. We will then have to decide what we want to learn and what to probe.

It is advisable to consider next what kinds of exercise are to be used for as probe tasks. Sanders and William (2001) describe their arsenal of make-tools as scaffolds of experience: they keep pictures, collage templates, workbooks and stickers that will make a combination suited to any given study. The probe kits are not commercially available, and there is no ready-made pattern for designing a probe kit or tasks. Aesthetic and visual quality certainly may reflect the designer's or the design team's personal thoughts and intuitions. While making them, designers often imagine how the users think, how they do the exercises and how they apprehend the kit. Many probe kits have included a disposable camera and photographic tasks, a diary or something similar, open questions as well as various maps, drawing and picture collage tasks (for an example of a probe kit, see Figs. 23 and 25) The following offers well-tried points of departure, and examples for designing the probe tasks.

Building up probe kits can be done by considering the perspectives of those to be examined by means of the aspects of user experience demonstrated above (Figs. 26–28). The user environment is another way of approaching the design of the probe tasks. The domestic probes (Gaver et al. 2004) were distributed in places such by at the phone, near the toilet and by the bed. Väinö also mapped out the domestic geography including bathrooms and the furniture. People were asked to draw the ground plan of their place and put stickers on it. If the interest of the study is a functional process, we can go and look at the stages of the activity: preparing for a patient transport, receiving a patient, transport and delivery. The multi-sensory aspect is also important when recording, describing and designing an experience (Wensveen 1999). Isen's findings (2004) that positive emotions promote flexible thinking and problem-solving are significant from the viewpoint of probe design as well. The emergence of positive feelings is something to aim at both from the perspective of the probe designers and those receiving the kits.

Probes can have nuances in their openness. If the required knowledge deals with a certain topic, the task can be focused more carefully. We can ask about issues such as health, the daily time for waking up, or the time for watching TV.

FIG. 23. In addition to planning individual tasks, designing a probe kit as a whole is also meaningful. This probe kit produced by the students of interaction design is like a surprise box with many kinds of exercises. (Probe kit by IT product design students at the University of Southern Denmark Sönderborg spring 2005)

FIG 24. The aesthetic appearance of the probes kit can be chosen according to the target group and topic of the study. This probes kit aimed at collecting female users' living context and culturally aesthetic preferences in China. It included introduction and invitation of this research, self image association and self photographing task. (photo Xiaoming Quiang)

FIG. 25. A probe kit does not always have to be complicated. This picture shows simplified probe kits from a study examining novice kiteboarders.

FIG. 26. Who and of what kind are the participants, what do they value, what are they interested in, what can they do, what would motivate them? What people share their lives, and how do they interact? This picture shows cards with questions such as “What is happiness”, “What is important in life”, “This is embarrassing, I am ashamed of…” from Väinö project.

FIG 27. What kinds of object do they choose, and why? What objects do the users use, how and for what, what would they like to own or use, what do they dream of, what are they used to? What do they do, what do they use, how, and how could they use things? What kinds of meanings do things have for people? How do these emerge? This picture taken by a school attendant participating in the Active@ work project, shows his favourite object.

FIG. 28. What is their environment like? What is the atmosphere like there? Stylish? Aesthetic? What conditions does their environment offer? This collage by Salu Ylirisku combines images from probes and observation phases from the freeride skiing study.

When the interest is in personal and individual matters, we will have to ask about these, and it is advisable to support people in expressing themselves. If the interest is new, fresh ideas, or provocation into thinking and expressing things in a new way, we can probe with material that is more difficult to interpret, but more stimulating as well (see Fig. 29).

In designing the tasks, it is worth considering from the outset how the material is collected, handled, communicated and stored. If the goal is to keep the materials in easy-to-handle kits, it is worth addressing the problem that single probe tasks and items can come loose and be lost. If the probes are supposed to represent the user information for parties such as industrial designers, it is wise

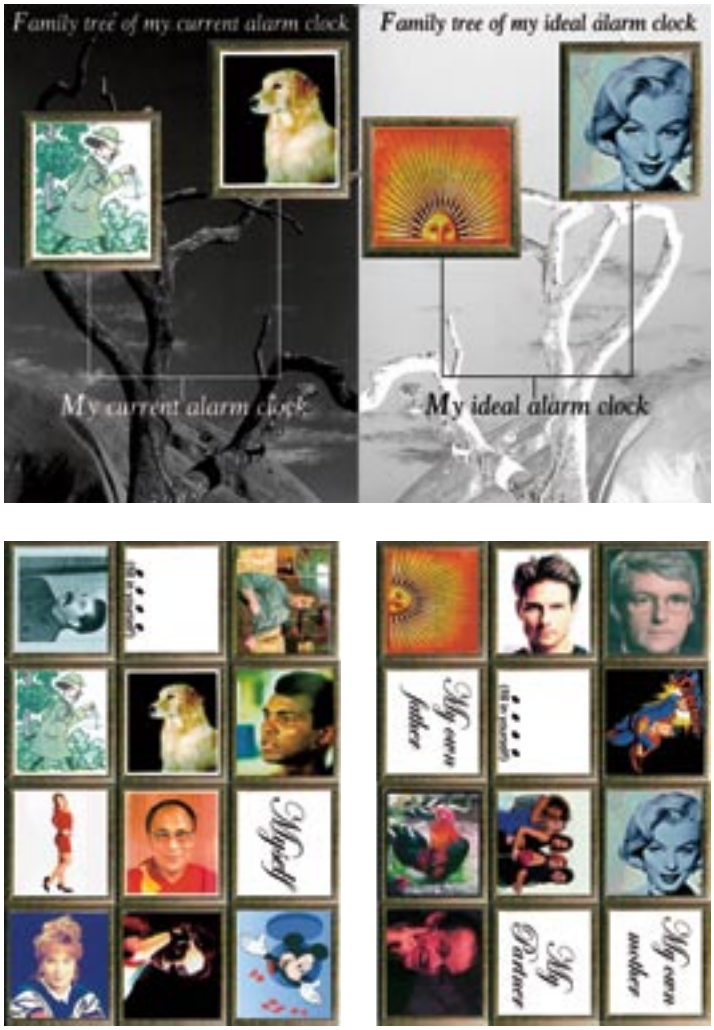


FIG. 29. Stephan Wensveen (1999) asked people to choose ancestors of the alarm clock in his probe study. It is entertaining to imagine what it means if the ancestors of the alarm clock of our dreams are the Dalai Lama and the sunrise. Such images can inspire design, even if it is not meaningful to do a systematic analysis. Wensveen also asked what qualities are most important in an alarm clock – such as waking us up at the right time, or whether it is also important to wake up at that time exactly. The target group was small, and the results were thus not statistically interesting. Wensveen however thinks that the observed meanings directed their decisions on design, focusing on the most desired functions of the concept waking up device. (Pictures Stephan Wensveen)

to keep digitisability and visual attraction in mind. Similar to industrial design in general, functionality and usability are vital properties in probe design.

The following presentation will focus on the properties of probe objects.

Probing daily thoughts and activities by means of a diary

Diaries are traditional self-documentation tools. In practice, they can be notebooks, booklets or electronic documents either with open or more structured questions where the participants are asked to record their feelings or activities during a certain period of time. The questions in traditional diary studies deal with temporal processes and their change, or issues associated with the events and meanings of daily life. An instance of this kind of process of interest to medicine and psychology is mood swings at the different stages of the menstrual cycle and, in sociology, observation of use of time taken on daily activities (Csikszentmihailyi & Reed 1987, DeLongis et al. 1992). Probes are even meant to record people's personal experiences and daily situations. The diary is a typical probing instrument, focusing on routines and feelings. Nevertheless, the traditional perception of a diary is only one of the ways of approaching to the design of a probing diary, because the form of the diary is free. The pictures (30–37) give some idea of the diary solutions in various projects.

Recording situations and feelings can be bothersome and time-consuming, which makes success dependent on the participants' motivation. Apart from actual rewards, meetings and phone calls with the participants, pre-interviews and ventilation of the problems can be rewarding (DeLongis et al. 1992). New technology also has been introduced to remind people of writing and the time of documentation (Csikszentmihailyi & Reed 1987, Forlizzi & McCormack 2000, Palen & Salzman 2002). Many still think that sufficiently open, diary-like questions offer them the opportunity to tell others about things that they really find meaningful in their lives (DeLongis et al. 1992). The diaries contain personal thoughts and feelings, and also record activities and phenomena of daily and private life that the readers can easily identify themselves with.

Probing the environment by means of photographs

Apart from diaries, photographs are traditional instruments of self-documentation as well. In the camera studies, the participants are asked to take photographs freely, or are given specific assignments. Photographs can also be used like diaries to record activities visually. The photography assignments in the probes seek meaningful prospects in the user's life. When the subject of the picture is selected and framed by the user, the things pictured produce a personal view. Furthermore, people can assess the environment through the camera lens

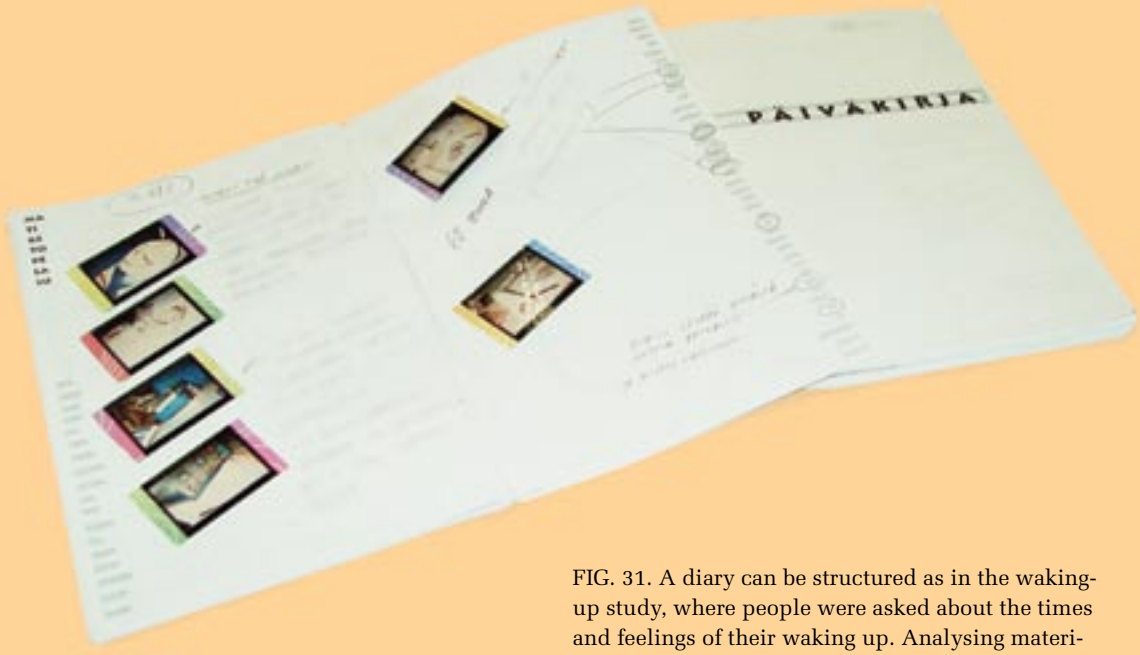


FIG. 30. The diary can be a simplified leaflet. This diary has words written in the margins, supposed to be associated with the issue being studied. The words are meant to help the writer to start writing by creating associations and offering practical hints.

FIG. 31. A diary can be structured as in the waking-up study, where people were asked about the times and feelings of their waking up. Analysing material accumulated in the diary is more straightforward in principle than material collected through a more open assignment. Wensveen (p. 26 2000) describes the diary analysis and the meaning of facial expressions demonstrating feelings: ”when analysing each day of a person’s diary and looking carefully at the facial expressions you can empathise with the person.” (Picture Stephan Wensveen)

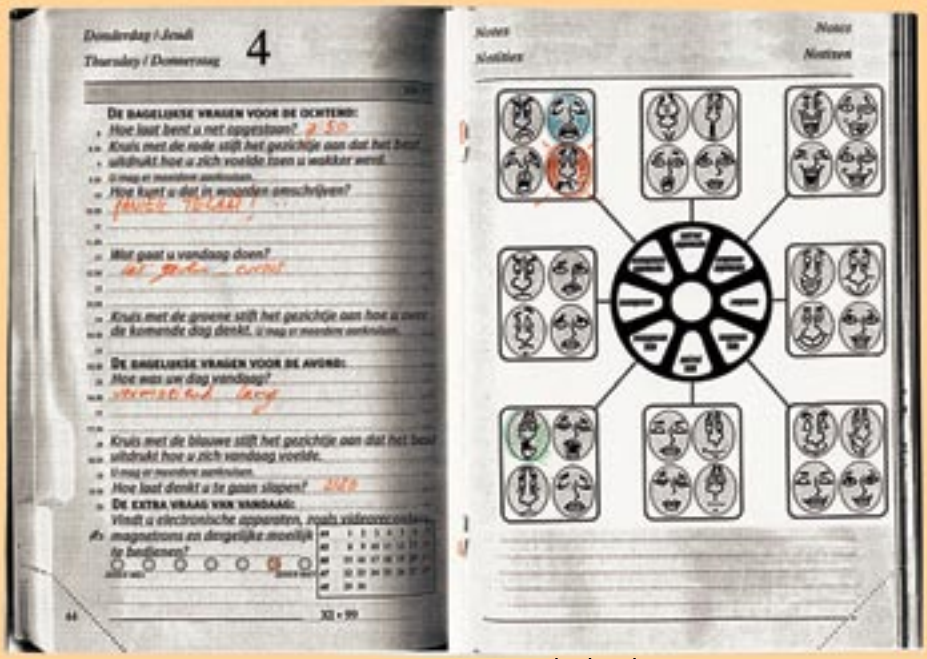


FIG. 32. The instructions for the diary of the physical exercise and well-being study asked people to write down free-form daily descriptions of their activities, thoughts and feelings on the subject of the study for a week. The diary had an appendix attached to it, a sheet of stickers to be used as an illustration. The reflections, activities and way of writing of the participants constituted an image of them and their lives. The things and stories recorded in the diaries contributed to a holistic idea of a person, although they digressed beyond the subject of the study to some extent. The stickers enhanced the writing and suggested messages to be interpreted. The blank pages offered the participants an opportunity to fill the pages to their liking in writing and drawing.

FIG. 33. The core of the probe kit of the freeride skiing study was based on a workbook with a character called Jaska asking questions and making assumptions, and with the actual diary pages and questions alternating. This combination seemed to work well, because the questions activated people to write, as well as reducing the openness of the diary assignment for their part. Jaska's questions prompted the freeride skiers to give reasons for their attitudes. This page asks the following: Taking risks at this level can hit hard: Taking risks seems normal in freeride skiing? When were you last scared? What does fear have to do with freeride skiing? (drawing Salu Ylrisku)

FIG. 34. A group of students (Ylirisku, Di and Kuusela) whose goal was to understand angry feelings, designed a tool for measuring emotions for a diary. People could put stickers with facial expressions for various emotions on it. The diary became a visually strong way of documenting daily life, feelings and situations. It turned out that the participants learned something about the factors of being angry, so that the diary contributed to reducing it. The diary was also useful for the interview, making it easy to return to the dramatic emotional changes and the events causing them.

FIG. 35. A group of students (Andell, Davlin, Jormanainen and Lehtonen) created a stress-relaxation container as an extension of a diary in their probe. Its user was asked to fill in red or green papers according to their moods. The colours and the visual appearance were also supposed to give the user a clue about the over all stress level during the study.

FIG. 36. The visual appearance of the diary reflected the views of the industrial design student Renita Niemi in a study commissioned by the radio channel YleX. The probe kit received praise from the participants for its aesthetic appearance.

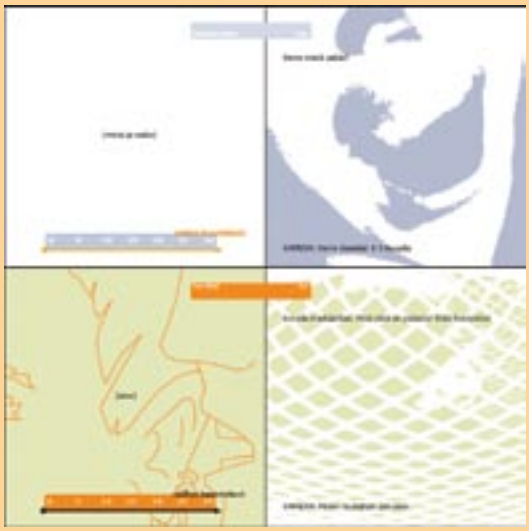


FIG. 37. The nursing and patient transport study team designed a pocket-sized notebook with stickers to make a diary for the nurses. The idea was that this diary would accompany the nurse in her pocket, so that she could record things occurring on the job. It turned out however that not all nurses had pockets in their uniforms. It also turned out that the diary had mainly been filled in after working hours on the way home or back home. The study showed that some presuppositions had been partly erroneous, but erring is part of the experimental procedure, and personal observations gained there supplement the research results. Some of the diary notes were quite productive accounts of the course of the day, the activities and the variety of feelings, while others dealt summarily with it. The writing was individual and depended on the diary writer's motivation and job description.

and thus be activated into accounts of their experiences (see Fig. 38). It is recommendable to give a few tasks to get the photographer going and to state the objective. Such exercises include "take a photo of your home", or "what have you got in your pocket?"

A sporty person has taken a photograph of faded sports shirts and shoes. He does not invest in himself and his equipment, but rather in proper clothes and equipment for his children. Someone looking after her well-being had only light products in the fridge, nicely arranged for the photograph. A socially oriented woman living alone photographed her fridge in a situation where beautifully prepared salad portions and drinks were waiting for friends coming to visit her to enjoy them. These kinds of pictures illustrate people's lifestyle and attitudes.

Another purpose of the photographic tasks is to give the user something to think about, either experiences of the day, or ideas for the future. The meaningful content of these pictures typically only opens with the explanation provided by the photographer. Tasks of the "challenging situation" type, or "could do with some help" outline the problem situations experienced by the user, and the ways out of them. "Which is my favourite tool?" or "This is a gadget that I hate" delineates significances associated with tools. Description tasks such as "What makes a home cosy?" and "for something beautiful" seek the user's values and attitudes. Some tasks can be very open to interpretation, such as "an achievement" or "the best thing of the day", where the description either demands looking into the subject from the photographer, or impulsive action as the occasion offers. Although these tasks also document the physical environment, the significances and narratives add a deeper dimension to them.

FIG. 38. The disposable cameras for the cultural probes had been wrapped in accordance with the style of the research material. The normal disposable cameras were supposed to be a special instrument with which the user had the opportunity to record special experiences, or through the lenses of which the ordinary views could look new. The assignments had been printed on these wrappings. The projects of the University of Art and Design Helsinki have often written the instructions for use for the disposable cameras separate from the assignments as well, such as on a separate card. Even if there is no desire to camouflage the whole camera, it is practical to keep the assignments with it when participants have cameras with them.

FIG. 39. Families participating in the communication probe study (Westerlund, Lindquist & Sundblad 2003) recieved the developed photographs before sending them to the researchers, and could thus draw and write on the pictures as well as about them during the self-documentation. (photo by participating family member)

Fulton Suri (2003a) sees the significance of the photographs as a help and a source of inspiration to telling personal stories. Her experience is also that the users' photographs support the design team in creating shared visions and starting points. Thus the photographs emerging from self-documentation are typically used to lay out the situations experienced by the users and their lifestyles for designers and other interested groups. A nurse had taken a photograph of a laboratory analyser which she detested. The designer examining the picture could only see a product of modern design. The nurse's story however described a small newborn baby, from the sole of whose foot she was to take a blood sample. When the sample is sent to analysis, this device starts calibration, the completion of which takes so long that the sample expires. The audience imagine a little patient whose sole will have to be jabbed again for a new sample. The attitude to the device changes, and the nurse's view is perfectly understandable.

In practice, it is worthwhile solving the problem of developing photographs taken with a disposable camera according to resources and participants (Fig. 39). In many studies, the photographs have been developed after the self-documentation but before the interview. People have taken photographs with their own digital cameras or camera phones in some cases, and the developing stage has been avoided.

Making people tell stories and express opinions through open questions

Open questions can make people tell small stories and express their opinions. Many probe kits include open questions written on illustrated postcards (Figs. 40), in the manner of cultural probes. The aged residents in the cultural probe study posted their cards to the researchers one at a time. The cards are however only one of the examples of asking open questions. The freeride skiing study pro-

vided positive feedback on the open questions included in the diary. The questions also facilitated writing the diary.

Self-expression through map, collage and drawing exercises

It is good if the exercises in the probe kit give an opportunity to express oneself in several ways, not simply demanding writing. This is important because people are different and their skills vary, and because the subjects to be probed are different. For some it can be difficult to express feelings and emotional states verbally. Map, collage and drawing exercises offer a variety of expression opportunities.

The map and drawing exercises can probe things that a visual outline expresses naturally, things such as the significance of a geographical environment, or moving around during self-documentation. The map exercises are very approachable, particularly when they are meant to represent actual places. The drawing exercises are often more challenging, demanding more skill from the respondent. They do however produce interesting visual material and personal observations in the best case. The exercises requiring creativity and exploration of one's own feelings are often visual, such as the ancestors of Wensveen's alarm clock (Fig. 29). Doing interesting exercises can also be assisted with ready-made picture bases or stickers such as in Fig. 41 and 42.

Collages are compositions including pictures and words which suggest both abstract and more realistic, tangible issues. In Serpiello's (2002) experience, collages work particularly well in user-centred design, when it is a question of sensory or abstract things, or something associated with powerful experiences in people's lives. Collage exercises can help to reveal preferences of taste or feeling. Sometimes even the collage-makers themselves only find out about the significances of the things to be told through their active process and picture choices. The nurses made visual representations of the atmosphere and acoustic landscape at the hospital and in patient transportation. The elderly people were asked to make a collage representing themselves, and to compose an ideal place to grow old in through pictures and texts. A student project asked people to make collages to describe the atmosphere and their feelings before and after a disagreement. All this results in visual narratives for the designers to find stimulation and understanding in. Even if collages are often familiar tools to designers, the whole meaning of the collage and the individual pictures in it communicate and arouse thoughts, the very idea of a user-centred interpretation is that the collage-makers' own explanations, stories and interpretations give the collage and its content a meaning (Mattelmäki 2003).

FIG. 40. The cards for the Well-being and physical exercising study dealt with personal matters attitudes. The pictures were meant to provide encouragement and even an inducement to answer the questions. Some of the respondents have clearly reacted to the pictures. In our experience, not all users have looked at the pictures on the cards very consciously, so that we cannot be sure of how much they affect any given answer.

FIG. 41. A project dealing with kiteboarding aimed at mapping out what kind of preferences novice kiteboarders have by means of stickers.

FIG. 42. The probe exercise demanding creative thinking in the Morphome project (Battarbee et al. 2004) asked the participants to think about the kinds of animals that domestic appliances bear some resemblance to, and what kinds of territories they have. (drawing by one of the participating families)

FIG. 43. The participants in the Väinö study received a floral greeting with their probe kit. The kit also contained a greeting to be attached somewhere with a suction cup to remind people: “Have a good day! Yours, Väinö.” People were asked to attach this reminder to the hall mirror, but it had in fact been put on the side of the kitchen cupboard and on the fridge door.

Serpiello (2002) also points out that collage-making is most successful when people dare to experiment and exchange their thoughts and personal stories. Sensitisation is required to achieve this. Some think that making collages is natural, but with others establishing a confidential relationship can be an essential part of the preparations.

Reminders and arousers tuning up the user’s thoughts and imagination

A probe kit may contain physical objects that will not document anything. The reminders suggest that the participant has some exercise to do (Fig. 43). The arousers for their part give people something to think about, and tune in the user’s actions and imagination to the experiential topic of the study. A project such as that probing weight control provided the participants with a diary and a camera, as well as a pin and a key ring reading, ‘exercise companion’. The domestic probes included a listening glass that people could hear the voices and noises of the house with by pressing it against the wall (see Fig. 10).

Piloting

Probes should be designed to suit the user. It is certainly worth giving a copy of the probe kit to somebody representing the target group to fill in and evaluate before the actual study. This kind of pilot study may provide some feedback on the number of exercises, their functionality, comprehensibility and language. At the same time, it is possible to ask for an estimate of the time required to get the instructions right for the actual participants. Collaboration partners can also be asked for comment. We should however keep in mind that the use of probes involves conscious risk-taking, and that surprises are also natural to probes, so that something too neat and easy-to-use may not achieve the goal.

- A copy of the probe kit for the Väinö project was to be examined by a retired married couple to find out about its functionality. The researchers

were particularly concerned that the toy dolls used as an illustration might be regarded as childish or humiliating. This couple found the illustration matter-of-fact, admiring the opportunity to use stickers. The lady however requested us to change the reminder card to be attached to a mirror with the greeting ”Looking good! Yours, Väinö.” To quote her: ”it doesn’t always look so good at this age”.

The logistics of probing

The researcher is in some degree of uncertainty whether the probes will result in a haul of material once they have been sent. DeLongis’ advice (1992) is to minimise the uncertainty by contacting the users and asking about the latest news at the documentation stage in order to maintain their motivation. At its best, personal interaction with the users motivates them to do the exercises and observe their experiences. In the Väinö study, the users were sent a couple of new question cards in the middle of the documentation stage in order to keep their interest up.

The probes should return to the researcher after the self-documentation stage. The users can either send the probe kits in a prepaid envelope, or the researcher has to fetch them personally. Return by mail is comfortable for the researcher. In the nursing and patient transport study, the dispatch and receipt could be done by post, and the e-worker material was transferred by e-mail. In practice, holidays, celebrations, trips and other things often delay the receipt or dispatch of completed kits. It is necessary to prepare for these delays by being flexible about timetables and by reserving time for contacts and inquiring after the material. Although personal meetings demand more resources, they help in keeping on schedule, and can also strengthen the dialogue and offer an opportunity for ob-

FIG 44. Researcher preparing her probes kits to be sent to the participants. When planning a probes study also the logistics of probing should be paid attention to.

servations. In the Väinö project, the kits were taken to the majority of the participants personally, and people were instructed how to fill in them.

4.4 A FOLLOW-UP OF THE PROBE MATERIAL IN AN INTERVIEW

As stated above, the material accumulated in the probes can be used as a source of inspiration as such. If however the intention is to extend, supplement and revise the signals collected in the probes, a tried and tested method is a personal interview. The diary notes and photographs can constitute tools for the interview situation and the participatory design workshops (for more on this, see Ziller 1990, Brown et al. 2000, Hulkko et al. 2004). Instructions for conducting these interviews can be found elsewhere (on appointments, documentation, equipment checks, etc., see Hirsjärvi & Hurme 2004), so that the following will only be a description of the specifics of the follow-up interviews.

Those who have taken photographs about the subject are ready to talk more meaningfully and more thoroughly than those who come to the interview unprepared (Carter & Mancoff 2005). This kind of sensitisation is particularly utilised in design-related studies to direct and prod people's ideas about the relevant experiences (Sanders 2001a). The researcher should also look into the material before the interview in order to make the interview go smoothly, in a spirit of spontaneity, so that it amplifies the material collected in the probes. The probe material can be equipped with notes on points where more information or specification is desired. Sometimes an abstract or a visual summary of the material helps to internalise it. Such summaries can be shown to the user with a question on his or her opinion about the interpretations. The interview is an opportunity to create a very intimate atmosphere and to discuss highly personal matters, because the photographs and other materials have given the interviewer an impression of the interviewee who has let the researcher or the designer in to take a peep into their lives.

Rothstein (1999) claims that ethnographic field researchers must have more confidence in their personal abilities and qualities than just methods and techniques. In fact, even the interviewer has to rely on instinct, and the situation cannot entirely be planned ahead to the last detail. The interviews in the probe studies draw on the probing material from any given interviewee, which makes it possible to be prepared and structure the interview in advance.

A probing interview should get an idea of the user through probes, interpreting the material and looking for further design opportunities, not simply record facts. Empathic design is intended to outline an individual perspective, looking into everyone as a personality. What is individual about this person? What pref-

erences, goals, wishes and habits does he or she have? The interview can complement this aim. It then requires courage to ask personal questions. Aaltonen and Heikkilä (2003) have discovered that an open and positive atmosphere in the interview makes for a confidential discussion. Although the interviewer had better bring the conversation round to the relevant issues of the study discreetly, he or she should also allow people to take their time and be genuinely interested in them in order to establish a confidential relationship. The interviewer should be aware of both the goals of gathering information and promoting interaction (Hirsjärvi & Hurme 2004).

Since some of the interviewees may be confused about the personal, experiential and occasionally odd probe tasks, it is good to start the interview by repeating what the study is all about, what the purpose is and what will happen in the interview, along with some mention of confidentiality. Spreading the probe objects out to be touched and looked at, as well as looking at the pictures taken by the interviewee is a natural way to move on to the actual conversation. The substance and significances of the pictures can be specified while going them through.

The interview is supposed to sensitise people to things and details to deal with and to make design ideas out of. It is beneficial if the interviewer has a designerly frame of mind, constantly looking for potential design pre-forms, listening and looking carefully, intervening and asking for more detail: "Which device is this, and why has it been pictured? Does it require a password? How do you keep it in mind? How would it work better? What about the length of the cord? Coilable cords? Cordless tools? Mobile or immovable?" or "You have noted down that you are lonely. Would you prefer team or pair work?" or "Tell us more about this event! How has it affected what you do now?"

- The physical exercise and well-being study, conducted in collaboration with Polar Electro, included four men who had undergone a heart bypass operation. They described their heart attacks in the interviews, their heart symptoms, operations and the scars traversing their chests, along with their feelings about these things. Even if these were not the focus of the study, the study as a whole, the interview situation and personal understanding benefited from these patients telling us about their personal experiences and us listening to them.

- A lady in the Väinö study who was about to have her sixtieth birthday made herself familiar by giving the researcher a warm hug the first time they met. They had talked on the phone, exchanging a couple of SMSs at the self-documentation stage. Apart from that, the dialogue with the

probe kit had made her feel that she was having a conversation with the researcher. This was a good experience for both of them, and the interview took place in a warm atmosphere over a cup of tea. Many other homes in the Väinö study were the same; the researcher left them well-fed with delicious things, along with some to take home, and good advice as well.

- As for time, it is worth allowing 1–2 hours for a probe interview. It may be beneficial to let several members of groups, such as the R&D team, face the interviewees. Representatives of various fields can take up questions that they are interested in, and the meetings can support empathy in design. It is good economy of time to conduct the interviews in groups. We should however take into account that the number of listeners or askers may influence the feeling of a confidential atmosphere.

- When the interviews dealing with the clinical collaboration in the hospital world started, we emphasised that we were interested in the potential of new mobile technology at the hospital (Battarbee et al. 2005). Although this topic of interest was already familiar to the participants, we wanted to bring the interviewee's thoughts into line with the representatives for R&D. This resulted in new ideas. One of the nurses said that he had been surprised at how he got new insghts on the subject at the interview, although he had been thinking about it at the self-documentation stage as well.

4.5 INTERPRETATIONS AND RESULTS

David Silverman (2000) advises those conducting qualitative research to keep the data collection simple. He warns that, in spite of gaining a seemingly more complete idea of the subject by using a variety of methods, the focus can become too diffuse, and calls for more competence in analysis as well. As for probes, this advice is a challenge. The material collected in probes can be interpreted as qualitative research by looking for clues, similarities and differences to facilitate understanding of the subject. The word analysis applied to probes may refer to a more scientific procedure than is usually necessary. More appropriate words would be making sense, outlining or interpretation.

The reliability of the material and its interpretation are challenges for probe studies. In finding out about people's experiences and feelings, the reliability of the results depends on both the honesty of the storytellers and the researcher's ability to record the material (Aaltonen & Heikkilä 2003). Discussing the experiential probe material in a team is productive, because a variety of interpretations

of the same material enrich each other and create dialogues. Both the interpretations and the design solutions derived from them can still be evaluated in an iterative concept design process. Looking for new paths of thought, reliability is of secondary importance when interpreting the probe material for inspiration.

Pictures as well as other probe exercises can be a key or a link to experiences. Photographs do not always focus on an important target but may include peripheral information (Carter & Mancoff 2005), material that the researcher might not be able to grasp in the interpretation. One of the reasons for this can be the difficult situation for taking photographs where the photographer has not been able to record an object direct. People can take photographs of apparently insignificant things, but these may still offer a recollection of a particular experience. Carter and Mancoff (2005) claim that the essential knowledge does not come from the photographs as such, but from people's explanations of the things in the pictures and the process of taking photographs. These things should be taken into account when interpreting materials.

Structuring probe material systematically where the goal is to support dialogue, empathy and a creative process does not serve the purpose. Good planning of the interpretation stage however underpins control and outlining of the material. According to Jääskö and Keinonen (2003), the ways of interpreting the user information can generally be divided into four forms of analysis: applying interpretation models, interpretation in the terms of the material, condensing and combining, and direct interpretation. The following is a discussion of these methods from the probing point of view.

Applying interpretation models can be an effective way of structuring the material, although pre-established models or topics are not the most characteristic for probing. The use of models or agreed topics for interpretation focuses the in-

FIG. 45. The study examining well-being of ageing people at work included a topic of interpretation called interaction, the observations of which were structured in the form of a communication network.

FIG. 46. The interpretation topics have been applied in a study examining communication and collaboration. The topics were communication content, people, networks and people's role in the communication network, spaces, places and tools, as well as needs and opportunities. This picture shows a designer demonstrating her interpretation of the topic people, networks and people's role in the communication network. Here the interpretation was not forced into a form that had been agreed on in advance. The collage showing here made use of the probe material.

terpreter on topics identified as important, and often also directs the way of laying out the results. The interpretation topics can be tied to the goals and subject of the study in advance, as in Figs. 45 and 46. The nursing and patient transport study divided the material into the topics of the probing exercises, such as equipment and transport, as well as atmosphere and colleagues.

In an interpretation *in terms of the material*, pre-determined categories do not eliminate possible new phenomena or perspectives. The details of the material form the basis of the topics and principles of analysis describing the whole. One of the frequently applied ways of sorting probe material is the grouping of insights. Individual insights emerging from the material are then recorded and grouped according to association by content. (A grouping practice along similar lines has been suggested by researchers such as Bayer & Holtzblatt 1998.) Because the probe material is generally very diverse, making for divergent interpretations, the analysis demands patience. The advantage is to gain distance from the individual users and

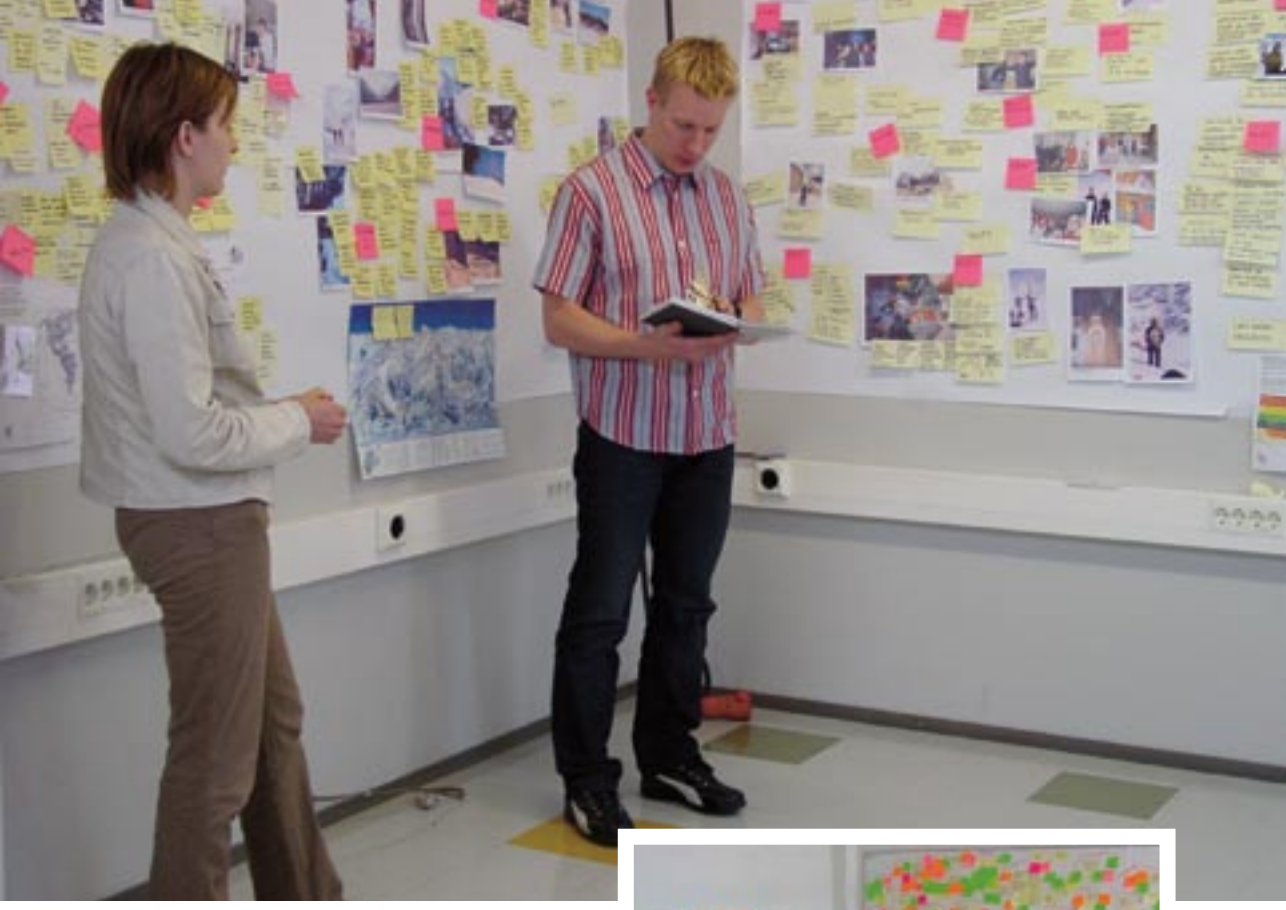


FIG. 47. Stickers and grouped photographs have been used in the handling of many probe materials. In the upper picture researcher and company designer are presenting their interpretations to others. In the lower picture probes kits are on the table and the project team members are grouping insights and design ideas.

the material to be examined by making observations and identifying phenomena. New traits can be found, to be compared with the original material that is a better support for empathy in design. Apart from this, interpretation in a group makes the material known to more people and commits the participants to user information and insights (Fig. 47). The drawback with a classification of insights is that individual observations with their insights for design may be lost in the classification.

Probes seeking knowledge utilise cognitive issues or structures. Sleeswijk Visser & al. (2005) suggest three stages for working on qualitative and experiential material for design, which are suited for handling probe material as well:

1 The attach-to-the-material stage with the researchers or designers recording their observations even during the study, learning from the context and
92 the experience along the way.
2 The find-and-be-surprised stage is about delving into the material, ploughing through all its parts, asking what? and why?, making comparisons, recording interpretations and insights, making notes
3 The discovering-structures-and-getting-a-general-idea stage includes repeatedly rearranging the material until it fits frequent or prominent issues

A well tried way with the probes is to present the material further in *condensing and combining*. The material can be organised in topics as a written report, a visual presentation or a browsable website. The abundance and subjectivity may then be an advantage to be emphasised. Pictures can make stories and feelings more visible (Aaltonen & Heikkilä 2003).

Sleeswijk Visser et al. (2005) have found that a practical way of communicating the findings from experiential material is to collect carefully selected extracts from untreated material and offer hints for interpretation by means such as key issues and their relations. Condensed and combined outcomes do not then produce a shortcut or directions to a final result, but rather a map showing possible routes, risks and opportunities to support the designer's interpretation and orientation. Studies with probes have typically worked similarly (see example, Figs. 48 and 49),

Demonstrations of research results in companies benefit from the original probe material. Alison Black (2003), who has long experience of user studies at a design agency, repeats the familiar proverb that a picture is worth a thousand words, especially when it is a question of visually oriented planners and designers. Pictures actualise and visualise a way of life, style and aesthetic choices. Pictures back up the memory, and also reach someone who does not have the time to go into the details of the text.

The digital transcript of the interview material from the nursing and patient transport study provided exchanges of words as well as specifying and clarifying passages to choose from and stick into a participant's folder. The folders thus worked as a personal description of a nurse. "An essential part of making up a story is introducing the interviewees' voice into the story. This means that the researcher selects the most suitable and characteristic passages of the text to illustrate the phenomena reported in the story." (p. 68 Aaltonen & Heikkilä 2003).

Condensing and combining are also used to create personal characterisations. Those made by Cooper (1999) are based on user studies, but do not represent real people. They are combinations of phenomena discovered or critical components.

FIG. 48. The e-work study packed user information into leaflets describing any given e-worker, the work-place and accommodation. These kinds of condensed visual summaries are quickly internalised.

FIG. 49. The material collected in the freeride skiing study was organised into a database where topics and personas could be browsed, and were presented both in texts, pictures and video clips.

Grudin & Pruitt (2002) from Microsoft are convinced of the use of personas. In their opinion, personas add to the designers' commitment and help them to imagine possible scenarios. Another advantage is that even if the material is based on user studies, the identity of the participants is not revealed: By contrast, we run the risk that made-up personas are not real and thus not credible.

Another alternative is to describe people just as they appear in the probes (Fig. 50). This is an appropriate procedure when the group of participants is very small, when making some interesting characters stand out in a bigger group, or when looking for a user of great significance to concept design. When describing real people, we can use material that they have produced themselves, handwriting, dialect and manner of speaking, which can make the descriptions touching,

genuine, and exaggerated to some extent. In such characterisations, matters of confidentiality including pseudonyms, and the consent of people shown in the photographs to publish them naturally have to be taken into account.

In the workshop included in the Väinö project, the researcher demonstrated material from particular probes study participants in the first person singular I, quoting them and showing pictures of each home and probe material at the same time. There were also collage-like editions, the purpose of which was to encourage discussion and be a mnemonic aid in the group discussion. The group tried to understand people's attitudes, motivations and background. The group members also linked the elements of the descriptions to their own background, reporting things from their own world of experience, through which they created their interpretations. The descriptions of the characters and the research material were taken up in various meetings during the project, such as interpretation and ideation sessions, so that the participants were familiar with them. The concepts developed towards the end were in one way or another based on needs and attitudes discovered in these people's lives.

The *direct interpretation* suggested by Jääskö and Keinonen (2003) can be a principle for interpreting the probe material if the designer is also a researcher, or is allowed to make a direct interpretation of the original material. The designers in the projects of Gaver and others (1999 and 2004) used the material as a source of inspiration in direct interpretation, picking up details and elaborating ideas. The material can be used for inspiring new ideas and insights. Gaver has demonstrated his projects using both probe articles such as photographs or map exercises and ideated concepts instead of reporting user needs discovered in the study. The original material as such can thus be a source of inspiration and direct interpretation without structuring and analysis proper (see Chapter 3).

FIG. 50. The nursing and patient transport study designed posters representing three nurses, placed in the premises of GE Healthcare. The posters were supposed to bring these nurses to the company to create discussion and break the stereotypical views of nurses and their working environment. The nurses use their own words in the posters, selected from an interview or a probe kit. The posters were illustrated both by photographs taken by the nurses themselves and the probe material completed by them, cards or diary pages. The posters demonstrated a broader and a personal image of the hospital world rather than focussing on the products manufactured by the company.

FIG. 51. The Väinö probes discussed beds and sleep with ageing people. A senior citizen in a nursing home missed the soft, wide bed at home. A second participant told us about the difficulties with getting from the bed into a wheelchair. A third praised the practicality of an adjustable hospital bed at home. A fourth had invested in a motorised, adjustable bed in which it was possible to read and eat if needed. Apart from this, mismatched sleep rhythms came up, waking up in the middle of the night, and problems with finding a good sleeping position. In one of the scenarios emerging from the project, an old man's bed troubles had been solved with an individually adjustable bed that is easy to get out of without disrupting his wife's sleep. It is impossible to say with certainty if the probe material worked as a source of inspiration or information here, or if the concept idea was based on direct interpretation. (Drawing Katja Soini with permission of Institute of Design Research)

Apart from the methods of interpretation described above, collaboration with companies has shown the multidisciplinary workshops to be a good way of sorting out and distributing the probe material. These workshops have utilised the probe material, interpreting it direct, and devising product concepts using the material and its interpretations as a source of inspiration. The team has usually discussed the probe material one probes kit at a time. The team members have reported their observations and interpretations to each other and let the interpretations support each other. Finally, the teams have usually presented the descriptions of characters and interpretations to other teams. Since the probe material never tells the whole story about people and their experiences, the material is supplemented, through storytelling. According to Aaltonen and Heikkilä (2003), storytelling includes two separate stories, the story to be told, and the listeners' story, which they build up in their thoughts based on their experience. The authors think that these stories need not add to people's knowledge, but they do help them to understand things.

- The probe material from the nursing and hospital transport study was discussed in a workshop under the guidance of Bill Gaver. After having told

stories to each other and worked on their interpretations of the people involved, the teams produced their concept ideas that suited the person described in the probe kit. The most sensible and most striking ideas were exhausted at the first ideation stage. At the second stage, wild ideas were looked for, springing from the experiences of some particular nurse. At the last stage, the topic was looked at in a new perspective, that of the nurse's hobby. A nurse interested in fishing was given something resembling a bag-net for washing the patient with, and a system like a fishing net for keeping the easily tangled tubes and cords in good order. Although the ideas were far from the daily life of R&D, many of the probing goals were realised in the workshop, such as supporting teamwork and empathic interpretation, as well as developing surprising perspectives.

4.6 THE PROBING PROCESS

Research and design include both routine jobs and stages of discovery and understanding that demand creativity. The tuning-in stage is there for outlining the object of design and understanding the phenomenon to be studied by making guesses about possible solutions. The tuning-in consists of preliminary study of the target group and phenomenon, recording the preconceived views, and examining the design challenge. A literature review can collect information and start cognitive processes, a look at one's own experience can help understand the factors of experience, ideation of solutions helps get a grip on the design challenge, and expert interviews and group discussions provide the briefing for wording the questions and help find the group to be examined.

The hunt for the target group and the planning of

FIG. 52. The designers at Polar Electro received the user descriptions in digital form. They were told to get to know the users in advance. There was an easy and playful team-up exercise for every user description: think of a weekend shopping list for the user, write him or her a card from your holidays, write a horoscope, think of a birthday present for him or her. The ingredients of the concepts produced in the workshop, such as smart equipment for physical exercise, were found in the users' daily lives and their meaningful experiences.

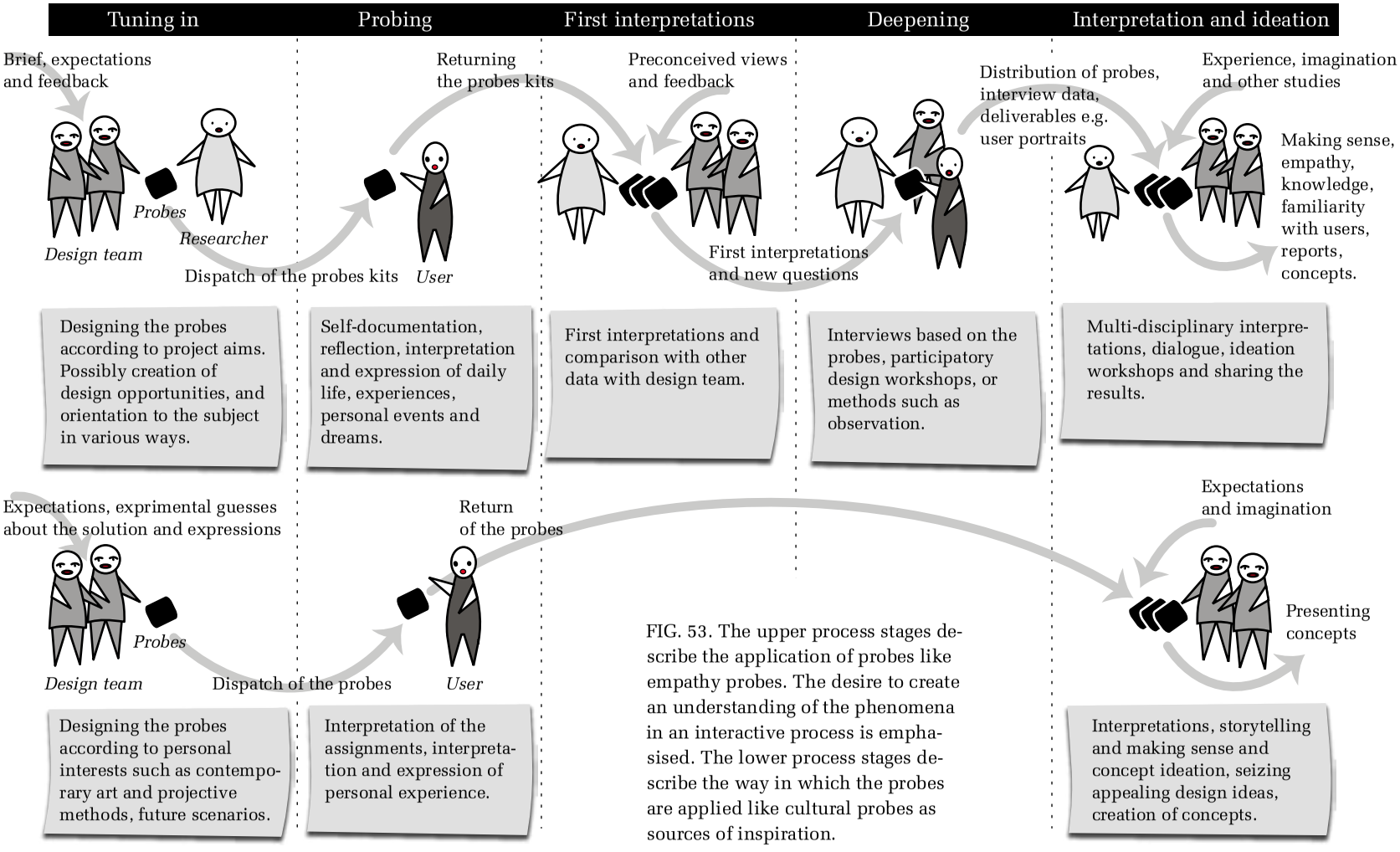


FIG. 53. The upper process stages describe the application of probes like empathy probes. The desire to create an understanding of the phenomena in an interactive process is emphasised. The lower process stages describe the way in which the probes are applied like cultural probes as sources of inspiration.

the probes can start at the same time as the tuning-in. There is no hard and fast pattern or formal constraint for the design of the probe kits, articles and tasks.

Although the planning and implementation of the probes offer the designers an opportunity to express themselves and the insights from the tuning-in stage, the target group also affects the practical solutions and the framing of the questions. The design should also consider practical requirements from the point of view of the user's motivation, the logistics of the self-documentation stage, the storage arrangements for the material, the interpretation stage and the presentation of the results.

What is done about the material collected in the probes and how it is interpreted depends on the purpose and context of the probing. If the material is supposed to provide information, it can be organised into summaries and outlines describing the phenomenon in question. If the purpose is to include the users in the planning, the ideas and design opportunities can be worked into scenarios or product ideas describing future situations. A probe process intending dialogue emphasises discussion both at the tuning-in, probing and interpretation stage. The dialogue is typically encouraged by meetings, workshops and ideation sessions. As for sources of inspiration, probes can be used without any particular outline for getting ideas and thoughts going. In collaborative industrial projects, the details of the material have provided starting points for a variety of interpretations and ideas. It is even possible that the inspiration is supported by the whole of the interactive process from designing the probe assignments to packaging the results, not simply the of data gathered through the probes.


5

Conclusion – after the probing

This book has described how probes offer a creative and experimental way of conducting user studies by applying a combination of traditional research methods, the design process and designerly thinking. The probing process can be regarded as a supportive tool for connecting designerly thinking to the users' world of experience. This process facilitates the participation of users, designers and researchers as well as a multidisciplinary design team. At the same time, it ideally produces and supports interaction between the company and the users, both during the user-centred design process and in the long run. Beside the dialogue, the probes also assist the inspiration of the designer and the design team. They can collect information about the user and the phenomenon being designed. Furthermore, they may encourage the user to join the designerly expression and visions of future experiences.

The probes contain elements of uncertainty. Probes are hardly the first methods to be employed in developing the practices of user-centred design in companies. Once the principles of user-inspired design are adopted, the playfully experimental nature of the probes can offer a fresh approach to user studies. Practice has shown that enthusiasm and renewal are not matters of course whenever probing is done. The design of probe exercises soon starts applying the

OPPOSITE. The Active@work project team is making sense of the probes data. (Mattelmäki & Lehtonen 2006)

same exercises over and over again, so that the kits and processes resemble each other. This might be a goal in turning methods into brands, but stagnant routines have often been regarded as something opposed to creativity when attempting a fresh approach, inspiration and a designerly frame of mind. Renewal and customising are demanding on resources, which may create a challenge to using the method in the hectic rhythm of R&D. Finding new ideas and experimenting with them are however desirable qualities in applying probes. The attitude of probing does not necessarily remain fresh with constant use if it is only a matter of repeating earlier examples.

The risk of being stuck in a rut may be avoided by employing new instruments in the probing. Devices such as camera phones and Internet-based systems can be used for recording the material. Interactivity can be increased by offering the participants an opportunity to look at and comment on each other's material, as is the case with website diaries (blogs). The digital technology also offers means of tuning up workable, usable probes to supplement the probe articles merely relying on imagination. Technology lends itself well to creative and designerly research in technological probes. The designers can produce open-ended guesses about possible solutions, recording their function and people's ways of going about them, as well as presenting future potentialities in outline form. Probes such as Urban Probes (Paulos & Jenkins 2005) seek people's reactions in surprising interventions, at the same time mapping out the prospects of future technology. Such experimental procedures resembling artistic projects may indeed increase in user-centred design.

The material accumulated in empathy probes demonstrated in this book has typically been handled in a designerly manner, by orientation, interpretation, sense making, searching for design opportunities, and aiming at visual and narrative summaries. One of the interpretation frameworks has been the employment of designerly solution-oriented what-if questions (Schön 1983). Apart from these, the probes are being applied in new areas such as examination of social problems and organisational change. Probes focusing on the individual perspective help make things visible and exchangeable. The Active@work project examines issues of development in the organisation, and the alternatives for improving the ageing workers' well-being (Mattelmäki & Lehtonen 2006). The probes were meant to sensitise the ageing workers to think of critical situations in their work, motivational factors and subjects for improvement. The material collected in the probes has been a way of representing the daily lives of ageing workers both within the organisation and to the cooperation partners. We attempted no theoretical frame of reference in interpreting the material relying on descriptions of practices and visual presentations, characteristic of and natural for designers. The narrated and illustrated outlines based on an interpretation have attracted considerable interest.

FIG 54. The making of the probes kits and tasks resembles design work to some extend. It includes looking for inspiration and ideas, fine tuning the visuals, and designing the practical elements.

The visual and projective exercises in the probes have aroused discussion about their application to understanding the daily lives of groups such as unemployed people, young dropouts and people living on the margins of society. These projects have entirely new goals and challenges. The aim is to produce an interface between design and people's daily environment, situations and practices, and to develop a dialogue, gathering material of interest to various parties. Practical challenges are faced such as how to make sure that disposable cameras are not sold on, or what kinds of exercise you can have analphabets do.

Designers can apply probes to support their work in a designerly way, but new ways may emerge in handling the material, when probes are applied by people with more traditional doctoral and post-doctoral training. The point is that attitude and aim essentially have some bearing on how the probes and the material accumulated in them are managed. If the requirement of academic analysis replaces or parallels that of designerly interpretation, the range of reference frames and technologies can be applied to a more systematic handling of the material to be gathered. Elizabeth Sanders (2005b) conducts systematic analysis of materials gathered by creative methods so that her materials such as collages can be studied quantitatively as well.

Research relies on theory, but probing also has a strong element of making. The outlines, instructions and experiences have both emerged from the literature and practical work. It is difficult to create a precise pattern of the design process for probes. The problem and the solution go hand in hand, and there is no single answer or method. An inspiring idea about things such as the overall appearance of the probe, a single probe article or a visual detail can tune up the probe design along with a consistent approach to the problem. Although the methodological instructions can in principle be taken to the extreme, the outcome finally depends on the agents, i.e., researchers, designers and even users in the case of probes. Practical instructions are helpful, but somebody conducting research must personally be tuned-in to receive signals, interpret them and be surprised at them, as well as tolerate the ambiguous nature of the probing process (and design).


6

Presentation of the articles

The articles in the Appendix, the essential framework of my doctoral diploma work in art, deal with the development of probing.

1 Mattelmäki, Tuuli and Keinonen, Turkka (2001) Design for Brawling: Exploring emotional Issues for Concept Design. In Helander, M., Khalid, H. M. & Tham, M. P. (Eds) Proceedings of the International Conference of Affective Human Factors Design. Asean Academic Press, London, p. 148–155.

Design for Brawling: Exploring emotional Issues for Concept Design (Mattelmäki & Keinonen 2001) is an account of a student project in which the use of probes was taught and learnt. The project aimed at teaching how to cope with a design challenge with elements of emotional behaviour, a user-centred approach and designerly interpretation. The subject of our course was angry feelings to examine the experience and the emotional expressions, as well as develop user-inspired, interactive ideas for concepts taking emotions and their expressions into account. The article is an introduction to a discussion from the point of view of design for experience, emphasising that it is not simply a question of methods but an approach to experientiality and the users. The article was published in the proceedings of a confer-

OPPOSITE. The Active@ work probes kits have returned from the ageing workers to the project team for interpretations. (Mattelmäki & Lehtonen 2006)

ence entitled Affective Human Factors Design. The text is largely the work of the first of the authors, but Turkka Keinonen, then Senior Researcher at the Nokia Research Centre, was both responsible for the planning of the whole project, the comments on the article, and the finishing touches.

2 Mattelmäki, Tuuli & Battarbee, Katja (2002) Empathy Probes. Binder, T. & Gregory, J & Wagner, I. (Eds.) Proceedings of the Participatory Design Conference 2002. CPSR, Palo Alto CA, 266–271.

Empathy Probes (Mattelmäki & Battarbee 2002) is a presentation of the physical exercise and well-being study that preceded the brawling course. This was the authors' first experiment with probes, an introduction to the method and its potential, as well as applying probes to collaboration with companies. This project discovered the potential contained in the experiential nature of the probing, the interactive process and empathic identification. The success of this experiment resulted from enthusiastic researchers and highly motivated users, as well as the fertile soil provided by the company, the open and reflective atmosphere in the design team in other words. This article was published in the proceedings of the internationally significant Participatory design conference. The responsibility for the approach, planning and reporting was entrusted to the first author. Both authors however participated in carrying out the research, considering the methodology and writing the article.

3 Mattelmäki, Tuuli (2003b) VÄINÖ: Taking user centred steps with probes. Proceedings of the INCLUDE conference. Helen Hamlyn Research Centre, Royal College of Art, London. CD-rom ISBN 1874175 94 2. <http://smart.uiah.fi/luotain/pdf/vaino_include.pdf>

VÄINÖ: Taking user centred steps with probes (Mattelmäki 2003b) elaborates on the subject of the preceding article, but emphasises the empathic nature of the method in particular, and the opportunity to challenge stereotypical perceptions of the users. This emphasis points out the use of probes as an instrument of teamwork. The Väinö probes were constructed in a project where representatives of a variety of companies and organisations met to discuss concept design and the challenges presented by the needs of housing for senior citizens. The material accumulated in the probes thus worked as the basis, the user material, and a shared tool for examining the issue, envisaging future trends and ideating new concepts. The project was able to monitor the work in the teams and the significance of the probe material for the context. This article was published in the proceedings of the biennial Include conference, organised by the Helen Hamlyn Institute, which gathers researchers and designers interested in design for all.

4 Mattelmäki, Tuuli (2003a) Probes: Studying experiences for design empathy. In Koskinen, I., Battarbee, K. & Mattelmäki, T. (Eds.) Empathic design. User experience in product design. ITpress, Helsinki, Finland, 119–130.

Probes: Studying experiences for design empathy (Mattelmäki 2003a) sums up experience gained from probing, and provides a broader outline of the probing process and the applications of probe objects in order to help understand the user experience and design for it. This article originally appeared in a publication with texts by authors from the eDesign project and related areas. The responsibility for editing the article in line with the rest of the book lay with Professor Ilpo Koskinen from the Department of Design, which means that this article, unlike the others, did not undergo an independent referee procedure.

5 Jääskö, Vesa & Mattelmäki, Tuuli (2003) Observing and Probing. Proceedings of the International Conference on Designing Pleasurable Products and Interfaces 2003. ACM Press, New York NY, 126–131.

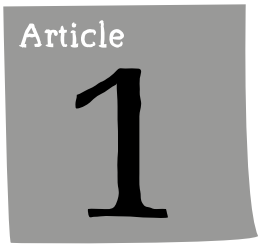
Observing and Probing (Jääskö & Mattelmäki 2003) maps out the perspectives of user experience, examining and comparing the use of probing and observation. This article was written as part of the Luotain project with the goal of developing design for user experience and the methods and processes in user-centred concept design. The article places probing on the map of user-centred and experiential design. The responsibility for the approach and the finishing touches lay originally with Mattelmäki, but both authors made an equal contribution to the writing of this article.

6 Hulkko, Sami; Mattelmäki, Tuuli; Virtanen, Katja & Keinonen, Turkka (2004). Mobile Probes. Hyrskykari, A (Ed.) Proceedings of NordiCHI04. ACM Press, New York NY, 43–51.

Mobile Probes (Hulkko, Mattelmäki, Virtanen & Keinonen 2004) discusses self-documentation, and challenges occurring in probing such as interactivity and difficulties with management of the material. It also introduces a new kind of probes, mobile probes, working on camera phones and Internet-based applications. Hulkko and Virtanen were in charge of describing the case studies in the article, but Mattelmäki was responsible for associating the article with earlier probe work, and evaluating new technology in this perspective, as well as editing the conference article.

7 Mattelmäki, Tuuli (2005) Applying probes: from inspirational notes to collaborative insights. In CoDesign: International journal of CoCreation in Design and the Arts, Vol. 1 No. 2. Taylor and Francis, London, 83–102.

Applying probes: from inspirational notes to collaborative insights (Mattelmäki 2005) sums up the experience gained in earlier probing projects, and discusses the usability of probes for concept design in companies in particular. This article can be characterised as the main article of this work, describing the probes and outlining the reasons for applying them, both based on literature and the opinions expressed in the interview material.



Design for brawling – Exploring emotional issues for concept design✖

Tuuli Mattelmäki and Turkka Keinonen

ABSTRACT

This paper describes a case study of a student course about design for user experience. The theme of the course was emotionally loaded behaviour, brawling. Our objective was to teach, how to tackle a combination of emotional behaviour, user centered design approach and designer's personal interpretation during product concept creation. The students were first introduced to the theme, then they did a user study and analysed the data to find opportunities for concept design. The paper presents the process of the course with some of the results.

Keywords

User experience, Concept design, User study, Emotional behaviour

1. INTRODUCTION

As digital gadgets are entering the everyday life of ordinary people new approaches for interaction design

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and user understanding are needed. The key is design for user experience. In interaction design it is not enough to focus on usability, but also hedonistic qualities need to be considered. Design for user experience seeks to see the people, not only as product users in a practical sense, but also in a holistic way as feeling actors. The emotional aspects are not easy to reveal. They are not easy to design for either, but they are essential.

Design for user experience is a design attitude, designers' aspiration to pay attention to the users' experiences and their relationships with products and systems. (Hummels, 2000, Margolin, 1997) The attitude, which is necessary for design for experience, includes respecting the users, commitment to the user needs and desires, holistic understanding of the interaction, and not to forget trust on designers' personal insight and creativity. Design should not be reduced to analysis. Designers' personal understanding is essential. (Buchenau and Fulton-Suri, 2000; Lawson, 1980)

Intuition and subjective visions are difficult to express. They are something the designers are supposed to possess, they belong to the tacit professional knowledge. To combine these ambiguous matters with user data is encouraged by empathic design practice in e.g. IDEO (Black, 1998). Handling the emotional aspects of interaction needs to be one of the skills and values that designers adapt as a part of their professional identity.

Emotionally focused exercises guide interaction designers to these skills and they need to be a part of interaction design curricula. The objective to teach these skills is to put more weight on the emotional matters and to learn consciously to look for subjective insights for experiences and environments. This helps in the interpretation of the user data in a design process. It is a way to make the students "include feelings to the list of critical variables ". (Segal and Fulton-Suri, 1996) Knowing the angle is the first step, gathering subjective experiences the second and wanting to act for the objective the third step of learning. In this paper we present a case study, how to teach this process to students so that they understand the emotional behaviour and embody the understanding in design concepts.

2. USER INSPIRED DESIGN COURSE – BRAWLING

We arranged a course with the above mentioned objectives for the MA students of industrial design and Usability School, which is a collaborative program for industrial design, cognition science and computer science students. The course was organised in University of Art and Design Helsinki UIAH in fall 2000. The program for the course was based on the assumption that the students have some

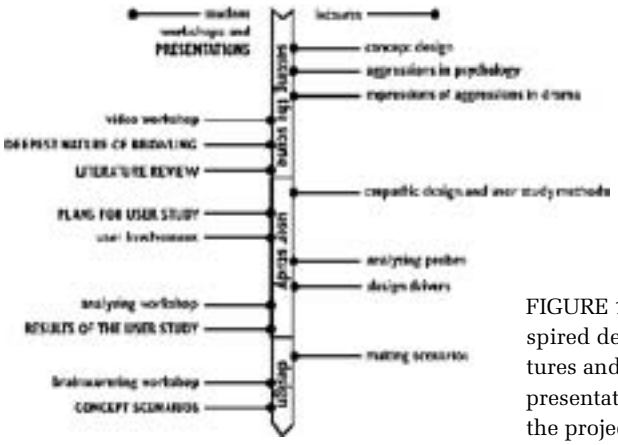

FIGURE 1. Process of the User inspired design course including lectures and student workshops and presentations in different phases of the project.

basic knowledge of usability and user centered design. Most of the courses organised for the students in Usability School are either traditional usability engineering and technology oriented or partly funded by companies and focused according to their interests. This course, on the contrary, was free from such limitations and explored a more innovative approach to interaction design. To emphasise that we titled the course User inspired design.

The theme of the course was the expression of aggressions, brawling. The idea for the theme originated from a scene in "Harry Potter and the Chamber of Secrets" (Rowling, 1999). Harry's friend received "a howler", a letter with a loudly screamed angry message that blew up on the moment of opening the envelope. Present communication technologies, e.g. messaging solutions, provide poor support for expressing emotions. For SMS and email messages people add smileys to be able to share their moods, to tell how the message should be interpreted. Brawling is communication where the emotional expression is primary and the content of the expression secondary. It seemed challenging to dig into the negative emotions as pleasure, sensuality and sharing positive emotional messages has been addressed before. (Battarbee et al 2000; Buchenau and Fulton-Suri, 2000; Hofmeester G.H. et al, 96; Jordan, 1999)

In this paper we present the process of the student course rather than what the students found out about the specific emotional behaviour. The course started with a very broad focus: we proposed a theme and some ways to approach it, but we did not want to limit the outcome of the concepts. The process included several steps, each of them bringing new insights to brawling. Psychological basis of aggressive behaviour, how the theme is presented in art, i.e. on stage and on film, structural analysis of the related elements, literature review, a user study leaded to a design phase, where the insights were turned into concept scenarios.

At the end, as examples of different approaches to the theme, we to present more closely two groups' projects.

3. SETTING THE SCENE

IDEO has studied emotional communication with a concept exercise called Kiss communicator, an intimate communicator between lovers. They found out that there is a need to make the customers "get into the mood" to enable understanding and discussion. They set the scene by showing a video-clip about a romantic couple. Also designers need to get into the mood, especially if the design is about creating something related to an emotional behaviour or state of mind. It can be achieved with videos but also by role-playing and by experience prototyping. (Buchenau et Suri, 2000) By applying similar approaches in students' exercises widens the set of tools that the future designers are able to use intentionally and consciously when needed.

The students were introduced to the psychological angle of aggression, which illuminated e.g. the differences between aggressive and non-aggressive persons and the conditions for aggressive behaviour. Dramatic point of view showed how aggressions are motivated, what are the forms of presenting aggressive behaviour and whether the behaviour is targeted externally or internally to oneself. These two lectures represented rather opposite sides of the topic: one being analytic and scientific where aggression was seen by definition as undesirable kind of behaviour. The other considered aggressions as meaningful and strong expressions, which can create, at best, a purifying experience – catharsis – for the audience. At worst aggressions can be just disgusting, but even in those cases they may be visually strong and engaging experiences.

The lectures were followed by a video session to give the students a possibility to collect examples of how aggression is expressed

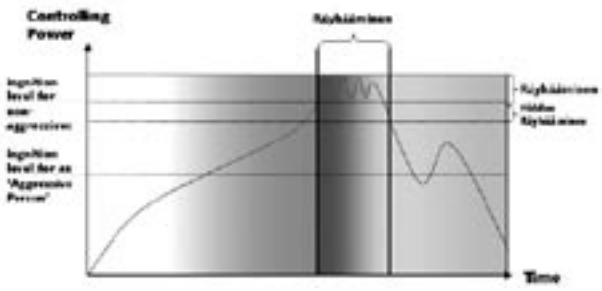

FIGURE 1. The group responsible for the rhythm (Marjo Kuusela, Tao Di, Salu Ylirisku) visualised their initial understanding with a temper curve inspired by sound waves. Their idea was that brawling is about controlling one's temper. The level of the control is lower for an aggressive person than for a non aggressive person. The Finnish word "räyhääminen" refers to expressions of aggressions, brawling. (Image from the students' presentation)

in film and in animations, how e.g. the compositions of colours, sound and language are connected to make an aggressive scene.

The course included also a literature review. The books were chosen to widen the perspective of the students e.g. to the field of design and adaptation of new technologies. They were about humane and emotional aspects of media and technology (e.g. Reeves and Nass, 1996), user centred design ideology and practise, which has strong influence on the program of the Usability School (e.g. Norman, 1998) and the social influence of technology and artefacts (e.g. Kopomaa, 2000) Each group had to present one to three books to the other groups.

Students started digesting the topic by making interpretations of elements of aggression based on the lectures and the video session as inspiration. Each group focused on a specific point of view: the rhythm, the colours, the composition, the language and the sounds of aggression. The objective was to turn the process very early into a productive mode by making the students not only to collect material, but also to select it and to turn it to design language of colour contrasts, vocabulary and interaction sequences.

Students worked in multidisciplinary groups. Most of the groups were also multicultural. Expressing emotions is an area of strong individual, especially cultural and even disciplinary differences. First, the students had to explain their interpretations to the others in the team. Arriving to common understanding required careful discussions between the team members to be able to present shared view to other teams. By doing the mutual interpretation the students gained strong personal grip about the emotional behaviour and visual signs of aggressions.

The students asked to give a presentation about "the deepest nature of brawling" to other teams from. The form of the presentations was not limited, but we wanted to stress the creative interpretations by proposing e.g. collages as a working method that is often used in design process to gain impressions about the atmosphere. (Hummels, 2000)

4. USER STUDY

Studying emotions and emotional behaviour for design purposes requires empathic approach. Designer's inner vision and subjective experience are important. They enable to link the user study to personal experiences. The students were introduced to the empathic design approach and user study methods with a lecture and reading material presenting design for user experience-ideas, the "Cultural probes", Sander's "Make tools" and Wensveen's Waking up -experience as well as some experiments done by the writers in this field. (Battarbee et al, 2000; Black,

1998; Gaver et al, 1999; Mattelmäki and Battarbee, 2000; Sanders and Dandavate, 1999; Wensveen, 1999)

The students were requested to study the meaning of brawling in everyday life. They needed to move from personal experience to studying concrete human everyday behaviour. This meant turning the principles, which they gathered in previous phases, into a form that can be used in communicating with people outside of the design community. The students made a small-scale user study in the spirit of "cultural probes", (Gaver et al, 1999) which was a user study done in EU funded Presence project to support concept design. In this approach different methods such as self-photography and diary are combined to construct an image of the people involved and their perception of the environment and activities. "Probes " refers to a research material package, which was given to the users. The package included little tasks e.g. a diary, maps, postcards.

This approach was selected because we regarded that it allows the designers to include their own insights into process, and still be open to users' opinions, and for its capability to address emotional aspects. (Wensveen, 1999) In the Presence project the designers said that while doing the "cultural probes" package they could already process some of their ideas and understanding of the different places and the people into the different tasks of the user study package. This was also our idea and for the planning of the user study the previous subjective understanding was found useful. We believe that probes can be used as stimuli to get information and inspiration about issues that support designers' non verbal thinking. It provides a tool for the users to notice and document consciously their environment, values, needs, social aspects, emotions and small but significant everyday experiences. The focus in the user study was all the time on the users' subjective experiences and personal views about how they face brawling, or brawl themselves.

The students were able to choose the group of users they wanted to involve in the study. One of the groups was interested in studying how visually impaired face brawling. Other groups had e.g. couples, a teacher, and a kinder garden manager. The groups created different kinds of packages according to their users and their own understanding about the theme. The packages included e.g. diaries of different kinds for gathering temporal data, collage-material for recording impressions and dreams post cards with both abstract or concrete images and questions, disposable cameras for documenting the users' environment and e.g. objects, situations, persons that were related to brawling. (Sanders and Dandavate, 1999),

Writing diaries and documenting their life is a laborious project for the users. The material needs to be designed in a way that makes the task as fluent as

FIGURE 2. Most of the probes packages included diaries with additional stickers with expressive faces. (group Alaharju, Belitz, Huuhtanen, Jäntti)

FIGURE 3. The material was especially selected for the purpose (group Kärkkäinen, Liikka, Nikkanen, Tiitta)

possible. It should provide a fast and easy first step for starting to put something down e.g. stickers. The material itself needs to be attractive and playful to motivate the use.

Probes produce inspiration material for the designers. On the other hand they concentrate the attention of the users during the desired period to the focused issues. Consequently in the interviews afterwards they were prepared to discuss the topics that they otherwise might have completely ignored. All of the users were also interviewed about the tasks they had accomplished. This was found to be very informative. Some of the groups asked the users to make collages related to brawling. They found out that collage as a projective task helped them to tell more insights about their feelings, situations and stories about their experiences.

This way of gathering user data provides rich information material giving a holistic picture of a person's life, emotional moods being part of it. To learn how to analyse this data requires patience, time and team spirit. It is a critical phase, because any piece of data can provide useful information and should not be ignored. The students should be advised not rush to the first ideas and conclusions but try to see the deeper meaning of the behaviour. The whole team should share the common understanding. The students interpreted the information by constructing affinity walls. (Beyer and Holzblatt, 1998) It is a method of creating meaningful information structures from several sources and small pieces of data. The idea is to let the data itself define the structure. Most of the groups found this phase of clustering the data confusing. Tutoring at this point can be difficult, if

the tutors are not familiar with the students' data. It seems to be crucial, however, to keep the teams from grouping too generally the findings and from loosing faith, but encouraging them to continue talking and trusting their own visions as well. After lot of analysing, brainstorming and discussion the students selected the most promising starting points and proposed a set of scenarios based on those.

5. CONCEPT DESIGN

Smart mobile devices are becoming a seamless part of everyday life. Simultaneously they are becoming increasingly versatile. They have different looks and features for different consumer segments. In many companies concept design is practised to elaborate new ideas with often exaggerated features around specific themes. (Moggridge, 1999) Concept design enjoys the liberty of ignoring many of the restrictions that are mandatory in product design. Concepts can enlighten vague ideas into more tangible and communicable form for the development teams. They can widen the thinking inside the company and give strategic directions. In general concept design seeks for possibilities rather than avoids risks. (Keinonen, 2000)

One of the aims of the course was to teach a model of product concepting process. Concept design calls for imagination and openness. Concepts are proposals for studying and forming attitudes and values for the design of products that do not exist yet. We wanted to make the students to think about the interaction and the opportunities as well as the role of digital systems in human life context.

Concept design searches for relevant and fruitful questions and starting points to be able to formulate a design problem, or positively seen as a design opportunity, a design driver. The students were introduced to UI concepting approaches used in Nokia Research Center, which are based on user centred design (UCD). The user data leads the process and helps to grasp the intangible open-ended task in a situation, where neither the future product ideas nor their users exist. (Keinonen, 2000)

Concepts are often presented with scenarios, which are usually illustrated stories characterising persons, who are using a system or a device in different contexts. Scenarios are able to show the essential issues about the user experience with the designed concept. They are a good way to concentrate into the interaction and the context, the user experience, and not to the detailed shape or logic of the different features of interactive systems.

5.1. Le pont fantastique

One group (Kari Honka, Pekka Partanen and Mariana Salgado) focused on visually impaired. The original "cultural probes" package was visually stimulating,

so the group had to re-interpret the approach. They selected sounds and objects, which reflected the ideas they had about aggressive situations and blindness. The selected sounds were e.g. traffic lights, a crowded party, bank automate and the objects were e.g. a cold metal square with sharp angles and a plastic gun. The study started with a focus group discussion. In this case the probes did not work as wanted, as a projective stimulus. The reason was that the focus group was organised in the centre for visually impaired, were they worked. Aggressive behaviour and emotions can be so personal and intimate that people are not relaxed enough to talk about them in their work place with their colleagues in their working environment. However, the interaction with the people, observing them talking and acting with each other gave students some insights.

The students were more successful with a personal interview with one woman at her home. The situation was comfortable. She told intimate stories about brawling situations and feelings. She produced also a collage of words about aggressions on her computer and played it with a speech synthesiser. The students were able to meet her in several occasions and observe her life.

Before designing the concept the students visited an exhibition called Dialogue in the dark in the Finnish science center. The exhibition was organised by visual disabled people. The students had to experience the world of blind people in the dark, with a white stick. They reported that it was a very strong subjective experience. They realised how scary, especially for seeing people, it can be in the dark and also how strong is the need of being in connection with the others by touching or by voice. Buchenau and Fulton-Suri talk about similar exercises which they call bodystorming and experience prototyping. They present them as a tool to gain personal experience and trough that provide a useful lens to look at the experience of others in real contexts. From their point of view "the information become more vivid and engaging when it resonates with the personal experience". (Buchenau and Fulton- Suri, 2000) The subjective experience of the students led them closer to the world of visual impaired.

FIGURE 4. The concept is a small interactive device, which can be easily used with one hand.

FIGURE 5. The user gets tactile information to her finger about the "silent" facial expression of the other person e.g. smile.

The students were impatient to start designing at this point. They also felt overloaded with all the problems of their users, which they wanted to solve. From the gathered data they had to select the phenomena which had most opportunities in them. The lack of information about other person's emotions in conversations seemed to be the most important problem, and it can lead to brawling through misunderstandings. For blind people silence can be aggressive because they are not aware of the environment.

They decided to design a concept for blind people to increase awareness about other people, especially their emotions and moods. Their concept was called "Le Pont Fantastique'. It is a little tangible device, which enables the visually impaired people to "scan" facial expressions of others to be better aware of their moods, interpret the messages and act accordingly in communication situations. The concept was proposed to recognise a limited set of facial expressions and head movements e.g. smiling, nodding and denying. It had to be a wearable object, which is available, when there is need for communication. The product had to be ready to be used anytime and utilised with one hand. Tactile output was necessary to avoid problems with concentration when the visually disabled users have more than one stimulus at the same time. The students presented their concept with radio program kind of scenario with some additional pictures. The scenarios had to be understood and enjoyed by their users, the visually impaired.

5.2. The tangible mediator

Another group (Tao Di, Marjo Kuusela and Salu Ylirisku) focused on two young couples and a nurse. They asked their users to fill a diary for one week. It was a booklet, where users filled in their personal temper curves for each day. The scales of the curve were time on horizontal dimension and negative arousal from

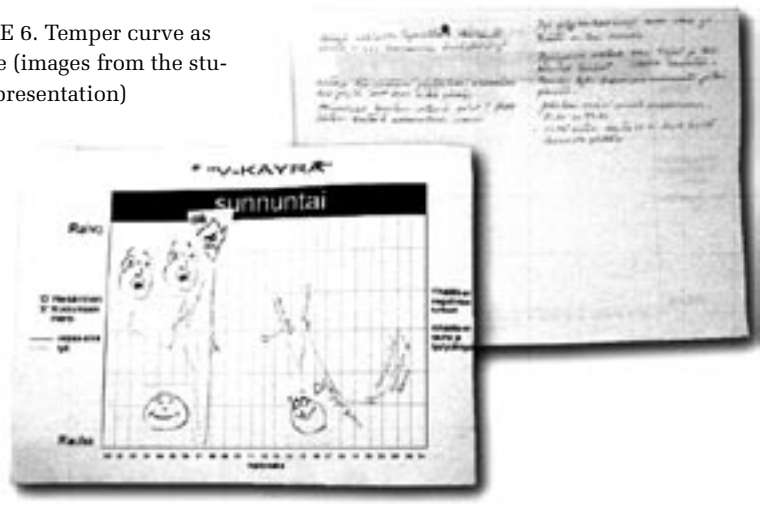

FIGURE 6. Temper curve as a probe (images from the students presentation)

FIGURE 7. Parts of scenario of the concept "The Tangible Mediator". The user is able to conduct the anger to an object safely through physical action. In the picture on left the lady is strangling her teddy bear – mediator to express her feelings. The system also supports in finding empathy by contacting suitable people for sharing the bad feelings. In the picture on the right both of the men are experiencing terrible times. The connection between them was made by the mediator after the physical input to the device. (Images from the students' presentation)

peace of mind to anger on the vertical axis. It included stickers with different faces to help in expressing feelings. The curves and the stickers made the filling in of the everyday feelings easy. It was also very easy to see how their moods changed through the day.

The users were interviewed after the week. The moments of changes in the emotional states were discussed with the help of the curves and the diary. It was found out that the developed framework for understanding the essential nature of brawling – the temper curve – actually succeeded in getting the users to control their temper with it. During the interview the users made collages to describe their state of mind before, during and after brawling. The students felt that the collages reflected the minds of the users in a way, which would be difficult to express verbally. The selection of pictures and the composition of mood and action pictures created understanding from a different angle. The students reported that the user study strengthened their previous personal findings.

This group, like the one who worked with visually impaired, turned the original starting point around for creating a concept for getting rid of aggressions. They listed several ideas with emotionally sensitive tactile interfaces e.g. a little brawler, a thing that jumps all over the house and shouts swearing words. The brawler starts when it is hit by something and the power of the hit controls the loudness and the speed of it. It only stops when somebody laughs. The students believed, however, that another person is the best solution for lack of empathy in brawling situations. In the selected concept, which was called "The Tangible Mediator", the user was able to relief negative tension with a tangible input device through aggressive action and to communicate with other people, who are in a similar mood. The concept was based on their initial curve model. The user

inputs her feelings, the device gives feedback about how the emotional state is understood and can then transmit the feelings to a defined set of people through their mediator devices.

The concept followed the design drivers, which were conducted from their user study. First, the system had to support communication for sharing emotions, getting feedback and even offering surprises. Second, it had to enable expression, which means releasing emotions through mediator. Third, it had to indicate the aggressive feelings at an early stage, give guidance and assistance for solving problems and provide entertainment. And fourth, it should have a physical, tangible control.

6. DISCUSSION AND NEXT STEPS

We consider the approach as a successful introduction to design for user experience. One team's project was selected to be presented in an international conference of inclusive design. (Honka et al, 2001) In general spontaneous comments from the students were positive, even enthusiastic, including e.g. starting to perceive the world in a new manner. They told having grown to more sensitive to the experiences that environment and objects can cause. This is one of the skills people in general, but especially creative design professionals should possess.

The students showed high motivation in elaborating the concepts even the goal of the work was far from clear. The task in the course was to design an artefact or a system that is related to brawling, a solution to deal with expressing aggressions. The outcome was not limited to be a technological feature or a device. However, all of the concepts were digital systems or services. Some of the rejected ideas were humorous and empathic e.g. "count to ten-device", "warning light for bad attitude", "hug service", "soft hammer", "a gender dictionary". The created concepts reflected commitment to users' situations and problems. All of the concepts aimed at turning the negative starting point to healing experience. The digital technology in these concepts was humane.

We are planning to continue this kind of courses. The themes will be different though. We believe that the approach can be applied successfully for other emotionally engaging themes as well. The process of the course should be flexible to guide itself according to the theme. To improve the results of the course some effort should be made to validate the concepts with users. We learned that the broad focus and the fact that nobody knows, what the outcome will be in the end, created a lot of confusion. That makes tutoring challenging at the point where the students are familiar with their users and their behaviour, the tutor is left out and the student groups are very much on their own to analyse the phe-

nomena and reach to solutions. The confusion should be avoided by emphasising in the start the facts that technology should be tamed to serve human behaviour and not the other way around. In such concept design projects the questions are not framed beforehand but can be entirely open. The opportunities for new experiences are there to be grasped.

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Article 2

Empathy probes✖

Tuuli Mattelmäki and Katja Battarbee

ABSTRACT

Design empathy is needed when going from rational and practical issues to personal experiences and private contexts. Probes are specifically designed material packages given to the potential users to document their private lives, contexts and experiences. This paper describes a case study of experimenting with the probes approach, combining it with interviews and a projective tasks. The study was done in collaboration with Polar Electro Oy. The aim was to gain a holistic and empathic understanding of the people who exercise for wellbeing. This paper describes the study and the gained experiences on building and sharing design empathy.

Keywords

User centered design, user study, probes, collages, self-photography, design empathy

INTRODUCTION

Design empathy is a skill often mentioned by leading human factors and designers [1, 12]. Design empathy means

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that people are seen and understood from where they stand, not as test subjects but as persons with feelings. To get an access into the subjective issues marketing or user research reports are not enough but design empathy – a personal contact and connection with the users – is also needed [12]. It has two directions: towards the participants to create an empathic and respectful dialogue and towards the designers to support empathic understanding.

Sanders [10] divides user research into three areas according to the focus and the kind of information that can be acquired with the methods: say, do and make. Say and do relate to interviews and observations. The make-tools are physical or visual aids to allow people to visualise and describe their expectations and dreams. According to Sanders these categories should be explored simultaneously to achieve an empathic understanding of the users.

As information technology has become a part of everyday life, people carry and use personal technology devices in changing contexts. To be able to design for positive future experiences the designer has to understand potential users as well as their physical and social contexts. This means widening the scope from task focused usability to taking into account contexts, actions, feelings, attitudes and expectations. [9,13]

These wider contexts affect especially the user research conducted before concept development. In the first phase of concept design the challenge is to find fruitful starting points and questions to be able to formulate the design task [8]. It is difficult to set well defined aims for the user studies at that point. One has to start by probing the possible area to find opportunities and searching for possible signals for new directions.

To gain a larger view into the lifestyles of people and facilitate a better understanding of people's experiences, more traditional user study methods e.g. observation and interviews can be supported with other approaches [10].

The Cultural Probes, described by Gaver, Dunne, and Pacenti [5] was a fresh user study approach into the private lives of people in different cultures. In the Presence project, as the traditional methods were thought to limit the view into too specific and controlled areas, "the probes were designed to be an alternative to the more traditional forms of user research"[6]. The word probe suggests an automatic recording device that is sent to unknown territories where human researchers cannot go, from where it collects samples, and sends these back to the researchers.

The probes in this study were specially designed material packages given or sent to the people to support self-reflection and documentation. These packages contained disposable cameras, maps with instructions and stickers, pre-stamped postcards, and were generally aimed at providing a constant trickle of inspira-

tional material to support a cultural understanding at the designers' end. Different items in the package were not designed to gather preset or specific information, but rather to be inspirational and provocative and project unpredicted views to the life of the elderly.

While Cultural Probes could be criticised for lack of formal analysis, it addresses user research from a concept design and designerly point of view, seeking for new opportunities rather than addressing problems [5][8]. Strictly theoretical methods have not been widely adopted by designers. Designers are influenced by the concrete things they can see and feel [3]. When the returned probes material is offered in form of visual stories the design team has a chance to review the material again to look for stimulation and ideas. The material supports thinking and serves as a memory trigger and as communication medium for ideation [2].

Our interest was to gain experience in using the probes approach in a context close to the design industry. Unlike in the Presence project, where the Cultural Probes were developed by the designers themselves, we were in a consulting position, between the participants of the study and the client company. This created a challenge of how to communicate the gathered data to the designers in an empathic and inspiring but at the same time usable and motivating way. Also, we did not want to send probes only to collect inspiring signals but wanted to experiment on combining the probes approach with interviews and make-tools in a process of continued involvement for a more holistic understanding [10]. Our emphasis was on using the probes kit to allow the participants collect data about their physical and social context, life style, attitudes, and experiences to be explained and discussed later in personal interviews.

THE CASE: HEALTH, WELLBEING AND EXERCISE

Being a heart rate monitor manufacturer, Polar Electro had an interest in expanding their knowledge of non-users, especially those who exercise for feeling good and being healthy rather than competitive sports. Their aim of the study was to look at the experience of well being and exercise from a wider perspective – to understand the everyday life of people, their feelings and motivations.

The amount of participants for this qualitative study was limited to ten and they covered ages from 24 to 71 and conditions from headaches to recent by-pass surgery. None of them owned or used a heart rate monitor.

Tuning in

The study began by researching exercise and nutrition facts for by-pass operation patients. At the same time the aim of the study and its participants were de-

fined to match the interests of the company. Designing the probes kit requires an understanding of the area of the study, and the willingness to understand the in-

formant. This willingness is the first stage in building empathy.

As health and wellbeing can be very sensitive issues, it was important to understand the feelings and the language of the participants and apply this knowledge to the probes material. A focus group was organised with half of the participants to open the discussion, erase our own possible preconceptions.

The Probes kit

Applying the example of other probes studies [5,14] the kit included a small diary booklet and a sheet of stickers, a disposable camera with a list of photography assignments, and ten illustrated cards with open questions. These were sent or given to the informants along with a stamped and addressed return envelope.

The purpose of *the diary* was to collect a set of daily routines and thoughts relating to health, well-being and exercise. Diaries provide tools for event documentation as well as reflection. To assist in the process of describing their feelings, a sheet of *stickers* was provided with cartoon faces and other little illustrations to do with everyday life, exercise, and the season of early summer. The use of the stickers was suggested but not expected.

The illustrated cards had a question on the reverse side with space for writing. The open questions were about issues of interest for heart rate monitor development e.g. how does exercising relate to social issues, how people achieve results, how do they reward themselves.

Some of the cards were about attitudes and facts, and were supported with a descriptive image such as a picture of a computer, a phone and a heart rate monitor. Some cards related to experiences and emotions had more provocative or suggestive images on them, such as a plateful of sugared cakes for a question about rewarding oneself.

The participants were asked to take *photographs* according to given assignments. As with the cards, some of the assignments were purely documentative, requesting pictures of the home and their information appliances, exercise environment. Other assignments required more interpretation and provided a possibility of emotional expression, for example “something disgusting” and “what do you see in the mirror”.

Self-photography can be used in situations where the researcher cannot be present, and it collects visual information about the physical environment. Also, in allowing the informants to take the photograph, the choice and framing of the target becomes subjective. They can decide for themselves what things they are

willing to show. One participant did not want to show any members of her family in the photographs and chose her subjects accordingly.

Interview

Each person attended a personal interview where the preliminary review of the results was validated and other issues arising from the material were discussed. The photos, now attached to an album, were leafed through picture by picture, and the informants told us about the things in the photos and other issues related to the study.

As a final closure, the participant was asked to build a *collage* describing their ideal wellbeing and exercising assistant. Collages are sometimes used in the beginning of the design process to find the spirit for the design and in user research and participatory design exercises to reveal dreams and emotions [10]. The materials were a large sheet of paper, glue, and cutout pictures and words from magazines related to exercise, life style, feelings, people, environment and products.

Analysing the material

This study and the gathered material were reported to the company by presenting the collected material and a report with descriptions about the participants as characters and arising themes and patterns on e.g. motivation, measuring, attitudes towards technology illustrated with examples from the material. To report these themes in a less digested and more empathic way and to bind the analysis to the collected material we used the original stories and words to illustrate them.

Communicating the results

Although there was no direct relation to an ongoing product concept development project, we wanted to experiment if the probes and the interview material as such could be used to find new points of views for a company producing heart rate monitors. We organised a workshop with a multidisciplinary group of people from Polar Electro Oy.

This study presents a limited number of people but in previous meetings with the representatives of the company it was found out that going through the material of 10 participants at once is too heavy and time consuming. We chose to experiment with the material of four informants with widely differing attitudes towards exercise. The first preferred exercising alone, with the second the motivation for exercise was mostly to meet friends and mates, the third was very duty driven, the fourth exercised for the pure joyful experience.

The diaries and other materials had not been designed for easy photocopying and distribution, and also the confidentiality had to be taken into account. The

diary texts, card answers and exerts from the interview were typed and combined with sticker messages and pictures the participants had taken. These files were then sent to the company, printed out, and distributed to each participant before the workshop.

To ensure that the workshop participants read the material each had a small assignment that required them to think of the informant in an empathetic way, such as writing a card from holiday on their behalf or suggesting a horoscope. This assignment was found to be a good way of starting the workshop. It created an empathic and playful attitude, which supported the teams in the concept design phase. All the presented concepts reflected needs arising from the material in a human-centred way and raised a discussion e.g. about the relation of physical and mental well being and growth.

SUPPORTING REFLECTION WITH PROBES

Case specific material

The probes material and the assignments are designed for the purpose. The empathy building process begins with designing the material, imagining the possible contexts of experiences, projecting designers' own ideas and questions about the research and design issues, and preparing a sensitive ear for understanding another person. In this case it happened by thinking about the issues related to exercising and heart rate monitoring as well as considering the values of life and exercising before and after a by pass operation.

The way the probes material is designed has effect: using ambiguous stimuli for users to respond to and allowing for expression verbally, visually and through action also enables the participants to express their emotions easier [10,14]. While having the material kit to document their life, the informants are attentive of the experiences and routines related to the issues being studied. To be asked to verbalise experiences, they become more aware of them [5]. One participant told us later that even after the study she thought what to write into the diary.

The diaries described daily routines and feelings of the participants. These thoughts with personal way of writing opened a subjective view into the life of each person. Some personal issues are easier to write than say aloud.

The stickers inspired some informants to make little humoristic or emotional messages. One informant explicitly told us later on that the stickers helped in communicating the feelings of the day. This suggests that providing people the possibility of easy to access illustrations makes the diary task more playful for the informants, but also more motivating and enjoyable for the reader, weather

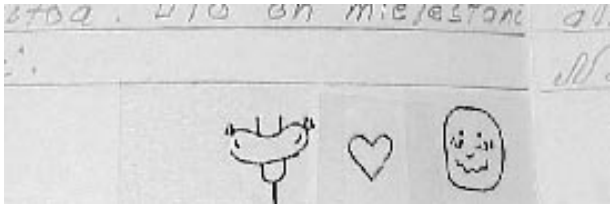

FIGURE 1. Stickers in a diary

it was a researcher or a designer. The similar experience about the stickers and diary facilitating the feeling of empathy for the reader was remarked in another probes study. [14]

The participants did not say explicitly that the illustrations on the *illustrated cards* had been helpful for answering the questions, some of them were not even sure whether they had seen the pictures at all. However, some of them commented a positive surprise when opening the package for the first time and finding the colourful cards. Having separate playful items in the package can affect the motivation of starting the documentation. The responses on the cards provided more detail about issues that were not expected to emerge from the diaries. Some of the issues asked in the cards, appeared, however, in the diaries: the material seem to have given food of thought and stimulation.

Photographs illustrated the life style of these people, their preferences e.g. in exercising equipment. This assignment was surprisingly thoroughly done by all the participants and they were eager to see their photos developed. They had enjoyed in playing with the camera even though some of the assignments needed thinking and effort.

Interview

The persons, their environment and experiences described in the diary became easier to vision through the photographs. However, the explanations of the meaning of the choices were important for understanding the pictures. The photographs also served as easy starting points for discussion, e.g. about making decisions for purchase or issues that had not been asked about at all. Through these *photo album stories* we were able to go deeper into interesting issues.

The collages were emotionally expressive and dynamic. The overall image communicated the ideal attitudes of the person. Through the collage people produced a visual and emotional explanation of the personal elements of well being: nature, social relationships, food, exercise, pleasure, a positive attitude, and the harmonious balance between them all. However, we learned that our interpretations of single pictures were sometimes incorrect. Again the specific reasoning behind the choice of particular images was the key to a deeper understanding of the collage.

FIGURE 2. Probes and designers

The collages were a useful extra to the probes and the interview. New issues that were not asked or mentioned before were revealed. These collages can be used as such to explain the characters and their way of life or even illustrating the feeling of future products. Also the marketing people were interested in using them as a resource.

BUILDING AN EMPATHIC DIALOGUE

Empathy with the participants

The informants must have a feeling of empathy and trust to provide subjective information. We met most of the participants personally before the study. The probes packages were accompanied with a letter explaining the aim of the study and the probes tasks with personal greetings. In response most of the diaries also ended with greetings.

The probes were returned to us prior the interviews for a first review which provided a starting point for a more reflective discussion. As we already knew about them and their life, and showed that we were interested in hearing more, the interviews were intensive and focused on personal issues and stories.

Supporting design empathy

"The design process needs to start with an understanding of the use situation" [7] In a process before the concept design the understanding can start with finding "the new eyes" to look at experiences [11]. We learned that it is not only the probes material that supports empathy but it grows during the process. In our case, as the designers of the client company were not involved in doing the study, it was important to build a dialogue with them to understand their interests and raise an expectation for the results. Their opinions were asked when designing the probes. When we got the probes back we invited the company representatives to

read and look the materials to get feedback what kind of issues they found interesting to focus in the interview.

The packages themselves with the interview produced visual and narrative data of the participants' world including what they do (photos), say (diary, interview) and make (ideal collages). [10]. Through the study each informant become vividly alive in attitudes, personality, motivations, and dreams. One company representative remarked as he was reading the original material, that the person could just as well have been right in front of him. The personal format and content of the diary complemented with the photographs was a powerful way of bringing the participant's way of life into the corporate meeting room.

DESIGNING THE MATERIAL FOR SHARING

How the material is to be communicated influences the choice and design of the probes. If needed the material should be designed in a way that it can be scanned and documented easily enough in its original format. When the probes are complemented with interviews or other methods, that data, e.g. photo album stories, should be easily combined with the probes.

With this type of user study, originality and credibility is the key quality in building empathy. Firstly, the probes kit materials are unique, handmade documents that communicate not only through the content, but also through handwriting, drawings, composition. The interviews are discussion about the materials, and there the most important qualities are the first person narration, language and vocabulary and then capturing all this and placing it in context with the original material. The same text handwritten and typed and printed out did not have the same empathic effect – the typed and printed matter was thought to be invented, not real.

The most preferred way for designers to have access to this kind of material is to put it on the wall or have it ready and available. If material is copied and distributed, the probes kit should be designed to support this and as much of the relevant originality should be retained.

CONCLUSIONS

Designers need both information and inspiration to be innovative, in that sense all the user data should not be cut up into small dry facts. [1] Analysing and digesting the empathic qualitative data into the design process needs time and effort, but at its best supports both communication, ideation and decision making. This way of doing user studies is also playful, flexible and easy to apply.

In this case the study provided empathic understanding of a segment of people. The personal stories and subjective descriptions supported a possibility of getting close to them and the originality was found to be an important factor in supporting credibility of the material. On the other hand the subjectivity brings another aspect: the data may be exaggerated or one sided.

The study was able to identify new perspectives for the client. After this study there are more defined questions to ask, situations and people to observe. In a concept design project the first challenge would have been achieved.

The opportunities of companies lie in the understanding of everyday life of people [13]. In this study an empathic user study approach was applied to document subjective user experiences in private contexts. The experience of the company was that they had received material to facilitate human centered design. The achieved empathy brought a new layer to their understanding of potential users and supported real product concept projects.

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Article 3

VÄINÖ – taking user centred steps with probes✖

Tuuli Mattelmäki

ABSTRACT

The probes approach can be used as a tool for collecting empathic material, both for inspiration and information, in a user centred concept design process. The case study was conducted in Väinö, a project, where different partners had a shared interest in learning about concept design and ageing people. The stories and illustrations gathered in the study were presented to support design teams common user understanding and insights for design empathy.

Keywords

probes/design empathy/experience/home context

INTRODUCTION

The ageing population is one of the potential topics of interest in several industry branches. A lot of data is available about the consequences of ageing and the requirements and needs of elderly people. But no matter how much scientific

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data the designers study, the individuals belonging to the user group may remain stereotypes. Or, the visions of the users are based only on the designers' own experiences. The danger with stereotypes is that they are not real people and ageing neighbours or relatives form a too narrow interpretation of the heterogeneous group of people. When working in teams, the design team must form a solid common understanding of these users.

One of the roles of user studies done prior to concept design is to probe for phenomena and opportunities. The aims include getting designers to learn to understand the people they are designing for, their motivations and actions and the context of these actions. Empathic approaches that create a holistic understanding about the users, support the design team in user centred design. Empathic user data includes also feelings and attitudes. Understanding what people feel helps the designer to empathise. (Sanders 2001) "Empathy takes beyond practical and behavioural to people's inner experience." (Black 1998).

The probes approach was first used as a design oriented tool to inspire the design of new technologies by Gaver et al. (1999). Hemmings et al (2001) argue that probes tools can also be used to gather ethnographic information, not only inspiration, from "socially sensitive settings". In the Väinö case study discussed in this paper the probes approach was used as a tool to gather empathic data, both inspirational material and information, from a group of ageing people for design interpretations.

VÄINÖ PROJECT

The Väinö project was organised by the Institute of Design Research, in Lahti area, during 2001–2002. The objective of the project was to apply user centred methods in concept creation for ageing people. The project gathered together several companies and communities to learn and experiment with user centred concept design process and consider issues related to the ageing population. Their interest was in the living habits and quality of life of the senior citizens and the possible business opportunities.

The project was carried out in several meetings and workshops, collecting partly changing team members from companies together. During the workshops participants learned about physiological issues, technological possibilities, usability and sociological facts related to ageing. The multidisciplinary team included people with various backgrounds e.g. engineers and architects from construction companies, furniture designers, marketing people from telecommunications, nurses from communal services and industrial designers.

As one part of the Väinö project, an empathic study was carried out to get subjective views from a group of ageing individuals. In this study, visual and play-

ful probes tools (Gaver et al. 1999), i.e. self-documentation packages, and complementing interviews were used to get a holistic understanding of nine people, aged from 59 to 82. The aim was to get close to these people to form a dialogue with them, but also to be able to represent them as real personas (see e.g. Cooper 2001) as well as different aspects of their home environment to the design team. The personas were presented to stimulate discussion, to widen the perspective of different actors in the team and to direct the interpretations for design.

The persons, their everyday life and lifestyles were documented and processed into textual reports and visual presentations. These representations of the personas were also used as tools to understand future visions and megatrends (see e.g. Jordan 2001) such as what would spiritualism or hedonism mean to this specific persona and how would it affect to her needs and expectations of different services. The booklets of probes material were brought to the workshops as well. The teams read the narratives and looked at the pictures to seek inspiration and to get insights. Also, team members "experienced it themselves" (Fulton Suri 2000) and tried out wheel chairs and different kind of prosthetic goggles and canes to build shared empathic connections to the ageing people. The concept design ideas were developed in the last phase of the project and they were presented through scenarios where the personas although projected to the future were easily recognisable.

PROBES STUDY

The name probes refers to a self-documentation package that contains different documenting assignments and reflective parts (see Gaver et al 1999, Mattelmäki and Batterbee 2002). The probes collects signals from the environment, situations, and subjective experiences from contexts where it would be difficult or even impossible for a researcher to be present. With the probes approach contextual and material aspects but also emotional and temporal issues can be documented.

The persons in the study were chosen to represent a certain age range and the way of life in three different situations: two lived in service housing, two lived alone with support from their relatives or from other service providers, and five lived independently. The aim was also to recruit people who lived in different kinds of apartments: four of them lived in houses and five in apartments.

Due to the interest of the different project partners the focus of the empathic study was wide: A telecommunication company was interested in understanding senior citizens in general and especially their communication with their family and other people. Housing companies wanted to gain understanding about needs, opportunities, and problems related to apartments. Among the objective of the

study was to identify how the participants live, how they take care of themselves, what are the things they value, and what is their way of life.

One of the starting points of probes approach is to make the self-documenting and reflection playful, motivating and easy for the participant. This is done by providing different ways of expression and also a possibility to select the tasks they feel relevant for them. Another probes principle is to leave space for unexpected views and interpretations by offering visual and projective assignments and open questions. In this case, a third point of view was in the need of transforming the data for the design team in an empathic way. This was done by communicating the material as originally as possible, with the photos taken by the participants, with the original handwriting, illustrations and drawings, and with the way of speaking and even the dialect in textual presentations.

In the first meeting a flower was offered to the participants to create a positive and respectful personal relationship. After the self-documenting period the package was pre-analysed to get an overview of the person and to create new questions for the interview. During the interviews, which took place in the homes, the probes material was looked through and some topics were more deeply discussed. Finally, the participants were asked to make a collage with pre-cut pictures and words to describe their "ideal place for ageing".

The items and assignments in the package were expected to collect material for the Väinö team such as opinions, feelings and memories as well as daily routines and actions. The participants were asked to photograph their favourite and most uncomfortable pieces of furniture, the best moment

FIGURE 1. The participants were given a package including illustrated cards with open questions, stickers and sticky notes, glue, camera with assignments for documenting their environment, and a booklet that contained a diary, open questions, mapping and drawing tasks. The package included a greeting card to be attached to a hallway mirror to make the participants remember the study.

FIGURE 2. Illustrations from accomplished probes.

of the day, where they would need help. They were asked to draw their apartment and a map of their social connections as well as verbally describe their bathroom and their telephone. The questions in the cards probed feelings of ageing, dreams related to living, their fears and shames, their opinions about happiness and good food.

PROBES SIGNALS

Because of the open and interpretative nature of the probes approach, it is not meaningful to specify the aim and result of each item in the package. In one package the person has covered the pages with expressive collages while the textual description of the everyday life routines is poor. In another package diary illustrates the daily actions of an active gentleman, while the photo and card assignments provide only little information. The probes are able to capture illustrated stories about individual characters in a personal way. The following examples illustrate some of the results gathered with the probes.

The photos provide visual material about the material context, which then stimulated narratives in the interview. Both the photos and diaries reflected relationships with artefacts. For instance photos of furniture illustrate many layers in people's homes. A non-usable chair can have emotional and aesthetic connotations relating to personal identity and memories. Often these ageing people have to consider moving into smaller apartments. They have to start thinking about giving up dear things. The fact of having to give up things was discussed a lot, both in probes and in interviews, although none of the open questions in probes was directly related to it. Having a manageable and ergonomic environment is only one part of designing for senior citizens.

The diaries and question cards reflected insights relating to the body and self-respect. These were also illustrated in photos and in the booklet. In many houses in Finland, the sauna and showers are situated in the basement, which creates problems for those who have difficulties in walking. The oldest lady in the sample thought, that she would probably be in a much worse condition without the

exercise that climbing the stairs provide. A bidet shower in toilet was found to support the ageing people in taking independently care of their daily personal hygiene and thus, maintaining a certain self-respect.

Shopping and preparing food was especially important to the women in the study, although also one man described his daily dishes and how he mastered his little kitchen (which was also photographed). Diaries and the card asking about good food, collected data about the way these people prepare food, eat and do shopping. Going out creates social occasions: "Shopping trips have become moments of celebration." Being able to choose and touch the ingredients creates appetite. A 70-year-old lady enjoyed baking and cooking. She explained in her diary how she had to take a nap in the middle of baking bread for a Christmas bazaar because of chest pain. Even a lady living in a service housing for dementia patients started to tell with bright eyes about her favourite recipe and what is the right pepper to use in the local stew.

Five of the persons were chosen to be presented more thoroughly in Väinö-project as reality based personas, because of their character or life situation. A 79-year old man had just moved into a service housing following the recent amputation of both legs. The oldest person, an independently living lady, remained active although she had several health problems. She took care of her grandson, house and the garden, cooked her own food and had no problem with microwave oven, videos, or remote controls. The 70-year old man was a strong-minded Internet enthusiast, who had recently renovated his apartment almost entirely by himself. As a contrast the 60-year old unemployed woman did not care about technology or devices at all. She enjoyed physical activities such as swimming, but described her-self as being peculiar and sleepy. The youngest person was a housewife who took care of her old mother living in the neighbourhood. Despite of a painful illness, she had an active social life with several hobbies and spiritual interests.

DISCUSSION

This study suggests that using an age range of 20 years to focus the user group is not fruitful in the context of senior citizen and home technology. Age is not the issue that matters, also other factors should be used. Subjective feelings of coping and staying independent are not related to the type of housing. The person living in service housing expressed that the self-respect is in being as independent in his daily tasks as possible. A person living alone in a house, finds that the cleaning service would interfere with her independence. Her attitude of staying active, the social contacts with neighbours and her relatives' weekly visits support her living at home.

Probes studies can be criticised for their broad and motivational focus and abstract nature of the concept design process. Some of the project partners expected to hear more practical suggestions to design for ageing population. Similar critiques towards the probes approach regarding fragmented information that is not concrete enough for product development decision making has been heard in other probes studies, too. In the study described here the aim was rather in creating a holistic picture of individuals and personal values than in usability or ergonomic problems related to ageing. The idea in this process was to create a motivational level of understanding before getting into the behavioural and activities.

Our experience suggests that visual and narrative material about individuals provided by probes and complimenting interviews can be used to transfer the user knowledge to the design team in an empathic way. The material supported the Väinö team in forming a common and empathic vision of the life of the ageing people. This common understanding also facilitated digesting statistical or theoretical material into the design process in a human centred way. Insights gained from the empathic study were compared with the team memebers' own experiences. During the project the team members talked about the presented personas, basing design ideas for the future concepts to their specific personalities and needs. Altogether, as expressed by one of the participants of the process: "The empathic study was good starting point, it went deep into the life of the elderly. And even in a small sample we can find how very different people, how very many different ways way of life and living there are."

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Article 4

Probes: Studying experiences for design empathy✖

Tuuli Mattelmäki

User experience takes place in physical, social and cultural contexts. Marketing and human factors data is often not adequate for designers to get a good empathic grasp of people in their dynamic contexts. Thus, also designers need to have a role in conducting user studies. When studying people for design, user data is processed through the designers' personal experience and interpretation. However, when moving from rational and practical issues to more subjective fields of experience, design empathy is needed. On the other hand, empathy, intuition, inspiration and subjective visions are ambiguous. They are something that the designers are supposed to master as innovative and sensitive professionals. Empathic design practice is about combining these subjective approaches with user data and other sources of objective information. [108]

The aim of empathic design studies is not to seek solutions for recognized problems, but rather to look for design opportunities as well as develop a holistic understanding of the users. Design empathy is not only information and facts but also inspiration and food for ideas. It requires a

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specific attitude and methods to support it. Design empathy calls for direct contact or connection between the users and the designers – studying potential cus-
144 tomers in their own context. [109]

However, for practical, ethical and economic reasons it is not always possible to observe peoples' everyday world. This chapter describes the Probes approach as an empathic tool. The probes are self-documentation packages for gathering data on people's actions and the contexts in which they take place. They also provide people with tools for reflecting and projecting their opinions and feelings for designers.

PROBES: STUDYING EXPERIENCES WITH SELF-DOCUMENTATION PACKAGES

Cultural Probes, introduced by Bill Gaver, Anthony Dunne and Elena Pacenti, [110] was an experimental design-oriented user study in the EU-funded project called *Presence*. The theme of the project was to design new media for elderly people. The word "probe" is associated with an automatic recording instrument sent out to capture signals and samples from places where human researchers cannot go. The probes in *Presence* were specially designed material packages that were given and sent to people in three different cultures. These packages were tools to gather inspiration and information on local cultures, people, environments and their relationships. The package included items such as a disposable camera for taking pictures, mapping tasks, postcards with questions, an album and a diary. Once completed, the tasks were sent back to the researchers and designers.

In *Presence*, the probes were described as a designerly approach to user studies. While making the *Cultural Probes* packages, the designers were able to process their own ideas and understanding of different places and people into the tasks and graphics in the probes package. The approach allowed the designers to include their own insights to the process, and still be open to participants' opinions. [111] The participants were also provided with means to verbalize and visualize their dreams and what they imagine, to look ahead with the designer. [112]

Stephan Wensveen's [113] probes study at the Technical University of Delft captured data about waking up experiences to design an emotionally sensitive alarm clock. This experiment indicates that this approach can be utilized also with people from near cultures. The probes enter private places and situations to document personal experiences in the original context in a multi-sensory fashion. Wensveen's playful and creative probes consisted of a diary, family tree exercise, disposable camera, an audio recorder and emotional advertising signals.

The probe proved to be a good tool to capture the experience of waking up. Its ingredients returned rich feedback from each individual, which helped to empathize with each person and gave a good feeling for the context in which they wake up. The results of some tasks provided more general information about people waking up, like the diary and the questions in them. Some were more inspirational like the task with the "parents" of the user's ideal clock. [114]

Our interest has been in gaining experience in using the probes approach in a context closer to the design industry. Unlike in *Presence*, where the designers themselves developed the *Cultural Probes*, we have worked between the participants of the case studies and the client companies. We did not want to send probes only to collect inspiring signals, but combined the probes approach with interviews and projective tools to get a more holistic understanding of the participants. Our emphasis was on using the probes package to allow the participants to collect data about their physical and social environments, life style, attitudes, dreams and experiences so that they could be discussed later in personal interviews.

To empathize with the user, we need not only a window into the user's life, but also an explanation of how he sees things in that window. In methodological terms, the probes approach can be divided into two main components: producing observations and interpretations. The first component of the approach is the probes package that documents the user's experience in the form of actions, thoughts, attitudes, dreams and moods in real physical, social and cultural contexts. The probes provide access not just to people's lives, but being visual and addressing multi-sensorial experiences, they are also useful for studying material aspects of people's lives and environments: objects, equipment, and their constellations in terms of colors and shapes.

The second component of the approach focuses on deepening the understanding and adjusting the direction of the interpretations. Interviews provide a possibility for discussing non-visible aspects of the user's life and getting deeper in interesting themes. Interviews can be complemented with projective tools such as collages, scenarios and cartoons to summarize thoughts about the design theme or to search for more subjective and emotional aspects of experience. [115]

PROBES CASE STUDIES

Our first experiment with probes concerned exercising and well being, and it was done in collaboration with the heart-rate monitor manufacturer Polar Electro (lat-

er *Polar*). The study was focused on non-athletes and non-users. The participants exercised for well being and enjoyment. [116]

The second study (*Väinö)* was done in collaboration with a group of Finnish companies. The partners were construction companies, a tele-operator and a furniture manufacturer, all of which were interested in senior citizens' living habits, quality of life and possible business opportunities. A probes study was done to provide empathic and subjective information about emotional issues, cultural attitudes, and practical needs and opportunities in the home environment, in addition to statistical data provided by other partners in the project.

The third study about nurses and transportation was a collaboration with Datex-Ohmeda (later *Datex*), a company that manufactures patient monitoring equipment for hospitals, and their design consultancy ED-design. In this study, the focus was on the very demanding working environment of nurses.

Finally, probes have been used in several student projects that have explored the possibilities of emotional approaches on usability and interaction design. [117]

DESIGNING THE PROBES

The primary aim of the probes package is to produce observations of the user's life in contexts in which experiences happen. The material the users provide with probes captures their world in their own terms and enables designers to utilize the users' subjective interpretations directly as a source of inspiration. When the designer's intuition works in the world created by the probes package, it is grounded in the users' self-understanding.

However, the probes approach goes beyond gathering information. In *Cultural Probes,* much effort was put into the finished look and design of the individual probes tasks. The designers wanted the material to reflect respect towards the elderly they studied. [118] The approach must also motivate the documentation

PICTURE 1. Probes package from VÄINÖ

and reflection by making the process fluent and playful. The probes materials are typically communicative, visually interesting and easily approachable, as well as specially directed for the users. The material can reflect the designer's view about the topics of the study and the design issues. Also, the package should be visual and designed so that it can be used easily in communicating the results of the study. The final aim is to activate the users to notice and think about their experiences. While having the material kit to document their life, people become attentive of their experiences and routines. When people are asked to verbalize their experiences they become more aware of them. [119]

Typically, a probes package contains a diary, camera, set of questions and tasks in the form of, e.g., cards and maps. More experiential items such as a dream recorder and a pinhole camera have also been a part of the package. [120] In more abstract terms, the packages typically consist of:

- Visual documenting elements (typically, a camera) that aim at documenting users' lives, their material and social environments, and the users' interpretations of them.
- diary that creates an understanding of how users' actions, routines, moods and thoughts situate in their everyday lives.
- Specific issues that can be probed with illustrated question cards, maps and task books. These tasks can also consist of open questions about opinions and attitudes ("What is your attitude towards technology," "what kind of a telephone do you have," or "mark on the map your routes in town during the study").
- Finally, there are "props" that are aimed at facilitating data gathering. For example, they instruct the user's self-documentation activities. As an example, we show how we have used "reminders."

Empathy has two directions: towards the participants of the study to create a respectful dialogue and towards the designer to support empathic understanding. The whole process of research with probes aims at supporting this dialogue between the users, and the design team. The probes package facilitates empathic understanding at several phases of the process (Figure 1).

(1) When designing the package, the researcher, designer and other team members are activated to find possible scenarios and experiences. [121] This phase is already a part of the design process. (2) The probes package captures the situational quality of experiences in the contexts in which they happen. It elicits the user's awareness to the elements of experiences and allows both documentation and self-expression. (3) When the team gets the package back for first overview, some ques-

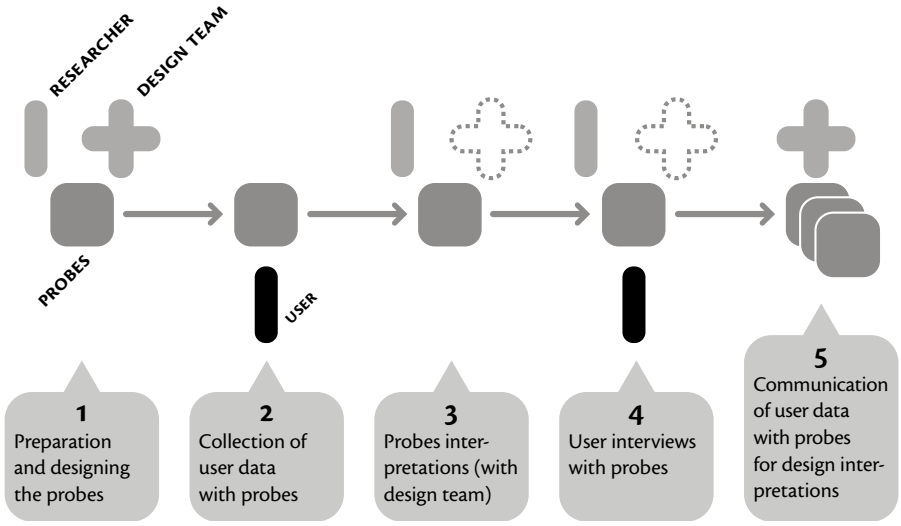

FIGURE 1. The phases of a probes study

tions are answered and new questions are produced. (4) The personal interview then complements the probes data. Data from the interview is added to the probes package. Components such as images and cards provide tangible tools for facilitating user-professional dialogue. Also, the data from the interviews can be added to the probes packages. (5) Finally, probes provide visual and narrative material that can be used to stimulate inspiration as well as supply information for designers and researchers. Probes provide tools for communicating user experiences to team members and other stakeholders. [122]

UNDERSTANDING USER EXPERIENCE: EXAMPLES OF COMPONENTS OF PROBES

Visualizing a User's Life with a Disposable Camera

Self-photography gives users an opportunity to document general and detailed information of themselves, their physical environment and lifestyles. The photos can illustrate, for example, their furniture or exercise equipment. When persons themselves take the pictures, the content and the framing of the picture is a subjective choice. The act of taking pictures and seeing the familiar environment through the camera lens stimulates the user to take a purposeful look and reflect on the assignments.

Pictures can be taken freely or according to given assignments. Our experience suggests that assignments, even open or abstract ones, are more useful. When the pictures are taken freely, the result might be a full roll of pictures of

lovely landscapes, while the designer is more interested in the use of sports gear. Assignments support the participants in using the camera in various contexts and the designers in getting more and relevant results. Some tasks for taking pictures can be documentative, aimed to illustrate life style ("Take a picture of the content of your refrigerator"), while other assignments can require more interpretation ("The best moment of the day" or "the most terrible piece of furniture"). The pictures taken by the users are developed before the interview. After the interview, the users' explanations and stories are added to the probes package.

Contextualizing Data with Diaries

Diaries are used to document everyday life, routines, thoughts and feelings. Diary designs can vary from blank booklets to ones with questions, illustrations, drawing tasks and stickers. People are to write down their feelings and thoughts as well as describe their daily activities and way of life.

People can be guided to write only task-focused actions with assignments such as "write down daily how many hours you exercise and your average heart rate." However, the task can also be given in a more open way ("Write about your daily life: actions, routines, moods and thoughts related to exercising and well being"). Such open-ended tasks support more holistic visions, but produce narratives that can be laborious to analyze, and which are largely outside the focus of the original design task. For example, a 82-year old woman described her Saturday evening by telling about warming her sauna, washing the stairs to the basement, watching TV in complete harmony about being alone, and both physically and mentally satisfied with the accomplishment. People can also tell personal issues about themselves, and thus open a subjective view into their lives with their personal way of expressing themselves. Some personal issues are easier to write than say aloud.

To assist the process of describing feelings, stickers with illustrations or words can provide help in projecting feelings and issues that do not verbalize easily. According to our experience, stickers inspired some people to make humorous and emotional remarks to illustrate issues in the diary. Easy-to-access illustrations make diary keeping more playful for the users, and more motivating and enjoyable for researchers and designers. Wensveen's experiences with stickers and written diaries facilitating the feeling of empathy are similar to ours. [123] The stickers can be little cartoon faces describing moods, or other small illustrations having to do with everyday life and the theme of the study.

Question Cards and Mapping Tasks

Illustrated cards with open questions can be used for gathering information about attitudes, opinions and other more focused issues. The card format was also used

in *Presence.* Cards make an appealing set of material and together with illustrations, the users' handwritten notes facilitate creating an empathic connection and interpretation between the participants and the designers.

The use of strong, ambiguous and contradicting images and objects arouse opinions and stories about attitudes. As an example, Ireland and Johnson describe a Barbie-doll dressed in army gear to provoke discussion on unisex products. [124] In another example, illustrated postcards were used as stimuli to make people talk about their experiences with mobile phones. [125] Pictures served as projective impulses into subjective memories and experiences, and facilitated storytelling.

In the Polar study [126] some questions on the cards about attitudes and facts were supported with factual images. For example, "Tell about your attitude towards technology" was illustrated with a picture of a computer, heart rate monitor and mobile phone. Other cards were related to experiences and emotions and had more provocative illustrations. For example, "How do you reward yourself" had a picture of pink sugar cakes on it. In the study about nurses and transportation, pictures were chosen to make tasks and questions attractive and stimulating in an environment with strict roles and responsibilities. The cards had five themes: personal issues, social environment, patient and transportation, technology and devices, and the physical environment.

Some of the tasks can be non-verbal for information about issues that are convenient to report in visual form. In *Väinö*, elderly people were asked to describe their social network and draw their routes in town during the study. In addition, questions that address moods, senses, including sounds and taste, can be easier to describe with pictures. In the *Datex case*, the cards with questions about the physical environment were collage tasks: "Choose pictures that illustrate the atmosphere in the hospital and tell more."

Props for Facilitating Data Gathering: "Reminders" as an Example

All the material in the probes package is not meant for documenting. There can be stimulators and visual reminders that remind and instruct the user about the study. The idea is that people do not necessarily carry the documenting equipment with them all the time, but with these reminders they can become more attentive of experiences that are interesting to designers. Thus, in *Väinö,* a visual reminder was attached to hallway mirrors to make the users remember their probes tasks. The users were also given a flower in the first meeting as a part of the probes package to create a positive attitude towards the study, and to remind them about it. In another example, a group of students asked people to wear a self-made amulet to make them aware of their experiences relevant to the study.

PICTURE 2. Cards: stimulating illustrations and open questions on the reverse side

INTERPRETING PROBES WITH INTERVIEWS AND COLLAGES

To make the probes data useful for design, it needs to be interpreted. In *Presence*, the probes materials were sent back to the researchers and designers directly. Researchers did not analyze data, but created coherent, gossipy stories of the participants in an effort to create an understanding of them. [127] Treated in this fashion, the users' world became a source of inspiration for the designers.

In our studies, we have added another step to the process. After the researcher or the design team has constructed a general understanding of the user and the elements from the returned probes packages, there is a personal interview. With this interview, we focus more deeply on probed issues. For instance, in the *Datex* case, we learned how wires and tubes are handled in hospitals. The subjective elements of experience revealed in probes were also discussed. For example, how aging affects one's ability to work at night. It is this understanding that makes our approach to probes an interpretive rather than an inspirational exercise.

An interview with the participants facilitated with the probes deepens the picture created based on the returned probes packages. In personal interviews, photographs can be looked through, reasons behind the choices can be heard, interesting details can be discussed further, and the stories relating to the material can be elicited. This is especially fruitful if the interview can be done in a real context. For example, in *Väinö*, we conducted the interviews in the people's homes. In *Datex*, interviews took place at hospitals.

When designing for user experience, designers need to focus not only on what people say (chiefly, diaries and interviews), and do (observations), but also on what they make. [128] Make-tools, such as collages, can help to get to dream-like associations and expectations and can enrich a probes study. Collages are quick and expressive. Pictures and texts give impulses to formulate ideas in a similar way stimulating cards described earlier.

In probes studies, collages provide a possibility of a quick and intuitive summary of the study. However, and equally importantly, it can also capture thoughts and associations that have not been mentioned previously in the study. People are asked to explain their impressions and ideas about the collage, and the meaning of not just the whole collage, but also individual pictures and associations.

Picture 3 is a collage by a 70-year old woman, who pictured the most important symbols of her past in it. The lower left corner describes a memory about Field Marshall Mannerheim, who was the president of Finland in the 1940s. Other pictures show other important aspects in her life including music and reading. From the probes and in the interview, she pictured herself as an independent woman, who enjoyed cooking and baking. The collage revealed another side of her cooking hobby: its social importance (top-left). In essence, her collage is an amalgam of symbolized feelings that represent key events and activities in her life. It would be impossible to understand these feelings without the interviews, or by inspecting the elements of the collage or the probes package alone.

PICTURE 3. Collage: an example

PROBES AS A DESIGN TOOL

Probes are tools for gaining access into the private and changing contexts of people's experiences. Self-documenting exercises, i.e., giving users diaries and cameras, are done in product development projects to look for perceptions and behavioral patterns. [129] In the first phase of concept design, the challenge is to find fruitful starting points and questions for framing the design task. [130] Probes are suitable tools for this fuzzy front-end phase of design. They help in mapping the network of related issues, and in creating a holistic and empathic picture of the user.

The probes approach is visual, and minimizes the designers' and researchers' presence. Often, it is the only viable research method. It is difficult to "plunge" into the users' kitchen or sauna for weeks at a time. Probes tools are designerly tools for creating a dialogue between users and designers. The users get means to document their life, stimuli to clarify their opinions, and both verbal and visual means to express their attitudes, experiences and feelings. The results do not provide design solutions, but create an empathic understanding of potential users. Equipped with this understanding, designers can still err, but it gives confidence in selecting directions in the future.

The probes could be developed into a more interactive dialogue using e-mail, Web-diaries, SMS and MMS messages or other mobile technology. This possibility would enable researchers and designers to react to data in real-time. It might also provide a possibility to combine probes with experience sampling methods. [131]

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Article

5

Observing and probing✖

Vesa Jääskö and Tuuli Mattelmäki

ABSTRACT

In this paper, we discuss and compare two user centred methods applied in concept design: observation and probes. The comparison is based on findings from two case studies. In these studies, user data was first inquired and then interpreted by a multidisciplinary design team, in order to support early user centered concept creation phase. The gathered user data and the current understanding of user experience served as a base for this reflection. In order to compare the findings, a framework of user experience qualities was generated from the point of view of concept design.

Categories and Subject Descriptors

A.0 [General]: Conference proceedings

General Terms

Design, Human Factors, Theory

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Keywords
Concept design, user-centered design, user experience, observation, Contextual Design, cultural probes, empathic design.

1. INTRODUCTION

Luotain – Design for user experience is an ongoing research project at the University of Art and Design Helsinki UIAH (http://smart.uiah.fi/luotain). The first objective of the project is to develop methodological tools to support user centred concept design in the context of product design. The second objective is to provide practical knowledge to broaden concept design activities in manufacturing companies as well as in industrial design concultancies.

Since last years, there has been a remarkable expansion in user centered design methodology. Only few years back, observation was regarded as the only technique to gather user information for empathic design [3]. We can witness now a variety of different approaches in techniques and methods, which have widened the whole notion of user experience. In order to develop methodology for user-centred concept design, a holistic picture of the issues related user experience has to be drawn.own material.

There are several models related to user experience [see 5, 6, 11, 12, 13, 14, 15, 17] However, these models seem to be on such a general level, that comparing them does not reveal practical, concept design oriented issues.

Our interest is to gain information about the differences of alternative user centered concept design techniques and compare how they are able to illustrate the qualities of user experience. In this paper we present a study in which a new framework of user experience qualities is used to compare two case studies with different user-centred design (UCD) approaches. The first case, which related to hospital laboratories, used observation [see 2] and the second case, which related to hospitals and patient transportation, applied the probes approach [8,15]. Our experience of applying the used methods are discussed and the first findings of the research project are introduces.

2. USER EXPERIENCE

User experience consists of a variety of aspects. In the following we go through relevant issues related to this phenomenon.

Desmet [5] talks about the role of a concern and its affect to product appraisal. "There are different types of concerns. Some are universal, such as concern for safety, for love or for self-esteem, some are abstract, such as concern for righteousness,

some more concrete, such as the concern of being home before dark". Concerns can be very personal, related to previous experiences or future preferences. All these have affect on the evoked emotion in person-product relationship.

Sanders [17,18] states that the moment when experience takes place is always woven into past memories, but also tightly coupled to the dreams of our imagination. She points out that these aspects which can be difficult to articulate verbally can be expressed through visual communication with tools such as collages.

In Battarbee`s and Mattelmäki´s [1] research, storytelling was regarded as a medium to reveal qualities of human product relationships that have developed over a long time span. In their stories people reveal many overlapping, life situation related and emotional meanings in their relationships with the products. Also, Forlizzi and Ford [6] point out the narrative character of meaningful user experience. Experience is dynamic. It changes and develops depending on time and context.

More directly industrial design and form giving related product qualities such as aesthetics and ergonomics have an impact on how user experience is formed. Also, usability forms one solid and useful framework when trying to understand the whole nature of user experience.

Jordan [13] has studied the experience of pleasure and how it influences product design. A product can reflect pleasure in relation to the users' or owners' self-image, social grouping, personal ideology and senses.

Consumer behaviour has a strong affect on new product development. Gabriel & Lang [7] point out consumer´s role as a seeker in choosing the right product based on personal motives. Product appraisal is always based on available product offer and the product novelty is regarded as a remarkable aspect when choosing the product.

Nieminen-Sundell [16] has conducted several years ongoing studies of how new technology penetrates and finds its place in the household. The products seem to fight their place in the home environment similar to flora and fauna in the nature. This phenomenon is relevant when concepting new product categories, which are replacing old technology or overlapping with current products in features and benefit they provide.

In concept design, the designers need to comprehend previously unfamiliar or complex phenomena of human activity. This can be achieved by utilizing variety of complimentary methods, and drawing an overview before going into more detailed aspects. To give an example, in the ELDER project, reported by Hirsch et al. [9], the purpose was to understand the experiences of elders and their caregivers in order to identify new product and technology opportunities. Since the brief was open and aim was to create a rich description of the eldercare experience, different re-

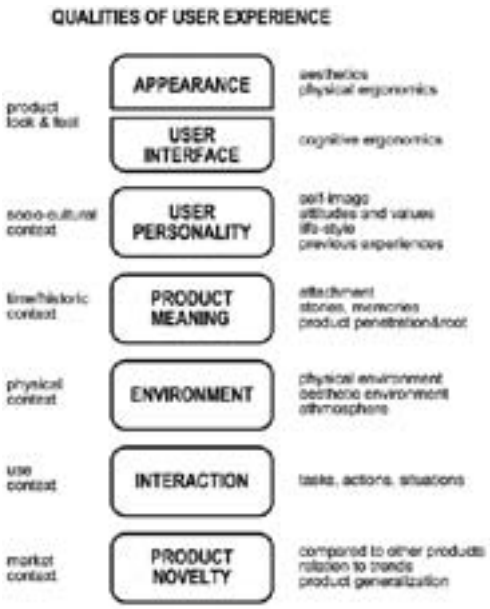

FIGURE 1. Framework of qualities related to user experience.

search techniques were applied. These included techniques revealing general user information; e.g. literature reviews about cultural and social issues and qualitative techniques such as lifestyle interviews, self-documentation and observations.

Based on activity theory, Kankainen [14] has pointed out two principally different levels of user need: the motivation level and the action level. This remark is particularly relevant in new product concept development, when it is crucial to understand what the user would possibly do with a new system and what would be the driving motivation. In other words you have to first be able to recognize the issues that are relevant to the intended user and that affect on identifying the appropriate attributes and qualities for the product concept. After that it is possible to get deeper into the functional and interactional level of the concept development. Kankainen sees a clear difference between techniques, which reveal aspects on motivation and action level.

As the presented issues show, the notion of user experience is wide and can be examined from many different angles. There are different layers of experiences, which may be studied and measured directly such as usability or ergonomics. More tacit and hidden aspects such as product meaning or personal motivation have influence in the user experience but are not that easily recognized or communicated to design, or even directly affected by design. Some areas are traditionally covered by different disciplines, such as product design (e.g. appearance and aesthetics), user interface design (product functionality and interactivity) or engineering and marketing (e.g. product definition and positioning in the market).

3. FRAMEWORK OF USER EXPERIENCE

The notion of user experience is essential in user centredness and needs more clarification. Since the objectives of the Luotain research project are rather practical, we feel that the available models or frameworks, such as in the research areas presented earlier, are not alone useful enough. They enlighten the issue in a general level or focus only on some aspects of the user experience.

In our framework of qualities of user experience, presented below (figure 1), we have combined most of the relevant aspects that have an impact on the human–product relationship in product concept design.

The qualities are divided into two groups; directly product related qualities (appearance, user interface) and different contextual qualities, which have an affect on the human–product relationship. We see that the framework can be used for several purposes. First of all, it is useful in understanding and articulating the different aspects of the phenomenon as a whole. Secondly, it can be used as a tool to make sense of what type of user data exists and to compare what type of data different techniques can reveal. For instance, the framework indicates that contextual information is in an important role when totally new concepts are developed. This is useful information, when a design concultancy is developing their user centred design services.

The doubts regarding the framework are related to our future research – how it can be applied to indicate the dynamics of user experience and weather it is, again, too general or theoretical to be applied in product design contexts. For instance, in reality the qualities of user experience are mixed and not that clearly distinguished as presented in the framework.

4. THE CASE STUDIES AND APPLIED UCD METHODS

The case studies carried out in laboratory and hospital environment were related, at least indirectly, to new product concept development cases, where our role was to introduce and observe the utilization of different user-centered concept design methods. This study focuses on the first phases of each cases including the user information gathering and the data interpretation phases, where the gathered user data was transformed into a useful format such as interpreted observation notes, work models and user descriptions.

The starting points of the two cases were partly different but the context was considered similar enough for a relevant comparison. In both, the context of the work in hospital and laboratory environment is quite similar. The users are professionals who handle rather complex technical devices at work. The work requires concentration and carefulness, since it can have severe effects on the

patients´ treatment. Because the equipment is not personal the aspects of user experience, which are relevant in consumer products such as purchasing and owning, are not so visible. In the hospital case, the aim of the data gathering was more open than in the laboratory case, where observations were mainly targeted around the existing product. Also, the applied methods, observation and probes were thought to reveal different spectrums of the user experience.

5. CASE: CONTEXTUAL DESIGN IN LABORATORY EQUIPMENT CONCEPT DEVELOPMENT

Thermo Clinical Labsystems develops, manufactures and markets systems for laboratory automation and clinical chemistry analyzers for routine and special testing in hospitals and private laboratories. The company had no previous experience in systematic user research activity. Nevertheless, the company has been able to create successful products with good usability and award-winning industrial design. User information has been collected informally through visits to and in collaboration with laboratories, and through marketing, maintenance and educational channels of the company.

The company and their industrial design consultancy joined the research project when their next generation analyzer development was under planning phase. The purpose was to gather in-depth data. Contextual Design, later CD [2] was chosen as the methodological approach. It relies on user observation and has been reported to be a successful method in system development projects, similar to our case. Five observation sessions where organized in hospital laboratories of different sizes and operational focuses in Helsinki region.

Observations were conducted by the product development team, which was responsible for the concept creation. The team consisted of a software engineer, a software designer, mechanical and electrical engineers, marketing personnel and an industrial designer. The field interviews were carried out in groups of two to five persons. The gathered data was interpreted in sessions held after the field interviews. In the interparetation sessions the gathered data was transformed to work models and written notees, as described in CD.

5.1 Findings

In CD, it is required that the gathered data is based on actual, observed work. This makes the data precise and valid. However, some aspects of user experience can be difficult to reach through observation. During the inquiry, observation occasionally turned into an interview, because we could not see all types of work we were expecting to see. For instance, the number of laboratory tests during a par-

ticular day was less than average, certain expected procedures did not occur, etc. Since the limited time available for the project, optional arrangements concerning these missed issues were not carried out.

Issues such as comfort, personal opinions about work, equipment as well as satisfaction, learning, organizational pressure and policies were discussed. Aspects related to the laboratory quality system, one of the major aspects documented into the cultural model, could be fully understood only after conversations with laboratory personnel.

Some of the work models seemed to be easier to adapt and use. The flow and physical models were easily understood and easily created. The idea of the cultural model was regarded slightly vague. It was also felt that sufficent data for that model was possibly not collected during the inquiry. However, also this model was created in interpretation sessions, although not as described in CD. Also, the sequence models were created but not as articulated as in CD. Artifacts were photographed and walked through in the sessions but not developed to models, as described in CD.

In order to create as detailed models as described in CD, the participants have to be quite familiar with them. However, models were regarded very useful. Through different model building the gathered data was interpreted with different perspectives. Through this type of processing, highly articulated information of different qualities of user experience can be revealed.

The available time for an interpretation session seems to be a critical factor. Half a day was reserved for one interpretation session. Performing all the steps, including interview walkthrough, work model building and notes creation, is an exhausting and time consuming task. Some of the "difficult" models were not finalized simply because of time and the group energy running out.

Bossen [4] has reported similar findings related to the CD process in practice, especially related to need of flexibility in the method tool-kit. In the case he describes, the company had hired a person familiar with the observed work domain. By describing the central concept of the observed phenomenon and listing the related acts prior the interview supported the interviewers in focusing on the

FIGURE 2. Observation and interpretation

relevant aspects. It was helpful to have an overview on the issues that should be covered. Walkthroughs of previous information, models or lists of the laboratory procedures could have helped us also to more clearly focus on the relevant topics, already from the start.

6. CASE: PROBES IN HOSPITALS

Instrumentarium Corp. Datex-Ohmeda division develops and manufactures patient monitoring instruments for hospitals. The context of use is challenging for user studies. UCD methods such as usability testing and observations in hospitals are an established part of the company's product development process.

The starting points for the case were the need to develop the concept design process, learn new tools and the need to create a new, more subjective layer to the present user understanding. The user study was not directly connected to a design project. The main interests of the case were:

- To gain empathic understanding, pictures and narratives of nurses and their work, different work situations, environments, experiences, social aspects, personal values and expectations
- To gather data documented and interpreted by nurses to seek opportunities and problems related to patient transportation.
- To get experience on probes approach in professional work context

Datex-Ohmeda applied the probes approach for the first time in this study [See 8,15]. It was chosen because of its expected suitability in a project where the design focus was open and the aim was to gather inspirational, visual and empathic data for new concept creation. The idea was to get data from "sensitive settings" [Hemmings], situations and places where designers have no access or the access can only be temporary.

As probes had previously been used in home and leisure context but not before in professional settings, there were some doubts. The playfulness, openness and inspirational quality of the probes were regarded as risks. Also, hospital administrators were not sure how self-documenting in hospitals would affect the nurses ability to concentrate on the care of their patients.

The probes packages included diaries, cameras and illustrated cards with open questions and tasks. They were developed in collaboration with UIAH, Datex-Ohmeda and their design consultant. The purpose of these packages was to document routines and actions as well as to support observing and expressing thoughts, expectations and needs related to different situations.

FIGURE 3. A probes task and interpretations in an interview

Six nurses were given a probes package for approximately five workdays. After accomplishing the documenting period, the nurses were invited to an interview where the probes material was discussed. Finally, they were asked to make a collage of an ideal transportation experience from pre-cut pictures and words, and explain it.

6.1 Findings

In this case, the diaries illuminated fragments of experiences during the shifts, such as interaction with patient's relatives, tiredness at nights, therapy with co-workers over a cup of coffee and surgeon's radio channel preferences. They did not provide as much material about transportation as expected, because during action the nurses were not able to make notes. They described, however, in the diaries or in the interviews, their own actions and feelings in some of those situations.

The answers in the question cards provided opinions and short narratives. All the nurses did not accomplish the projective tasks in the probes package, e.g. choose pictures that illustrate hospital atmosphere. The ones who did, made a visual narrative of the asked themes. The self-documenting tasks in the probes packages should allow different means of personal expression.

The interviews complemented the self-documenting by providing a possibility to discuss some issues more deeply and to document the nurses' own interpretations to some of the probes assignments such as photos. The collages with their explanations illustrated the transportation process in a visual and humorous way and also suggested some possible guidelines for future designs.

The photos visualized the hospital context, co-workers, the equipment from nurses' point of view and illustrate places and situations where possibilities for designers' presence are limited. However, the scenes to the contexts were quite shallow without having explanations of the meanings of the photos.

After the user study phase, the data was categorized into groups including individual motivations, teamwork and transportation. Discussing the interpretations brought analogies and insights, such as the nurses' underlined attitude of

separating "work and life". These categories did not bring as many new views as was hoped for, possibly because the categorizing people had been involved in some stages of the user study and were too familiar with the data.

In probes approach, although most of the documenting is done by the users, time and resources are required for e.g. designing the probes packages, recruiting users (and in hospital context, getting them permissions to participate), pre-analyzing, organizing personal interviews, transcribing the interviews, categorizing, sorting and communicating the results. Time is often a critical factor in company context. In that sense, the approach requires guidelines for streamlining.

Time and engagement is, however, needed for creating a personal dialogue with the users and an empathic, user centred attitude. This attitude and the ambiguity of the probes material make an objective interpretation difficult, even though, the focus of the probes approach is not in objective results.

The probes packages with the complementing interviews provides authentic environment descriptions, user profiles and use scenarios with wealth of visual material that makes the descriptions more memorable. The results consist of fragmented illustrations and narratives. To fill in the missing information requires either skills in storytelling and imagining or more focused approaches depending of the aims of the project.

7. RESULTS

Gathered user data of the case projects was reviewed according to the developed user experience framework (Figure 4).

The reviewed data, in case of observation, included the interpreted work models and affinity diagram. In Probes case, the reviewed data included probes packages, transcribed interviews and collages.

Observation is a useful technique in tracking different contextual data such as work flows, sequences of actions, the physical environment, ergonomic and usability issues as well as interaction between persons and products. A review of the notes and models created during the CD interpretation sessions showed that the most of the data was related to issues such as users´actions, the steps of the procedures, functional issues related to product handling and interactions with the analyzer. Issues related to the personal aspects of users where barely revealed. They were discussed during the inquiry, but for some reason they were not noted. It also seems that the work models in which data is interpreted do not encourage this type of examination.

This does not mean that observation is not a useful technique when studying issues related to personal aspects or market context, which were not present in

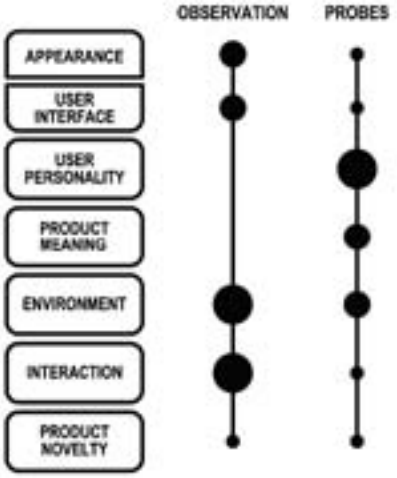

FIGURE 4. Qualities of user experiences reached in two case studies. The size of the circle refers to the amount of data gathered.

the data either. According to our findings, the focus of the user study determines very much what type of data will be gathered. Also, as the CD case indicates, the manner in which the data is interpreted (e.g. through specific work models) has a strong affect on what type of results will be achieved. For instance, models revealing issues of users' personality in socio-cultural context, as well as models related to product placement from market point of view, could be developed in order to widen the perspective.

The probes and the observation techniques can be regarded as complimentary methods in the user centered design process. The probes approach covers various aspects of user experience. It may bring out issues that cannot be seen or revealed through observation or in an interview setup.

"Discovering what people know helps us to communicate with them. Understanding what they feel gives us the ability to empathize with them." [17] Probes could be used as a technique to draw the big picture before setting the focus for the more detailed observations. This interpretation was shared with a member of the Datex-Ohmeda project team, who had previous experience of observations. To gain detail level data from observation, you have to be familiar with the studied phenomenon.

The probes material was useful when nurses' subjective thoughts, motivations and feelings related to work situations were reviewed and discussed. Processing that material further into the textual categorization did not bring as many new insights as expected. On the contrary, it seemed to flatten the vividness of the user data. The probes packages, complemented with quotes from the interviews, communicate user data quite well. While in observations the collected raw data has to be further processed to make sense. In the probes approach, the presented

framework or the models used in CD could facilitate a more structured interpretation of the rich data.

166 Usefulness of the visual material, such as illustrations, photos and collages, is evident. Both the persons taking part of the user study and the researchers interpreting the findings benefit from them. This supports the idea that multisensory stimuli, which allow analogies, associations and multiple interpretations can enhance the results.

8. ACKNOWLEDGMENTS

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Article

6

Mobile probes✖

Sami Hulkko, Tuuli Mattelmäki, Katja Virtanen and Turkka Keinonen

ABSTRACT

This paper describes a new digital user study tool called Mobile Probes. Mobile Probes arose from a need to develop contextual and dynamic self-documenting tools for studying people's actions in mobile contexts. The technology used in the pilot study was based on dual band mobile phones with GPRS connections and an external accessory digital camera. A system was also developed for sharing and sorting the data. The system was implemented with Java software to enable the device to send and receive data, and PHP scripting to send and edit the questions and to view the answers through a dynamic web server. Another pilot study was conducted with a flexible platform that operates a spatio-temporal mobile log. The results of the studies show that Mobile Probes are a promising way to conduct user studies. Ideas for future development of the tool are discussed.

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User-centered concept design; User Studies; Mobile devices; Digital ethnography;
170 Cultural Probes, Self-documenting; Shopping; Mobile work

ACM Classification Keywords
H.5.2. User interfaces, user-centered design

INTRODUCTION

The Cultural Probes study [7] has initiated a variety of ways to apply self-documentation in user studies for the design of interactive products and systems. Self-documenting tools and projective tasks have been used in design ethnography and in field studies of sociology and psychology. This paper first presents an introduction to the self-documenting tools including examples of probes studies. Secondly, two user studies, in which digital mobile probes were used, are described. Finally, the experiences of these digital self-documenting pilots are presented and directions for future development are discussed.

Diaries

In diary studies the subjects are given diaries to document their feelings or activities during a certain period. De Longis et al. [6] state that when several events become documented, a more credible and solid description of the person can be attained than e.g. from only one observed situation. Diaries are also claimed to reduce the retrospective reflection and to gather more contextual data in comparison to interviews, where situations are mostly memorized. The richness of the data can be seen as an advantage of the diary method. The challenge, however, lies in motivating the users and in the analysis of the open and subjective entries [19].

Diaries are used in design ethnography to capture activities in context, to understand needs and motivations related to the use of technology and to gather user requirements for design [see 19]. Having to reflect and write into diaries can cause sensitization to the documented issues [6]. In design related diary studies this heightened sensitivity to specific actions and environments can be a positive effect. Diaries can help people to notice and to understand their everyday experiences and so become more prepared to discuss them in interviews and create ideas in participatory design workshops [20].

Self-photography

Similar to the diary method, self-photography has been used in various disciplines. In social sciences it is one possible technique for field observations. The subjects are given cameras and asked to take photographs either with or without

specific assignments. In self-photography the observed has thus the control and "the understanding begins with the view through the eyes of the observed" [23].

In design ethnography self-photography can have several roles: first of all the photographs illustrate the users' perspective on their world. Secondly, they can be used as a tool to facilitate other approaches such as interviews and participatory workshops [2,10,23]. Thirdly, photographs are a rich and visual way to support communicating user study results to designers and other stake holders [1].

In a study reported by Brown et al [2] self-photography was used in a diary-like manner to document activities visually. The users were given digital cameras to photograph thoughts and activities related to information capture. The advantage of using this method was in gathering data during action. The photographs were also applied as props in the interview that followed the documenting period. The users found photographing easy and less laborious than writing notes in diaries.

Projective tools

Collages and other projective tools have their roots in psychology. In user studies projective tools aim at stimulating associations in order to discover users' needs, values, feelings and dreams for the starting points of design. Collages are often a collection of pictures and sometimes also words, both abstract and concrete, which aim to convey an expressive message. In user studies they are used to study issues that relate to e.g. senses or abstract experiences. The results are visualized associations that can aim to support design inspiration and understanding. [18,20,21]

Liz Sanders is one of the pioneers of using projective tools systematically in design studies. Make-tools aim at gathering data from people about issues that are not easy to verbalize. The tools support the users to express themselves and reveal sensitive and irrational but relevant thoughts by providing metaphors and associations [20].

Experience sampling method

Experience sampling method (ESM) is used to study the quality of subjective experience [5,19]. To conduct a study, users are given electronic paging devices. The device alarms randomly asking users to write down quickly what they are doing or how they feel based on the given questions or claims. In user-centered design ESM has been applied to identify and rank user needs and preferences of architectural redesign of home environments [11]. In the study, images or short videos were captured automatically when something was happening in the studied room. The users were able to browse and comment the images when it was convenient for them. The redesign of the home was guided by the samples of the real activities and also feedback in the actual context.

Probes

The core of the probes approach is to give people (possible future users) tools to document, reflect on and express their thoughts on environments and actions. One of the aims of the approach is to create a communication link between the users and the designers, and to inform and inspire the design team.

The Cultural Probes and Domestic Probes [7,8,9] applied an artistic, inventive and aesthetically pleasing user study approach. The designer-researcher teams' purpose was to investigate aspects of people's lives and to create narratives which stimulate and inspire the concept design of provocative interactive devices and systems.

The Residential Probes study [4,9] emphasized design ethnographic orientation and information gathering rather than inspiration probing. They were used in "sensitive settings", such as in a hostel for former psychiatric patients, where other user study methods than probes were considered disturbing. The aim with these probes was to inform the researchers. They study complimented other design ethnography methods in a research project context. The probes thus facilitated understanding the needs of differently-abled people.

Technology probes [10] were technical applications which enabled being in contact with remote family members. The aims of the technology probes were divided into three different areas: a) to gather information about the users and the use of technology in a real context, b) to field test technology, and c) to inspire designers and users to think about new uses of technology and reflect about their everyday activities in new ways. The results gave insights into the practical needs and more playful desires but also provided real-life use descriptions.

At the University of Art and Design Helsinki several probes studies have been conducted in collaboration with companies. In these studies the main area of interest has been in gathering visual and narrative user material with a wide perspective for concept design. Creating an empathic dialogue between the study participants and the company designers has also been important. The focus of the studies has taken the use of the probes tools from the home to nurses' work context and further to mobile contexts such as exercising and free ride skiing. [12,13,17,18]

The objective of mobile probes

Masten and Plowman [16] vision digital ethnography as a new approach full of opportunities. The traditional design ethnography tools are updated with the possibilities of new technology. PDAs, emails, mobile phones, pagers, and digital cameras are used to gather user data and servers and computer systems to sort and share the data. Among the advantages are the possibilities to remotely and

simultaneously observe several users, to automatize the sorting of the data and to create digital user databases for the stakeholders. Furthermore, users can become more active contributors instead of being only passive sources of data.

One of the challenges with probes studies has been to motivate people to complete the probes tasks in mobile contexts. This is necessary, because many of the interactive devices designed today are becoming mobile and their use is influenced by their changing contexts. According to our experience, the probes seem to work often in a retrospective mode, i.e. people tend to document their behavior only after the action is over and they are back at home. A retrospective component in probes studies is completely acceptable and worth recording. However, the fresh sense of context and action that might be captured with probes when applied real-time is obviously lost when this happens. Therefore, we have been interested in developing more contextual interactive probing tools.

Another challenge with probes has been the interpretation and sharing of collected material in projects where companies are involved. The original rich and visual material often needs to be digitized afterwards for storing, sharing, and presentation purposes. This can require a considerable amount of work. To solve the problems of 1) variable context while recording and 2) flexibility in the probes analysis phase, we have experimented with digital mobile probes in two cases. This paper presents these two pilot studies using mobile interactive probes with case Shopping and case Mobile Work, and discusses the results as well as the possibilities for development.

CASE SHOPPING

The first mobile probes pilot study was part of a collaborative research and development project including two universities, several clothing industry companies and a department stores chain. The aim of the project was to create a new kind of sales point for clothing retailers. This aim was based on a vision of a sales point incorporating new technologies such as virtual mirrors, automatic body measurements and wall displays, which provided a wide range of possibilities for concept design. These kinds of solutions already exist in some form, for instance at Prada's flag ship store in New York [15].

A user study was conducted before the concept development phase to ensure a user-centered design perspective, which was a fresh view point to the companies involved. Two user segments were identified for the study from earlier quantitative market research: Frequent Shoppers and Efficient Shoppers. The companies knew their buying habits but the shopping and decision making behavior on an individual level was not clear or well known. Sales personnel were also seen as

an essential user group for the success of the future sales point concept and they were included as a third group for the research. The mobile probes study was carried out with frequent buyers and sales personnel.

The probes approach was chosen as a method to cover a broad area of issues related to shopping, such as subjective preferences, social considerations and pleasure. The idea was to be able to document people's habits and thoughts related to shopping for clothes. Shopping behavior is mobile, as people tend to move around inside the shops and from one store to another to browse the alternatives. The challenge was to make people document their thoughts, feelings and actions while they are on the move.

Typically the basic probes packages include a theme diary and a disposable camera. The digital equipment included a mobile phone with digital accessory camera and a Java applet running on the terminal with tasks and questions for self-documentation.

Testing Environment

The self-documenting started with an introduction meeting where the study was explained and users were instructed on how to use the mobile probes system on the device. The self-documenting period, which lasted for two weeks, was divided into two phases. First, the participants were asked to document their daily life as it related to clothes and shopping and to answer questions with text and images. The second week's tasks focused on the shopping experience and the participants were asked to answer the presented questions while shopping. The participants were encouraged to continue the first week's self-documentation during the second week as well. After the two-week period the participants were interviewed. In this semi-structured interview all the answers and images taken with the device were discussed.

With the sales personnel the self-documenting period lasted for one week. It also started with an introduction meeting. After this the personnel self-documented their daily work with the device. Also the shop personnel were interviewed after the self-documenting period.

During the self-documenting period the researchers, together with the companies involved, were able to see raw data accumulating onto the server's database via a web page.

Technology

The mobile terminal used for the shopping probes was Nokia 7210 dual band mobile phone, which supports GPRS data streams for fast internet connections and Java technology for third party software. It has a 128 by 128 pixel color dis-

FIGURE 1. Nokia 7210 phone and external digital camera

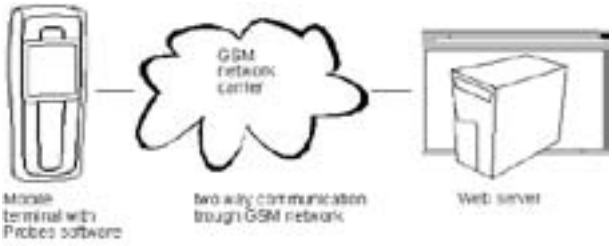

FIGURE 2. Technology Platform

play. The user can attach an external digital camera onto the device that will save captured pictures to the device's memory. There is enough memory for 50–100 images on the device, depending on the image quality. The mobile phone supports Java MIDP 1.0 programs with the maximum size of 64Kb. The size of the program limits the possibilities of software functionality. On a mobile network, there are different methods to connect into the Internet. The Mobile probes used the most recent one , a GPRS connection that provides a 48 Kbps data stream, which is sufficient for text and image data transferred between the mobile terminal and the server.

The phone ran a Java application, which probed the participants with questions and assignments, and sent the answers to the server. It was developed with Sun Microsystems Java 2.0ME (MIDP 1.0) [12]. The Java 2.0ME platform provides functionality to communicate with an internet connected web server through GSM/GPRS networks. Communication between the terminal and the server was based on the html method of GET/POST data communication.

The backbone of the system was an online Linux server with PHP scripting language support [26]. PHP can be used to create dynamic web pages that are constructed on the server and then sent to the user's web browser. This way all data can be separated from its presentation. All the probes questions and user-submitted answers were stored in a SQL database. A basic user interface for formatting the questions and viewing the users' answers was developed with PHP. With the system, the researchers could edit the questions even during the on-going self-documenting period. Answers from the users were collected into the database from were they were presented to the researcher and other persons involved by a dynamic web page.

User Interface

The Nokia 7210 device limits the size of the Java MIDlet to 64 Kb. Due to this limitation the user interface and communication with the back end cannot be very sophisticated. Early ideas included graphic intensive user interfaces and multiple question types with related images. This approach was hampered by the devices memory limitation and a practical approach of a hierarchical navigation structure was developed.

The structure of the user interface was divided into different categories depending on the studied subject:

- For sales personnel it included categories
1. Daily diary with repeating question
2. Daily updated question
3. Instructions for picture taking tasks

- Furthermore, for the shoppers
4. Questions to be answered while shopping

When the user selected one of these categories, the phone's software would make a connection to the server over the GSM network and fetch the corresponding question for the user. The user then had two options, either to return to the main menu or continue to the answering screen. In the answering screen the user could type in the answer and send it to the server.

In the image taking assignments menu the users could only see questions that would direct to the picture taking process. After this they were instructed to close the Java application and take the picture. Pictures were not sent but returned with the device after the research period because the java MIDP version 1.0 which runs on the Nokia 7210 doesn't support picture taking capabilities and the sending of

FIGURE 3. User interface

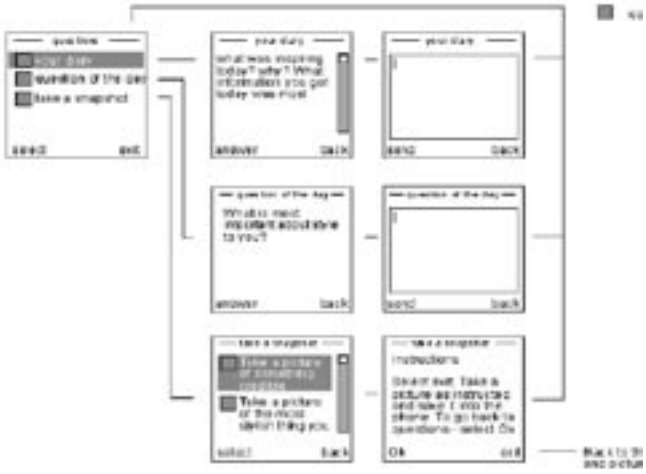

FIGURE 4. The 'best shop in town' according to one shopper

files over GSM from Java applications. However, there are currently devices on the market that can do this.

Results of the study

The first mobile probes pilot produced in total 101 images and 150 text replies from the 13 participants. The five shoppers provided 30 pictures and 101 text replies. The relatively low number of images can be explained by the fact that the use of the external camera is not very practical and the quality of pictures taken indoors is poor. Also, taking pictures insides shops is often forbidden.

Mobile probes proved to be complicated with the sales personnel who participated into the study. In sales work, the use of a mobile device can be seen as extremely rude by the customers. When interviewed the personnel gave this as the main reason for their low reply frequency. The shop personnel did not answer as many questions and the answers were mostly written before or after the working day as some of the personnel stated in their interviews. None of the images featured customers. This suggests that they were taken before or after working hours.

Thus, the context awareness of the system was not evident. Some of the answers were not related directly to shopping habits but did explain subjective values and opinions around clothing and shopping. Only some of the replies indicate by referring to the context that the answers were created in a mobile situation.

"Oh, now it's so that I just came from the bar so stories are on that level. Observations: the present fashion of 'sausage skin' shirts and the modern women's body structure with sausage on the waist line is not a good match"

Images included some pictures of shops but only from the outside. The pictures concentrated on the clothing itself as well as on the persons and their social situations.

Designers started to participate in the project during the analysis of the collected material. They stated that the mobile probes replies complemented with

the data from the interviews helped to explain the social behavior surrounding shopping. For example shopping in groups was presumed to happen but its full implications were unfamiliar to the designers.

The interpreted material helped the concept creation process. According to the designers, the probes study would have been more useful if they had been involved in the probes study from the beginning. This way the collected material would have been easier to understand and its use would have been more efficient during the concept creation process. As a continuation, one of the designers conducted another probes study focusing on shopping experiences.

CASE MOBILE WORK

The Mobile Work case was a research project, which focused on enabling mobile work through developing mass customized products, services and applications with seven participating companies. The main research challenge of creating a model that enhances the productivity of work by supporting individual user needs in a sustainable way is still in progress.

The user study was divided into three phases. First, in each company a focus group interview was conducted to form an understanding of mobile work cultures in the companies and to identify the main themes related to mobile work. Secondly, a one-week self-documenting phase was carried out to gain understanding of mobile workers' individual experiences. The research questions were based on five main themes, which were identified in the focus groups. The third phase included participatory workshops where the gathered data was sorted and interpreted together with the users, researchers and company participants.

The self-documenting tool, which was developed for the project, was influenced by the mobile probes shopping case, and the Experience Sampling method [5]. The exploratory and open-ended probes approach was chosen, similarly to the mobile probes pilot, to cover the extensive area of mobile work, such as present physical, social, psychological and ideological issues, as well as visions for a better enabled mobile work and life style. The Experience sampling method's influence on pre-structured themes supported the aim to study patterns and intervals of activities and related experiences. The five tasks and questions which were sent to the users daily during one week were categorized according to the pre-structured themes.

Technology

The technology used in the mobile work case was different from the one used in the shopping case. Tasks and questions were sent as text messages (SMS) to

the users' mobile phones. The users sent their answers with their mobile phones equipped with digital cameras to a dynamic web page. The web page was a mobile platform on the Internet that was originally developed for another project to communicate context-awareness, mobile experience, and its narrative potential [24]. Thus, the platform was applied here for the user study purposes. The user data consisted mainly of multimedia messages (MMS), but e-mail and text messages (SMS) were also submitted.

Interpretation and sharing of the data

After the data gathering phase, interpretation workshops were organized to analyze the material. Before the workshops, users and company participants were able to familiarize themselves with the 277 messages and 225 images in the web page. The messages were categorized by the users and by the questions

The web page system allowed messages to be printed out in a card-like format with a user, time and question tag (see Figure 5). In the workshop the users made a collage of their individual mobile work experience from the printouts. The individual collages were further interpreted in small groups to define the main components of mobile work experience. The collages and company-specific focus group reports were further elaborated to create mobile worker profiles and multi-level requirements to develop solutions for mobile work.

FIGURE 5. A context-related message sent by a user tells about typical mobile worker's everyday problems.

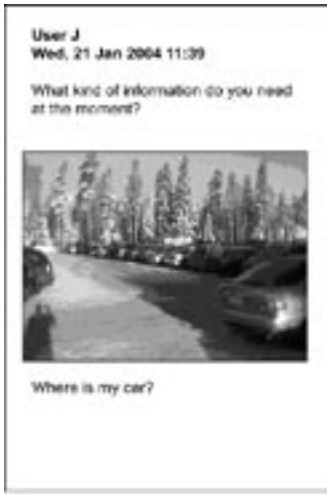

FIGURE 6. Multi-disciplinary team workshops were organized to create individual collages of the mobile work experience components.

Experiences from the study

The use of mobile phones with cameras was found to be natural, as presumed, in the study. Firstly, mobile phones are the primary working tools for site independent mobile workers today. Secondly, the participants were also active lead users of mobile phones.

The number of photos was better in this study than in the mobile probes pilot: 81% of messages included an image. The main reasons are related to the users, the more elaborated camera phones and multiple possibilities of sending messages. The experienced mobile phone users were also willing to try new gadgets. They were also accustomed to the technical problems with MMS and it was easy for them to send messages by e-mail or SMS if something was not working or it was more convenient for them. The mobile phones had built-in cameras which made picture taking easier.

Despite the experienced users, some usability problems were encountered. For example it was not technically possible to reply with a MMS to a SMS message. The exact content of the question was sometimes hard to remember because the question was not visible or could not be easily checked while answering. The question tag was needed at the beginning of the reply message for the automatic categorizing in the web site, which complicated the answering task. Time-automated group-SMS-service was not used for sending the SMS questions and tasks. This created time-management pressures for the researcher who was conducting the study.

Because the study was conducted alongside work, the users were prompted to answer the question when it was convenient for them. Based on the message content and information from the users, the answers were both descriptive and predictive depending on the questions. The delay by the operator in transmitting the messages led to low reliability of time logging and so confirmation of context-awareness was needed.

The platform supported the user study in many ways.

1 It received messages and categorized them automatically.
2 On-line viewing of the answers reduced the uncertainty experienced in previous probes cases about the users' activity in task accomplishing and about the amount and the quality of the answers.
3 The platform enabled managing the content commenting on the data entries.
4 All the participants were able to familiarize themselves with the data prior to the workshops.
5 Printing the messages in pre-defined form was practical and effective. The messages were a powerful conversation tool in workshops. The interpreting

of the material with the users and the company participants supported the step-by-step understanding of the complex phenomenon of mobile work.

LESSONS LEARNED

Our experience suggests that the mobile probes are suitable for user studies. In the interviews it became clear that the users had found the method of replying with the mobile device both natural and playful. The analogy of text messaging was accepted because most participants had used mobile devices and text messaging before. With one participant in the shopping case, however, usability issues with the device caused severe problems during the study. The person had never used a mobile device before, so the user interface was unfamiliar. Due to this problem she was unable to answer the questions with the mobile device at the beginning of the study. Later on, she was motivated to learn to use the mobile device and started to provide replies to the questions.

A mobile phone is a natural object to carry and use in everyday life. People are able to communicate their experiences when ever they wish. The problem that the participants found in the shopping study, in addition to usability problems, was the fact that they had to carry two devices instead of one i.e. their own device, plus the one with which the study was carried out. In the mobile work case, the participants used their own phones. Nevertheless, usability problems were encountered with other issues.

Mobile probes can be developed into a context aware method. According to the users, the mobile device was carried with them during the study. However the context awareness of the answers is not always evident. In the Shopping case only a few of the replies are clearly impulsive and hint at the place and situation, most of them are opinions and short descriptions, which carry no clue of the context in which they were written. The pictures show that the camera was carried around, even on trips abroad. In the Mobile Work case the amount of pictures was higher and the content of the answers and pictures indicate both contextual and reflective data.

Mobile probes were found to be an effective way of conducting a probes study. All the data from the users was stored on one database in both of the cases and the answers were sorted by user and by question. This was a major change compared to tangible probes with separate items such as postcards and photo albums. Also, once the tangible probes are sent to the users to be filled in, the researchers can only hope they are completed and the users' interpretations of the questions and tasks have some relevance with the study aims. An improvement is the possibility of seeing the data appear on the server and observing the focus and motivation of the users.

Companies are looking for effective tools. The resources required for designing or customizing probes packages for each study can be a problem in the business context. The possibility to change and edit questions and tasks through the web system can be considered as an improvement. Also, the online view to the data allows interaction and possibility of adjusting the tasks in an iterative manner. In the shopping case, one company used the web interface to browse through the raw material collected from the probes study. In the mobile work case all the users and workshop participants browsed the raw data to deepen their understanding about the studied phenomenon.

In the shopping case, as the answers started to appear on the web page, the lack of pictures of both the context and the person was evident. Pictures make the persons and the activities seem more vivid. Furthermore, in our experience with probes, and according to the comments of the designers involved, the interpretation of photos without any explanation is difficult and misleading. In that sense, as in the mobile work case, assisting the interpretation with users' notes about the content of the pictures streamlines the process.

DIRECTIONS FOR THE FUTURE

Device Development

The biggest impact on the use of mobile devices as a user study tool comes from the device hardware development. Most new mobile phones have a reasonably large color display and a built-in camera. These devices are capable of recording different media types like sound, images or videos. Current camera resolutions are reasonably low but future devices will include better optics and better image quality. With these devices it will be possible to take pictures or videos and save them on a MMC memory card. The limitations of memory and image quality will be reduced.

The Future of Java technology in Mobile Devices

Within a year there will be new mobile devices available with a newer version of the Java ME platform. This new MIDP 2.0 platform will provide new functionality and a more open view into the native software of the device. There will be the possibility to take images, videos and sound recordings through a Java application and send these media types over the GSM/GPRS network. These possibilities will enrich the information that people can provide. It will no longer be just text and images but a full scale multimedia that will illustrate people's lives more accurately for the parties involved.

With new specifications for network communication between Java applications and the backbone server, real-time communication would become possible. This enables the server operator and the Java application user to communicate between each other or between even larger groups. Media exchange is also possible in this way.

Flexibility

Developing the flexibility and compatibility of the digital system application and mobile phones could make the user study tool more usable. If the fast development and short lives of the mobile phones is considered, the commitment to a limited range of devices is not sufficient. The tool should support various modern technologies. The visions of the application possibilities are wide from design ethnography to collecting emerging trends and further. [see e.g. 16]

CONCLUSION

The users' motivation to participate, complete the tasks and document relevant issues is the key to successful self-documentation studies. In that sense the users' motivation should be one of the driving forces when developing the tools. We can identify four design drivers for the development of the mobile probes in the future:

1 Playfulness; game-like surprising tasks together with visual and open ended clues that enable associations and subjective interpretations.
2 Flexibility; allow customization for different user segments and purposes.
3 Easy to access; the user is able to complete different assignments smoothly with one device.
4 Collaborative Server; assignments, raw data and analysis can be shared with all parties.

There are vast possibilities for conducting research with mobile devices. The focus can be in documenting present activities and cultures. Or, the interest can be in probing new possibilities as users tend to create new practices and social innovations emerge with new technologies.

The material provided to the users can include inspiring images or videos. Researchers can prompt users to reply with visual and multi-modal messages and present context aware questions on-line. The navigation of the probes software could be more playful and include question related images, videos or sound

clips. Also, user replies can vary from text to different media types. Experiences from other probes studies, where text messages (i.e. SMS) and multimedia mes-
184 sages (MMS) have been used support this idea [14,22].

One way to conduct mobile fuzzy front end [3] user studies, where the focus is often unclear, would be to provide an interactive dynamically changing system where user replies would direct the research focus. Researchers could make additional questions or provocative triggers on a particular subject if they find some answers important or inspiring. The raw data can be shared with company designers from the server through the web. This access enables direct questioning, inspiration and empathic insights, as well as multidisciplinary interpretations. The user data could even be displayed in the design teams' work space as an on-line user study channel.

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Article 7

Applying probes – from inspirational notes to collaborative insights✖

Tuuli Mattelmäki

ABSTRACT

In user-centered design, attention has shifted from improving usability and addressing ergonomic problems to wider perspectives such as experiences in everyday life. This shift has forced user-centered practitioners to evaluate and develop tools for finding new means of understanding user experience for design. Visual, playful and open-ended probes have raised fresh interest in the design community. In order to create a deeper understanding of this approach, this paper presents the fundamental qualities of probes and, based on empirical data and literature, describes four reasons for applying them in the product development and concept design context: for inspiration, for information, for participation and for dialogue.

THE PROBES APPROACH

The probes approach has stimulated much fresh interest in the design community. (Fulton Suri 2003a; Gaver, Dunne & Pacenti 1999; Hemmings, Crabtree, Rodden, Clarke &

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FIGURE 1. Examples of probes kits and artifacts: On the left: Väinö probes kit including workbook with diary, open questions and drawing and collage-making tasks, a selection of stickers, a camera with picture taking assignments and illustrated cards with open questions. Most of the illustrations were created with little dolls which simulated elderly people and their life situations. On the right: Suunto probes kit, including mapping tasks, two cameras, a diary booklet with daily questions, two pens and a note pad. The theme of the probes kit was invented around a sympathetic novice skier, whose pictures illustrated the introduction letter and the assignments.

Rouncefield 2002; Mattelmäki & Battarbee 2002; Wensveen1999; Westerlund, Lindquist, Mackay & Sundblad 2003). Probes are design-oriented user research toolkits that are based on self-documentation (see examples of kits in Figure 1). They do not aim primarily at documenting but purposefully invite or provoke users to reflect on and verbalize their experiences, feelings and attitudes, and to visualize their actions and contexts. They address the challenge of studying users in their own settings, which are mainly personal. They can also be used to create interaction among groups of people, i.e. designers, researchers and users, who are often previously unfamiliar to one another (Gaver 2001; Hemmings et al 2002).

This paper has two aims. The first aim is to deepen our understanding of probes; the second is to study how exploratory probes can be applied in product development and design companies. What are probes useful for, in a company context?

This paper first introduces how the probes were first used, and describes examples of how the probes approach has since been applied. Secondly, the qualities of probes are defined, and four reasons reported in the literature for applying probes are summarized. Thirdly, an empirical study on the experiences of applying probes in company contexts is presented. This review study was done because there is scant understanding of the feasibility of applying probes from the design practitioners', companies' and users' points of view. Finally, the find-

ings are discussed in relation to user-centred concept design activities in a company context.

FOUR EXAMPLES OF HOW PROBES HAVE BEEN APPLIED

Probes have been used for several purposes with varying aims and in different contexts. In this section, as an introduction, Cultural Probes (Gaver et al 1999) and three other studies are presented to show the range of ways in which the probes approach has been applied.

The approach was first introduced as Cultural probes in an EU funded research project. This project focused on three communities of elderly people: one in the small town of Peccioli, Italy, another in Oslo, Norway and the third in Bijlmer, a suburb near Amsterdam, the Netherlands. (Gaver et al 1999, Gaver 2001)

The Cultural probes study was conducted by an artist-designer-researcher team whose objective was to investigate the cultural and personal aspects of people's lives. After collecting background information (i.e. literature and having people fill in questionnaires) the researchers felt that in order to design for these people statistical facts were not enough. The need for empathic understanding and the open design brief gave rise to the approach in which the aim was to eliminate stereotypes and to create a sensitivity for listening to users.

Cultural probes were aesthetically well-designed packages containing tasks such as photographing and answering questions on illustrated postcards. These tasks were given to the users who completed and returned the documented probes to the researchers. The tasks were open ended and ambiguous in purpose, to elicit ideas about new possibilities and to avoid "focusing on needs or desires they already understood" (Gaver et al 1999). What if Bijlmer was a body? Where would its eyes, ears or heart be? These tasks were influenced by projective methods used in psychology and contemporary art philosophies were supported by maps and stickers for the elderly to think about.

The Cultural probes study was described as an artistic, playful, aesthetically pleasing and provoking process by the developers (e.g. Gaver 1999). In contrast to the traditional requirement of scientific objectivity, they wanted to empower the designers' imagination in combination with the needs of future users (Gaver 2001).

Among the aims of the Cultural probes was to create an interaction between designers and users (Gaver et al, 1999). Furthermore, as pointed out by Thackara (2000), the project revealed new ways of thinking about the design process: "we're beginning to understand what it means to design with people rather than for people." Although these aims and results seem to share the qualities of participatory design philosophy, the process appears designer driven. As Gaver et

al (1999) observes: "Just as many influences went into designing the probes, so have they been one of many influences on our design process." This initial probes approach emphasizes a design inspiration focus and aims at provocative future design proposals.

Probes were developed in a new direction in the Informational probes study (Crabtree et al 2003; Hemmings et al 2002), in which the approach was applied to information gathering instead of inspiration probing. These probes were used in sensitive contexts, such as in a hostel for former psychiatric patients, where the use of alternative user study methods was thought to be problematic. The probes thus provided ways of gathering data and facilitating the understanding of the needs of differently-abled people in their present life. The probes were used to inform the researchers and also to establish a conversation between the users and the researchers for the next research phases.

Another approach was taken in the Technology probes (Hutchinson et al 2003) study. Here the probes were not self-documenting kits but technological applications, such as a writable LCD tablet with a bulletin board-like interface, which enabled the users to be in contact with remote family members. The aims of these probes were to gather information about the users and the use of technology in the real context, to field test the technology, and to inspire designers and the users to think about new uses of the technology, and to reflect on their everyday activities in new ways. The results provided real-life use scenarios which were later used in participatory design workshops.

Influenced by the Cultural probes several empathy probes cases have been conducted at the University of Art and Design Helsinki in collaboration with companies (Mattelmäki & Battarbee 2002; Mattelmäki 2003 a, b; Jääskö, Mattelmäki & Ylirisku 2003; Jääskö & Mattelmäki 2003). The main interest has been in gathering versatile, experimental and subjective user data with an open brief for concept design. Typically these probes studies have included individual interviews with the users after self-documentation to discuss interpretations of the data, to address more focused themes and thus to enhance the user understanding.

Figure 2 shows the typical empathy probes process, one aim of which has been to project reflections of the users into the companies, supporting the engagement with user data and facilitating design empathy. Communication throughout the process proved to be crucial because not all members of the design team engaged in a project can be directly engaged in the user study. The meaningful sharing of the gathered data and the interpreted results with company representatives has also been an emphasis. For example, the raw user data in the probes kits is interpreted into narratives and user portraits in multidisciplinary workshops.

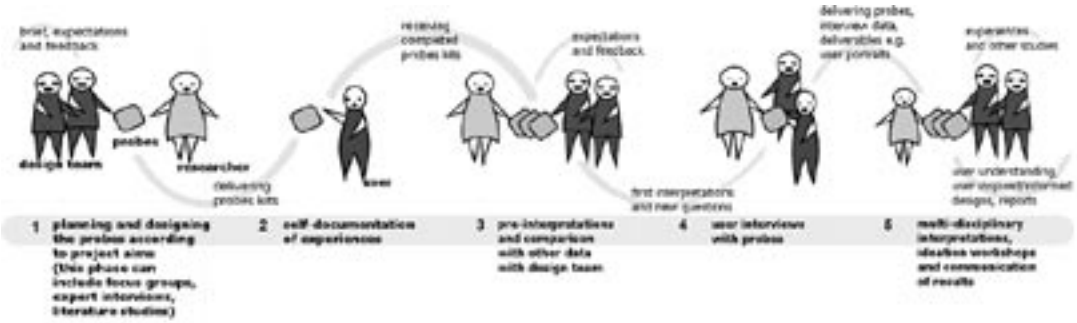


FIGURE 2. Empathy probes process

PROBES' FUNDAMENTAL QUALITIES

Since the Cultural probes study was published in the late 1990's there has been great interest in creating new innovative approaches for user-centred design and especially for the early fuzzy front end phase of design. Some of these approaches have much in common with probes, i.e. their playfulness (e.g. Shedroff 2003), innovativeness (e.g. Hanington 2003) and projective nature (e.g. Sanders & William 2001), although Cultural probes are not cited as an inspiration. Among the new approaches there are those that acknowledge Cultural probes as their forerunner. These approaches have developed in two directions: in the first self-documenting is applied to gather signals, e.g. Cultural probes and Informational probes. The second direction experiments with "experience prototypes" (Buchenau & Fulton Suri 2000) to reveal new opportunities for technology and to empower users to take part in the experimenting, e.g., Technology probes, Urban probes (Paulos & Jenkins 2005). To make a distinction between what we will call probes and other innovative user-centred design approaches, three fundamental qualities can be employed. The two first qualities link probes to applied ethnography as defined by Sanders (2002). The third stresses the fact that the users have an active role in recording signals.

First, probes are design oriented and have an exploratory goal. They are used for exploring new opportunities rather than for solving known problems. This quality links probes to concept design activities, where the goal is often not known, fuzzy and adjusted through an iterative process. Like the probes sent into deep oceans or into space, the probing instruments are developed to gather data to help in answering research questions about domains that are difficult to access or even imagine. In user studies, the probes are tuned to selected aims but also include a wish and a risk of unexpected results. They empower both users' and designers' interpretations and creativity. Furthermore, the open ended probes can be descriptive, documenting the present, and/or predictive, looking ahead to possible futures.

Secondly, probes concern the users' subjective world. They ask users to experiment and to make interpretations and explanations of their experiences. Thus, they offer users' individual points of view as bases for enhancing design.

Thirdly, the probes are based on self-documentation. Thus, the recording of the data is done by potential users, who are considered as active participants in the design process. The probes are collections of tasks given to users to encourage them to interpret, document and express their experiences and ideas. The probes' tasks aim at focusing the users' attention to noting and recording their everyday life, their values, needs, and social and emotional engagements. The probing is done with probes kits, which include various probes artifacts and tasks.

Physically the kits can include artifacts such as disposable cameras, albums, illustrated cards, and pens. The tasks often include, but are not limited to, taking pictures, filling in diaries and open-ended questions, drawing maps, making picture collages and recording sounds. The probes philosophy encourages creativity in planning the tasks and designing the probes artifacts. Thus, the probes kits tend to and should be different for each project.

The choice of the probes tasks is influenced by the goal of the study, the users, the context and the experience under investigation. One possible goal can be to create descriptions of individual users. The probes tasks are then specifically designed to capture users' attitudes, lifestyles and emotional issues. The media used can vary from paper and stickers (e.g. Gaver et al 1999) to an audio recorder (e.g. Wensveen 1999). Mobile phones or other interactive devices can also be used to gather user data (SMS and MMS messages) (Sejer Iversen & Nielsen 2003; Hulkko, Mattelmäki, Virtanen & Keinonen 2004) or to provide instructions for the probes tasks (Jönsson et al 2002). The self-documenting can be carried out by using digital probes: for example, diary entries and photographs taken with web cams and digital cameras can be exchanged via the Internet (Virtanen, Mattelmäki & Heinonen 2004).

REASONS FOR APPLYING PROBES

As the previous examples illustrate, probes have been applied with various aims and attitudes. In each case the probes have been developed and applied to support the aims, contexts and designers involved. These aims, attitudes and reasons are discussed in the literature, within which four reasons for applying probes can be identified.

Two of the reasons, to enhance design inspiration and to gather information, have been mentioned in several studies, e.g. Hutchinson et al (2003), Jönsson et al (2002), and Wensveen (2000). Gaver et al (1999) applied probes to support design-

ers' inspiration, to start interactions between designers and users, and to provoke the users to participate in the design process. Informational probes (Hemmings 2002) were designed to gather subjective information and to open dialogues with users. The reason for applying probes in participatory design, i.e. taking users as design partners, has been discussed by Hemmings et al (2002), Hutchinson et al (2003), Paulos and Jenkins (2005) and Westerlund et al (2003). In the following section these four reasons, inspiration, information, participation and dialogue, and their characteristics are summarized.

Inspiration

The aim of design is to create new solutions. Inspiration probes aim at providing new insights for designers' creative thinking. The open and aesthetic probes tasks leave space for interpretation and inspiration both for the users and the designers. Probes studies that aim at inspiration are presented and shared by showing the raw data, completed individual tasks, probes artifacts, and the design ideas (see e.g. Gaver 2001). The results are interpreted in a designerly way, i.e., looking for patterns and exceptions, creating semi-factual stories or capturing appealing design ideas. Requirements of objectivity can be left aside (Gaver et al 2001).

Information

The goal of information oriented probes is to find information about users, their experiences and needs. The tasks for probing information are primarily descriptive and leave less space for interpretation than the probes for inspiration. Probes in their information-gaining role deal with subjective points of view and the early phases of design, where a general overview or an active rapport with individual users should first be established before focusing on gaining a more detailed understanding using other ethnographic approaches. The users in such probes studies are "transformed as active enquirers into their everyday lives, rather than passive subjects of our research" (Crabtree et al 2003). According to Hemmings et al (2002), the artistic design of the information probes artifacts is less important.

Participation

The participatory design attitude accepts users as creative people who can participate directly in the design process when given the appropriate tools and encouragement. In probes, users are given tools to experiment, observe and potentially also record their own experiences. They are provoked to use their imagination, or to act and interact with technology, prototypes or imaginative smart systems. For example, technology probes were used to give the users new ways of thinking about the possibilities of remote interaction (Hutchinson et al, 2003). Urban

probes (Paulos & Jenkins 2005) were used to make interventions, experiment with technological prototypes and empower user experimentation.

Dialogue

One of the aims of user-centered design is to build a dialogue between users and designers. Cultural probes create a direct interaction between users and designers. Crabtree et al (2003) have also reported their experiences of using probes to develop and support dialogue. Through the probes process the involved people become familiar with each other; the process encourages "continuous conversations" and promotes collaboration (Crabtree et al 2003).

EXAMINING PROBES AS A CONCEPT DESIGN APPROACH

Keinonen, Andersson, Bergman, Piira & Sääskilahti (2003) argue that defining products for the fast-paced phase of developing and manufacturing is only one of the objectives of concept design activities in companies. Through concept design companies can also, in the long term, learn about and concretize alternative future opportunities, test and prepare markets for future products and furthermore, exercise individual and organizational creativity and learning. These activities can include technical, design and user studies focusing on phenomena which are not yet known but are envisioned as opportunities for future products.

Cultural probes (Gaver et al.1999) and most of the reported probes studies were carried out in exploratory design and research project contexts. The experiences of the use of probes in these studies have been reported based on the authors' own experiences. However, there is a lack of knowledge of their feasibility as an approach from other stakeholders', i.e. design practitioners', companies' and users', points of view. Thus, to explore whether a probes approach might be applied in concept design activities in companies, the following study was conducted.

Data and Method

Seven probes cases were studied. These seven cases were conducted in collaboration with companies and as part of design research activities at the University of Art and Design Helsinki. This industrial and academic collaboration allows experimenting with new ways to approach user studies for design and supports developing user-centred design practices in companies. In all the cases probes were applied to gather user data for concept design. In most of the cases the data was used for looking beyond current products and for understanding user experiences

for design. The combination of companies involved, of probes tasks and of other approaches applied together with probes in these cases is described below.

The Well-being and exercising study (Mattelmäki & Battarbee 2002) was the first of the probes cases conducted. The study aimed at understanding the relationship of well-being and exercising in the life of non-athletes. The probes kit followed the example of Cultural probes (Gaver et al 1999) and included a camera, a diary and open questions on illustrated postcards. Each user was interviewed as part of the study. This was followed by the Weight management probes case (Auno 2003) with a more focused theme. The aim of this study was to understand people with weight management needs and to design an interactive concept to support them. The probes kit included a key holder. The users were asked to imagine that the key holder was their smart exercise mate and they were asked to use their imagination and to record interactive features and situations with it. This encouraged the users to describe everyday situations in which their weight management goals could be supported, e.g. giving advice at the grocery store. Both cases above were done in collaboration with Polar Electro, a Finnish manufacturer of heart rate monitors.

The nurses and transportation study (Jääskö & Mattelmäki 2003) widened the use of the probes from home and leisure to professional work. The probes study aimed at providing a personal picture of nurses: their attitudes, motivations, and the social and technical aspects of their work. The specific focus was on patient transportation situations. The study was done in collaboration with Instrumentarium Corp. Datex-Ohmeda Division, a manufacturer of patient monitoring equipment, and the Finnish design consultancy ED-Design. A collection of the probes artifacts used in this study is shown in figure 3. Figure 4 illustrates the use of probes data in the interview, in which the contents of the photos are explained to the design team by the nurse who took the pictures.

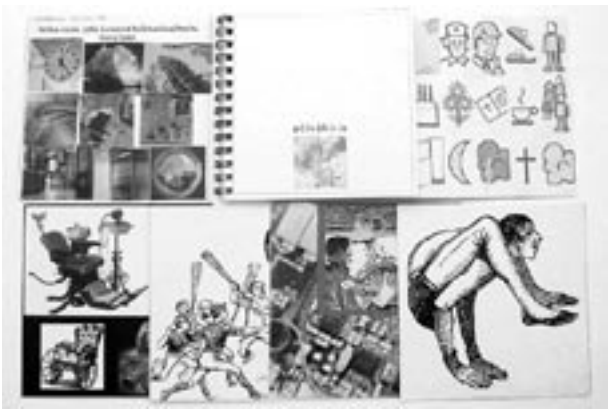


FIGURE 3. Nurses and transportation probes kit enclosed images for collage making, a diary with stickers and several illustrated cards with open questions.

Case	Theme interviews	Telephone interviews	Email interview	Total
Väinö	1 in-house architect		1 architect 1 project manager	3
Nurses and transportation	1 in-house designer 2 senior usability specialists 1 design consultant	1 program manager	1 design consultant 2 users	8
Free-rider skiers	1 interaction designer 1 product manager			2
Tele-work	1 in-house designer 2 design consultants 1 manager 1 marketing manager 1 senior researcher	1 manager	6 users	10
Total	12	2	11	25

TABLE 1. The role of those interviewed and method of interview in the four probes cases

In the free-ride skiing case (Jääskö et al 2003) the probes were designed to collect data about an extreme sports culture. The probes kit, which included a workbook, was built around the character of a sympathetic novice skier who asked questions and made comments. The results were used to focus participatory observations. The case was part of a project with Suunto, a Finnish manufacturer of sports instruments.

In the tele-work study (Virtanen et al 2004) the aim was to gather data on the different aspects of working at home and the use of home office furniture. The probes supported other user study approaches such as participatory design sessions. In this case the diaries and open illustrated tasks were sent and received through the Internet. The case was conducted in collaboration with Lundia, a Finnish manufacturer of modular furniture, Sato-Rakennuttajat, a construction company and the Studio Salovaarat design consultancy.

In the Väinö study (Mattelmäki 2003b) the aim was to study elderly people's home environment, attitudes and feelings related to ageing and independent coping at home. The project had various participating stakeholders, ranging from community welfare to telecommunications organizations. The probes kit is illustrated in figure 1 on the left, and some of its tasks are presented in figure 5.

The YleX case probed material for a radio channel design for YLE, the Finnish

broadcasting company. The probes kit included, among other artifacts, a radio and tasks in which users were asked to record sounds with their mobile phones (Niemi 2003).

In all of the examined cases comments and experiences were gathered throughout the study and all the users were asked to comment and give feedback on the approach. Furthermore, company participants were interviewed in four of the case studies: Väinö, nurses and transportation, free rider skiers, and tele-work. Table 1 presents the role of the interviewed and the method of interview. These semi-structured interviews explored questions such as the following: were the goals of the project met; what were the strengths and weaknesses of the process and how should the approach be improved; was the project useful to the company, and to the interviewee professionally and personally; and what meaning and value was gained from the different phases and tasks of the probes process. The data consists of transcribed interviews, personal correspondence and notes from discussions and case meetings. The author participated in all the cases, in the role of researcher, adviser and/or tutor.

The data was sorted with reference to the four reasons for probing described earlier, i.e., does the data indicate that the probes were 1) inspirational and 2) informative to the early phases of concept design. Furthermore, that probes 3) support user participation and 4) foster dialogue between users and designers. Comments and descriptions of how designers work and how the approach could fit into company practice were also studied. Understanding of the application of the probes approach by other researchers, the companies and the case contexts, and knowledge which accumulated during participation, informed the interpretation of the data. In the following sections the findings are presented.

PROBES SUPPORT DESIGN TEAMS' INSPIRATION

The phase of making the probes kits was described as inspiring by professional industrial designers who designed some of the probes artifacts and different from the ways they had normally approached user studies, i.e. probes focused on individual users' experiences instead of on the use of a product. The design of the probes kits expressed the designers' personal styles and skills. One designer, for example, stated that if the probes kit were designed by him it would have had a different look. Furthermore, choosing, drawing and editing the probes also made the designers imagine the way the users would use and interpret them.

"Personally I was really exited about this. I liked to think about it and search for good pictures, and to make these. For me it was natural… And

they [the nurses] can see that we have put in effort, that we respect the person. It has to be done well to make them understand that we are serious about this. If you just gave them a pen and a plain leaflet – here you are… there should be a trigger, to make them want to get familiar with the stuff." [In-house designer/ Nurses and transportation]

In the examined cases the probes were used to gather subjective views of users' experiences. The designers stated that they prefer to see the big picture of the role of the product or system to be designed in the users' context. They want to understand how products are used, who the people who use them are, and what their goals and motives are. Thus, in the early phases of design, designers want not only device-specific information but need a more holistic picture of the users as people and their context.

Moreover, the interviewed designers were willing to get involved, to make personal connections and to be able to make their own interpretations of the users' worlds. The probes process and data can support this process because its nature allows versatile interpretations.

"I like to marinate myself in all kinds of material. It is a personal way, maybe an architect's way. To gather a lot and sleep over it. Through whose interpretation do I get the results? Others want a ready made package; I want to have time with it myself." [Architect/Väinö]

Visually oriented professionals point out that they need concrete visual material with which to work. The interviewed designers do not find that reading research reports is useful for ideation. The data need to be presented such that it can be quickly "scanned" for framing the design brief or creating ideas for solving the current design problem. A design consultant said that in a design consultancy the design task can vary from a paper mill to a detail of a user interface. One designer can be involved in several projects at once. One needs to quickly adapt to the style and feeling of the environments, the future users and the use situations for which the designs are meant. Probes data were seen to serve that need. Selected photographs and short quotes from probes studies trigger the imagination but link it to everyday reality and authentic situations.

On the other hand, one of the designers warned that detailed descriptions of the current physical environment do not help when designing future concepts. Designer's work is about asking "what if " questions (Schön 1983). User studies should help exploration and provide insights and facts for more focused design evaluations or research.

"Dramatic material is strong because it facilitates the empathizing… An [industrial] designer's work is research: to make a hypothesis, to focus and to evaluate. The (user) research supports this evaluation, provides facts for more detailed evaluation…This kind of user data works first as an inspirational broad sweep. When the design is at a certain level, one should go back to the user data and evaluate which elements have been realized. One can't pay attention to all. It is the designer's skill to choose the targets and forget about the less interesting ones…. The format of the data is important." [Senior design consultant/ Tele-work]

PROBES PROVIDE USEFUL INFORMATION ON USERS' NEEDS AND CONTEXT

In concept design the aim typically is to specify a product idea without using the specification directly for production (Keinonen et al. 2003). Flexibility and openness play a major role as innovations are not pushed but are to be fueled. This also creates special needs for information gathering and sharing. In early concept design, the challenge is to frame what information is needed. The explorative nature of probes can support this framing. For example, a naïve question about the dangers of down hill skiing provoked the freeride skiers to write strong statements about their safety attitudes which provided the product manager, also a skier, with new insights:

"In a way the wrong questions were the right questions. If the question was posed stupidly we started to really be able to discuss and find the core of what it was about." [Product manager/Free-ride]

Yet the openness and exploratory nature of probes can lead to unexpected directions. For example, when the case focused on exercising, the photographs taken by a user illustrated his wife's blooming flowers. When users are given open questions and projective tasks the focus and the quality of the results are uncertain. One user, for instance, recorded daily activities in her diary, while another did not fill in the diary at all, except for sending summer greetings to the researchers. A product manager stated humorously that at the point the probes are sent to the users, one can only cross one's fingers and hope for the best.

"The gathered data is not as such [as required] for everyday product development work… I expected to get more concrete issues… But it was a surprise how subjective and personal the presented issues were." [Usability manager/Nurse and transportation]

Although probes are typically aimed at future concepts, their application can also reveal faults with current products. During the probes cases some users commented on products they had used and also expressed how they would like to have them improved, although that was not the main objective of the probes studies. When the users are given time and tools, they are able to experience and to consider their problems, needs and dreams. In a company context this means that even though a study is done to innovate new concepts, it can result in improvements to the ongoing product development and even to existent products.

"Self-documenting reveals the weaknesses and problems of a product. The users have time to think about the issues and they don't have to rudely say them to our face." [Design consultant/Tele-work]

When using probes, attitudes, moods, as well as activities, are documented over time, but the contextuality of the actions often remains general. For example, in the freeride case the situation in which the diary entries were written was not recorded. Freeride skiers do not take probes kits to the mountains to document their experiences while skiing. Nurses are not able to take pictures when they are transporting a patient from an operation. Later in the evening, they might recall their days' activities. In this kind of self documenting notes about actions are often reflective rather than contextual observations of dynamic experiences.

There can be contradictory expectations of probes results with respect to long and short term product development. The companies and collaborative designers have concrete problems they need to solve in the short term and thus require concrete answers to these immediate questions. For this the probes tasks are often too unfocused, subjective and emotional. In the case studies some hidden information expectations were not met by the probes data. These expectations were related to ongoing product development. However, some of the probes study findings were noted as being useful to short term product development, i.e. they raised the importance of some already known problems and affected design decisions.

"We did not get deeper than the surface of the patient transportation situations. There were attributes, such as how the devices should be: weight, battery life… Most of these things had been found in previous studies. It is difficult to say whether we found anything new…. This was a reminder about the problems…About the contexts we gained knowledge that could not be achieved in other ways. This was related to personal relationships, stress factors, positive issues, what keeps them going and the importance of a strict separation of work and free time. Such things are not really

available through observation. In interviews, depending on the situation, people rarely start to say that their boss is terrible, or those smells,…not really…" [Senior usability specialist/Nurses and transportation]

And

"There is always the problem: When you prepare enough you get the [probes] packages sent. Then you receive a massive amount of data. Then it is the analyses and filtering and what it means specifically to us. Not only that it is nice to know more about the sports… We would not do any of this if our clear goal was not in getting more turnover and better bonuses… The data we have gathered gives answers to "what and why". But no products are created before we have the "how". Those have to go side by side." [Product manager/Freeride]

The strengths of the probes lie in the subjectivity of the information gained. The weakness is, unfortunately, the same. The data, comprising photos, texts, and tasks produced in multifaceted ways, is, even where possible, complex to interpret in a way that produces reliable information. The fragmented pieces of information, subjectivity and the broad focus were mentioned as negative aspects in some interviews.

"The strength is in the vivid knowledge about the concrete tele-work environment...A good method to gather data, the analysis needs developing." [Senior researcher/Tele-work]

In the case studies the probes were used in conjunction with other approaches such as focus groups, expert interviews and observations. This was done to gain a more holistic picture of user experiences with different points of view (e.g. Sanders 1999). The approaches supported each other. In the free rider skiers' case the understanding created from the probes material was used to support participant observations. In the tele-work case the probes were applied in parallel with other activities such as participatory design meetings. Researchers and the company representatives were able to dive quickly into the users' way of life.

PROBES ALLOW USERS TO EXPRESS THEIR NEEDS AND IDEAS AND TO PARTICIPATE IN DESIGN

Probes' success or failure lies in their ability to motivate users who are considered active participants – to provide inspiration, information, or to co-create

ideas for design. Thus, the users were asked to describe their experiences with using probes.

The aesthetics and the surprising character of the probes in the examined studies was highly appreciated and mentioned as engaging by many of the users. Some of the users in the nurses and transportation case stated that they were willing to participate because the approach and the focus of the study was novel. Some of the users commented that the approach was "a bit odd", and practical issues such as picture taking with a manual flash sometimes negatively affected users' motivation.

The possibility for expressing oneself in different ways and thinking over issues from various angles was found to be interesting, creative and motivating. Nevertheless, accomplishing the probes tasks, writing diaries, taking pictures and answering the open-ended questions was found to be not easy, requiring some effort and reflection. This was time-consuming but also pleasing for most people. Some of the nurses, for example, reported that they became more conscious of their environment, devices and work. Furthermore, even after the study they continued to observe their environment. And finally, they also felt that participating in the study taught them to think more creatively and to visualize issues in a new way.

"When I started to write I realized how personal (the issues were) – although writing to a strange person. This is more personal than e.g. a telephone interview. This is my profile!" [User/YleX]

Those probes tasks which were not simply documenting but asking users to frame an opinion or a feeling required thought and deliberation. The openness of the probes made the users reflect on what the researcher might mean by certain questions and how to frame an answer. Thus, the tasks sometimes created a feeling of uncertainty. Some of the users gave the completed probes back with comments such as "I hope I did it in a way that you expected" or "I don't know what you will make of this, but here you are."

"First I thought, what on earth, what are they looking for?" [User/YleX]

PROBES CREATE A DIALOGUE BETWEEN USERS AND DESIGNERS

Gould and Lewis (1985) have described the key principles of user-centered design. They emphasize the necessity of creating a dialogue with the users early

FIGURE 4. A nurse is explaining and interpreting probes to the design team in an interview.

and often. Prior to system design the designers should have direct contact with the potential users in order to understand them, e.g., who they are, what their activities are, their attitudes, even their emotional and cognitive characteristics. Both objective and subjective approaches can be used by design teams to discover what matters to the users (Fulton Suri 2003a). Tools that allow designers to make personal connections and relate to the users' situation are also needed.

"Basically the strength is that there is a method with which you can get close to the user… User-centered design aims at making the design team engaged actively, to visit the use context, to see the users or the (probes) material to have a personal touch. Instead of getting a cold readymade product specification. " [Senior design consultant/Nurses and transportation]

"This study brought different kinds of information, experiential, empathic. It is interesting to get under the user's skin. They (the persona representations) were the central part, the rest was general. This brought subjectivity." [In-house architect/Väinö]

In general, the possibility to engage with users and in the user study activities was the factor that motivated and created insights for designers and other stakeholders. Meeting the users face to face during the probes study, as in figure 4, or being able to interpret the raw user data was considered motivating. The possibility to participate in the study personally increased the commitment to the results and the motivation to use and share them in the company. Those engaged directly in the probes process found the process to be a valuable tool for learning and understanding as well as for gaining personal insights:

"The hospital world has been quite strange to me and I have never been especially interested in it. The material that was gathered in the tasks and

the interviews opened to me their world a bit. And the best is that it made me become interested." [Design consultant/Nurses and transportation]

And

"The clips from the diaries, what they [the users] have been doing, their thoughts and pictures. One starts to get to know the people" [In-house designer/Tele-work]

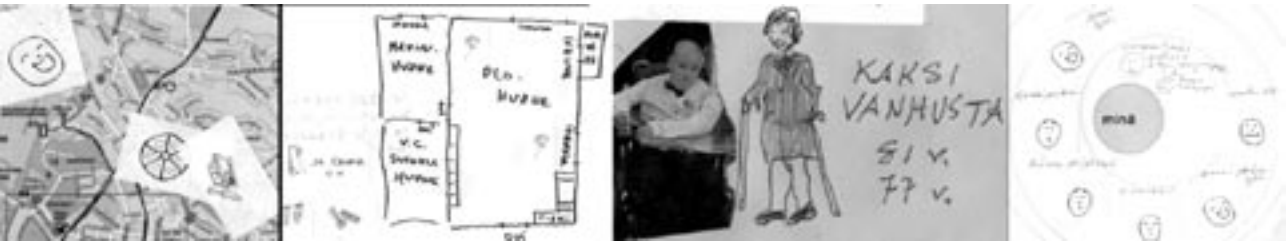
Subjective, narrative and visual user material can be used for "in-house marketing". Even the blank probes kits were passed around in the companies for co-workers and other stakeholders to comment upon. The probes artifacts and the philosophy of the tasks often raised positive emotional responses.

User profiles based on probes data and subjective descriptions deepen the understanding of the studied phenomena. In the nurses and transportation case, the users were depicted in posters which described the nurse as an individual instead of focusing on the technology developed in the company. The posters were found to be an interesting and not overly serious way to spread the idea of the users being something other than a stereotype. Describing situations where the company's products played a secondary part was found to provide a fresh point of view. The posters activated discussion in the company, creating a more holistic perspective on usability.

"…to make them remember that the users are ordinary people with emotions and feelings. Everything cannot be explained with logic and reasoning." [Usability manager/Nurses and transportation]

"The meaning of the empathic (probes) study: the (designed) concepts are based on them and that is the link to reality." [Design consultant/Väinö]

FIGURE 5. Examples of Väinö probes tasks:
my town; my home; who we are; my contacts



On the one hand the nature of probes leaves space for interpretation, and to avoid one-sided and overly subjective conclusions, the interpretation should be done in multidisciplinary teams. On the other hand collaborative activities in companies need facilitation to establish a common understanding. The probes, the raw user data and outline presentations were used in workshops as means to familiarize team members with the users or the design theme. The user representations gave starting points for narrative telling, role-playing scenarios and brainstorming ideas. These sessions allowed participants with different backgrounds and levels of expertise to share their knowledge, insights and associations. They provided possibilities for new collaboration practices inside the companies and with other partners.

"The workshop was good, the material was looked through and some product ideas were created… brainstorming. We could think that before starting new product development, we could have this, send packages to the use context the product is meant for, and we would have a kind of brainstorming session, where the material is discussed through and interpreted." [Senior usability specialist /Nurses and transportation]

DISCUSSION

One of the objectives of this paper is to examine the ways in which probes can function in design and product development companies. The results of the study above and the four reasons for using probes and their characteristics presented earlier in this paper are discussed and summarized below.

Probes support design inspiration and allow personal interpretation. Conducting a probes study is a designerly activity. Designers put their professional artistic skills and subjective insights into the probes design. In this phase, they may already start to generate preliminary solution hypotheses and experiment in reframing the design space, which according to e.g. Schön (1983) belongs to the designerly way of thinking.

Making the probes kits is a natural and motivating task for designers and orients their thoughts towards the users' worlds. Visual aesthetics are a natural component of designers' self expression; hence to inspire designers and to approach the users in an appealing way, effort is put into the aesthetic design of the probes kits. Designing probes resembles designing a product rather than planning research. This may be one of the reasons industrial design students and designers find this approach appealing. The size of the package, the usability of the diary, and the outlook of the tasks have to be designed.

Open and interpretative data as well as probes tasks and illustrations with metaphors trigger the designers' associations. Wide perspectives and flexible access to different sources of information and disciplines are necessary for creative thinking (Ahola 1978; Lawson 1980; Schön 1983). The openness and broad brush character of probes leave space for imagination, which is still grounded in the users' world. In companies there is a need for research and design approaches that support creativity to explore new fields of human life and to innovate in new product and technology development (e.g. Bødker, Nielsen & Petersen, 2000; Cagan & Vogel, 2002; Fulton Suri, 2003a).

Probes data provides information on users. However, in the studied cases feedback on the usefulness of the information for company use is contradictory. On the one hand, the probes data opens fresh and holistic perspectives and vivid information on individuals and their contexts. On the other hand, the data may be too ambiguous and fragmented with too broad a focus to be used for concrete design decision-making in companies. For the purpose of information gathering, probes should not be used alone. Sanders uses workbooks, which she calls primes, to make users become more aware of their experiences related to the theme of the study (Sanders & William 2001; Sanders 2002). Primes are similar to probes in their open-endedness. However primes are used primarily for preparing the users to express their creativity in later participatory sessions. Probes can function in the same way. Probes can be used as an introduction to the design theme and the users. With the help of this introduction, both the users and the other participants are better prepared to discuss interpretations, share information and even co-create design ideas. When applied as one approach among others probes can e.g. make interviews more effective by providing a means to familiarize oneself with the people and phenomena in focus, and complement observations by bringing up subjective issues and longer term reflections. The comparison of probes and other user-centred methods cannot be done within the scope of this paper but is a subject for future research.

Probes allow users to express needs and design ideas. There were individual differences in how the probes were considered by the users. The approach was enjoyable for most of them but also created feelings of uncertainty and confusion. However, reflecting and expressing was found to be pleasurable and interesting. The feedback also brought up feelings of frustration and confusion about the openness and ambiguity of tasks, and the purpose and goals of the studies. How much the participant wants to and can adapt a playful attitude to the expression of their ideas in e.g. drawing or writing and imagining possible futures depends on the individual (also discussed by Sarpiello, 2002).

Users' expertise and creativity can be harnessed to support and provoke the design process (e.g. Sanders 2001). To encourage motivation, probes need to be

fitted to the specific users. This fit may include characteristics such as practical task-related issues, aesthetics and the visual and textual language. The tasks should be both meaningful and playfully surprising. Furthermore, the probes should enable various ways for people to explore the issues studied, and to participate and express themselves.

Probes were able to create a dialogue. Probes support the user-centered dialogue on three levels: The interpretative dialogue within the design team, the direct dialogue between the users and the designers, and an inner dialogue, in which user experiences and designers' insights become linked. This inner dialogue is about design empathy as described by e.g. Fulton Suri (2003b). The strength of the probes approach is the ability to get close to the user.

For the user, the dialogue is opened with the designers' expressions and design ideas. For the designer the dialogue can start by ideating the study aims and designing the probes tasks for the users. The dialogue continues either in face-to-face meetings with the users or through representations of the users: the probes material, user portraits and authentic descriptions of situations.

In addition to the interaction between the users and the designers, user-centred dialogue takes place in companies and in design teams. Multidisciplinary interpretations, workshops and communicating of the probes study results can enhance this dialogue. The subjective probes material represented the users' perspectives and environments, which created a feeling of the users' presence within the design team. The process also offered possibilities for sharing interpretations and ideas. Engagement increases the importance given to the user data and to transferring insights to and across the organization.

Probes kits signify respect for users and can be seen as gifts to them, a sociable way to start a relationship or dialogue. Although the company participants commented on how beautiful and funny the probes kits were, in a company context, there is pressure for simple, reduced and effective processes, and the cost of custom designing a probes kit for each study can be seen as an obstacle in the long run. One possibility to solve the problem of resources for designing probes is to develop "scaffolds" (Sanders 2001) or frameworks for the creation of probes that support but do not constrict their uniqueness and creativity. If the designing of the kits becomes too routine a procedure, it can negatively influence the designers' engagement and hinder the fresh development of the tool for each purpose and context.

The human-centred design process as described in ISO 13407 (1999) proposes that the user studies and their deliverables are done prior to the solution design. In companies this means that often user studies are conducted by user specialists, who filter the data on behalf of the designers. Design oriented probes are not

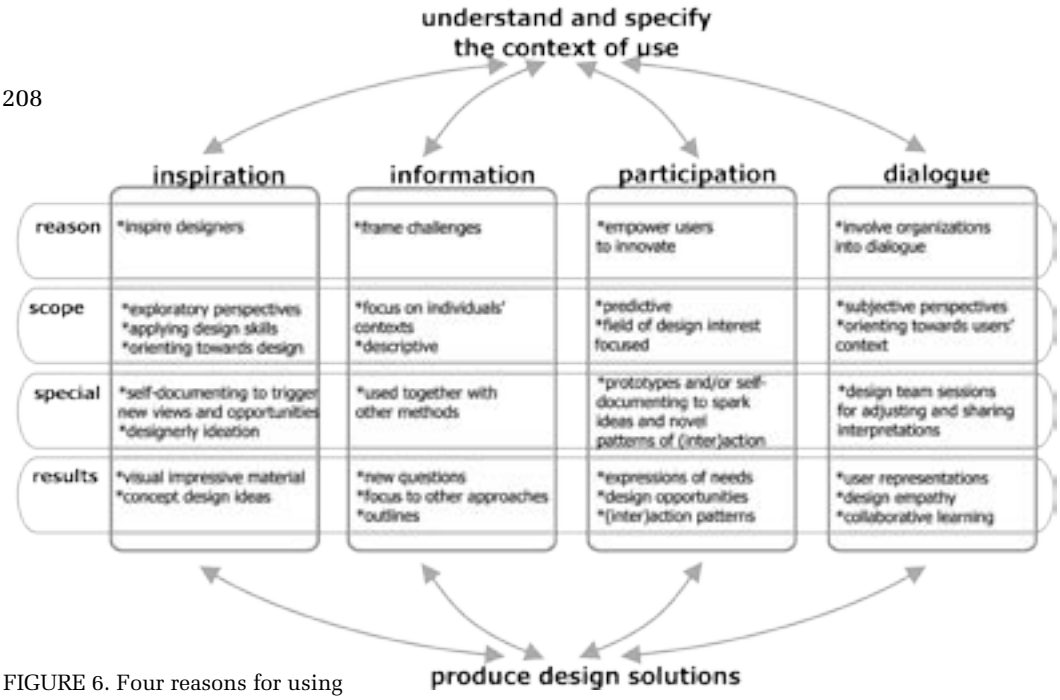


FIGURE 6. Four reasons for using the probes approach in reference to ISO 13407 human-centred design process (ISO 13407, 1999)

a method for gathering information at one end of the design process, i.e., the starting point of the user centered process, or for supporting inspiration at one end of the process. Rather, the design and user studies should go hand-in-hand and iteratively. In the company setting, such iterative and multidisciplinary collaboration needs facilitation, and tools and practices for establishing and maintaining dialogues for common ground (Brandt 2004). The aim of using probes can be to bridge the user need identification phase and the concept design phase. Figure 6 summarizes the four reasons for using the probes approach in human centered design and their typical characteristics when applied in concept design.

To conclude, the data obtained through seven cases suggests that the four reasons for applying probes are also relevant to user-centred concept design in design and development companies. The probes data, and process, has been seen to fuel design inspiration. They enable a user-centered dialogue between the users and the designers and within the design team. Probes help to familiarize the design team with the users and the research theme and to focus the research questions. Because the probes results are often too subjective and fragmented to be used for product development decision-making, they should be complemented with other approaches. Some users find the open and thought provoking probes tasks inspiring, while others can find them irritating. Thus, the quality of probes

results is dependent on the probes tasks and users' motivation, and of course, on the design team's skills and resources.

Some of the challenges of probes, i.e. uncertainty of the motivation and contextuality, might be avoided by a more interactive dialogue. There are already systems being piloted that use new personal technology for self-documenting (e.g. Palen & Salzman 2003; Masten & Plowman 2003; Hulkko et al 2004). These "mobile digital probes" systems can support more interactive probing and the possibility of interpreting and sharing the data during the self-documenting period. Furthermore, the digital systems can provide possibilities to categorize and communicate the data in more systematic ways.

Objectivity or systematic analyses are not key words in the early design context. Fuzzy front end user studies aim at finding user values, needs, desires and fantasies (Cagan & Vogel 2002). Probes allow interpretation, inspiration, creativity in data gathering and ideation. Gaver, one of the pioneers of using the probes, says that he is skeptical about framing probes as a formal methodology. He feels that by so doing the approach would become heartless and superficial (Gaver 2001). When methods are written into handbooks or definitions the innovative use of the tools can be frozen. Freshness can be maintained by avoiding routine procedure (Buur & Bagger 1999). Approaches should be applied with a creative attitude and developed for each purpose. In that sense probes have flexible and useful qualities also for business purposes.

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The end

This dissertation examines the innovative user-centred design approach called probes. Probes are explorative, design oriented and based on self-documenting. They aim at revealing users' personal perspectives to enrich design and support empathy.

The design field is facing new challenges and the probes are linked to these changes: The focus of design has extended from plain products to experiences. Along with this change the view of the user has changed from performers and consumers to more holistically understood actors. Designing for experiences requires an ability to empathise. Empathic approaches are seen to support designerly way of working in concept design. The user-centred concept design is done in multidisciplinary teams in which new practices are needed to facilitate cooperation and creativity.

The probes and their inspirational character have raised a wide interest and discussion in the design community. They have been applied both to experimental and business projects but a detailed consideration has not yet appeared. This dissertation introduces the probes approach, describes with illustrative examples what the probes are, how they have been applied in different projects, and concludes the reasons and practices of applying them. The book is addressed to academics, students and practitioners and it offers instructions for applying probes based on literature and well-tried practices.

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