Situated research and design for everyday life

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SITUATED RESEARCH AND DESIGN FOR EVERYDAY LIFE

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Summary

This paper elaborates theoretical and methodological aspects of design processes in a disability context and aims to relate them to other sciences. It particularly emphasizes situated aspects of research: the need for being ***there, with*** *the users in their daily lives, i.e.* ***where the action is****.*

Research on different human aspects of functional limitations for the individual enhances the need to focus on ***functioning per se*** *and* ***design*** *for functioning, be it learning and empowerment or well-being, recreation and pleasure or safety, freedom and flexibility.*

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1. Introduction

Human needs, wishes and dreams are the starting points for design research in the area of rehabilitation engineering. The design of technical solutions represents in itself an interpretation of problems in a language of its own, different from the word-based analyses of observations, interviews, questionnaires, etc. The degree of benefit and enjoyment for the end users is an important benchmark for the research process.

"THE DESIGN OF TECHNICAL SOLUTIONS REPRESENTS IN ITSELF AN INTERPRETATION OF PROBLEMS IN A LANGUAGE OF ITS OWN..."

The process begins and ends with the individual. At the same time, the method, and to some extent the language of rehabilitation engineering research is that of technology, often in a context primarily involving scientists from the natural sciences and technology [Jönsson, B., 1997].

When it comes to the area of rehabilitation engineering and design, it has more or less the same goals as medical rehabilitation – to cure, alleviate and/or comfort. However, rehabilitation engineering and design are mainly concerned with the *lived* ability and disability, while medical rehabilitation builds upon diagnosis-based interventions. The tools of rehabilitation engineering and design are exterior and their value is related to the *action* of the users, to their *preferences for the future,* and to the *influence of and on the surroundings* [Dourish, 2001; Hutchins, 1996].

It is natural for researchers within rehabilitation engineering and design to relate to the *natural sciences and technology*, since that is where most rehabilitation engineering research proceeds from. *Which aspects of the natural sciences and technology can be included and which cannot?* What should be added? Which aspects of the *cognitive and social sciences*, including education, make sense in this context? And how far reaching and sufficient is the current theoretical and methodological basis for *design sciences*? The design sciences have successfully established their own theoretical and methodological foundation over the last 20 years but without relating it to any great extent to other sciences. In this paper, we attempt to bind together the impulses from design research with those we have from other areas.

The original scientific backgrounds of the authors are in physics, engineering, computer science, design and education.

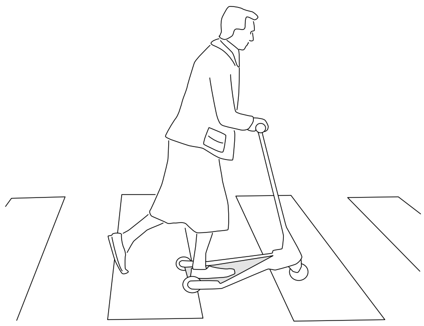
2. Design

“Design is such a natural human ability that almost everyone is designing most of the time – whether they are conscious of it, or not.” [Nelson and Stolterman, 2003, p. 1]. Design is not only a professional activity or research – it is also a common, daily-life, human activity, not least among people with disabilities. We can distinguish among design as an everyday activity performed by everybody, design by professionals and design by researchers. Professional design is that which is based on professional design competencies and often either put into production (e.g. mobile phones) or made into individually tailored solutions (e.g. a submarine interior layout). Design by researchers is a special category; as designers we explore reality and obtain knowledge through design. Ideally, a design process leads to designs ready for use by the individual. Even when this does not occur, rough prototypes and concepts may result. These, accompanied by insight into problematic situations, may lead to more general knowledge that can be applied in other design processes.

Example: *Support in the design situation on the detailed level.* A game for people with cognitive limitations called “The Plumber” was developed and used. What was most important was not the actual prototype, but the principles that were discovered through its development and usage concerning rules for taking turns, simplified dice, the elimination of some rules and visualization of others. These principles can then be used for other games.

The results in the doctoral dissertation *Customer-Oriented Product Development* indicate that user-produced ideas might not only be relevant and useful, but also technically innovative [Magnusson, 2003].

Example: *The shopinette.* When Elisabeth, 84, didn’t have a practical vehicle with which to go shopping, she invented one: a kick scooter with room for a shopping bag on the foot platform [Svenska Dagbladet, 2003]. The prize-winning shopinette fulfills all the requirements for stability, space, steering and braking which were obvious and necessary features for her. At the same time it provides food for thought – that contemporary design and technical developments so far have devoted so little time to such an important area as *Elderly People and Design* [Jönsson, B., 2003].

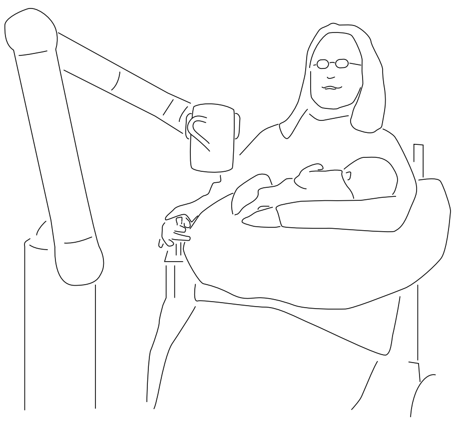


Independent of the purpose of the design or who is going to implement it, user participation is necessary in most contexts, particularly for people with disabilities. It is worthwhile taking a closer look at design and design processes in order to understand the core activities and problems encountered. Lundequist divides design into three classes: design of artifacts, production of artifacts and use of artifacts [Lundequist, 1995]. You might also distinguish between:

a) qualities a future artifact should have (i.e. the goal of the design), b) means needed to produce an artifact (methods, activities and resources), and c) definition of goals and designing of methods for the use of the final artifact (i.e. planning of use, operation, service, maintenance and redesigning of the final artifact).

Design for rehabilitation engineering requires that we utilize all the means at our disposal to acquire information. We need to try and place ourselves in the user's situation, before and during the entire design process. The process cannot be considered complete just because the product is there and functioning in application. Certec, Division of Rehabilitation Engineering Research, Department of Design Sciences, Lund University [www.english.certec.lth.se] often maintains that the most important step in research comes when the artifact itself, the way in which it is used and its effect on the person involved yield information back.

"...THE MOST IMPORTANT STEP IN RESEARCH COMES WHEN THE ARTIFACT ITSELF, THE WAY IN WHICH IT IS USED AND ITS EFFECT ON THE PERSON INVOLVED YIELD INFORMATION BACK."



Example: *Right handedness is not in the hand but in the brain.* A robot arm can be mounted on a wheelchair's left or right side. If the person is right handed and has some slight function left in her right hand, it is likely that the joystick is already mounted on the right side. That means it is more difficult to also have room for a robot arm on the right side. Thus, it is often placed on the left. This causes problems, for example, when the person is going to pour a glass of water from a pitcher. She pours from the right, just as she would have done if she had been able to use her right arm. But the robot arm blocks the view of the glass and it is difficult for her to see when she is pouring. A right-handed person should have her robot arm and other aids mounted on the right. Always. But problems can arise because of this. When a right-handed personal assistant is going to help button her jacket, the robot arm is in the way [Eftring, 1999].

The thoughts of "the reflective practitioner" [Schön, 1983] are important, not only during but also after the individual design process. They can advantageously focus on what has been revealed in the person involved through the advent of the artifact and on what has changed (in exceptional cases it can actually be the person's entire life situation). Another situation is when we first need to have a large number of artifacts for different purposes for the same person or group before we can see the real common denominator. Through such an insight, we can more quickly get *at the best possible artifacts* for the group of people involved [Svensk, 2001].

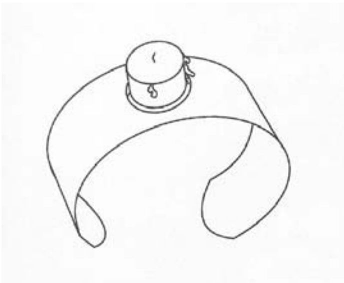
Example: *Diffuse cognitive contours as underlying problems*. To see *the common denominator* in such widely varying activities as brushing teeth, cutting the grass, baking a cake, vacuuming or telling time can be difficult. If you study an entire arsenal of cognitive artifacts for people with cognitive limitations, it can become apparent how the solutions are essentially similar to one another and how they solve one and the same underlying problem: the phenomena have *diffuse cognitive contours* and that is why the users need *distinct cognitive artifacts* to assist them. The next design process that deals with a shaving aid, for example, can as a result of this insight, get straight to the point: what needs to be compensated for in this case is also diffuse cognitive contours. This doesn't mean that a shaving aid can be designed without user participation. But the key person involved does not have to invest too much unnecessary time in testing prototypes that do not address the actual, underlying problem. It is also obvious that the designer saves considerable time and money [Svensk, 2001].

Example: *More is different.* Time measurement is an example of an area of crucial significance for people with cognitive limitations. Not being able to orient oneself in time results in constant anxiety. If you examine *many* clocks developed for people with cognitive limitations, you can see that they all have fixed, person-independent points and scales, i.e. ones that are not dependent on or associated with other people in the surroundings. Moreover, these forms of time representation concentrate on the *strengths* of the person for whom the clock is intended [Svensk, 2001].

2.1. The time factor

The time factor is often critical in rehabilitation engineering and design. Children with disabilities are, of course, aging at the same rate as able-bodied children. Solutions that appear two years later are no longer solutions to their current problems. The same goes for many adults with rapidly progressing illnesses or disabilities.

Time is a very important but unfortunately often neglected factor. The development of a new assistive aid often takes so long that it is impossible to link the process to the person it was intended for. In the meantime, he or she has moved on to other dreams, wishes and needs. If you are involved in an interactive design process, there are two slightly different ways you can approach this issue. In the first, the aim of the project is to create, together with the person who needs the artifact, one that he or she finds useworthy in the specific and current situation. During the process, an artifact emerges that is a more or less successful response to the co-designing person's immediate needs. This process can necessitate several prototypes, tests and mock-ups in order to approximate an artifact that meets these needs. If you do not find the right solution immediately, you feel that you are at least heading in the right direction together, and that things will happen along the way. What is created is intended primarily for the person who is the co-designer, but with the hope that several others with similar needs can also use it or gain inspiration from it to start a design process of their own.



Design: Helena Ondrus, 2003

In the second approach, you as a researcher in cooperation with the above-mentioned user of the artifact create a picture of the existing needs and how an artifact can be designed to suit the group or category of people for whom it is intended. In this scenario, the person you are working with is a representative of a group and the objective here is to gain knowledge about the group's needs through this person.

In both cases, it is important that *something for one person can be something for many with similar needs.* The difference is to be found in the time aspect. In cases where the first approach is applied, those involved have to be fully aware of the fact that time is *not* neutral.

Interactive design also involves the creation of expectations, inspires and offers hope for many people with disabilities. This entails, if nothing else, a moral duty on the part of the researcher to succeed in producing an artifact within a reasonable time framework. In this context, "a reasonable time framework" means soon enough so that it can be used by the person(s) who have participated in the design process. They may not be particularly interested in giving of their time and effort again if there is no visible result. It is important to safeguard the credibility that exits between the researcher and the co-designer. Accordingly, the result of every design process should, as far as possible, make a difference for those involved in the original design process.

2.2. Design for experience

Design does not only result in *form* and *function*; it also results in experiences.

Example: *To have control over your own history.* At an early stage in the Isaac Project [Jönsson et al., 1998], a man wanted to take a trip back to the institution where he had lived when he was a child. He wanted to take digital photos of the different buildings that had been significant to him for decades. Why was that so important? One likely explanation is that he always had to rely on others (staff members) to remember important elements of his life history. When they quit, his own history slowly but surely crumbled away. When he had control over the pictures of the buildings, he was no longer as dependent on others to remember.

Example: *Insight through user testing*. A researcher started a project on navigation in urban environments. The objective was to give friends of people with cognitive limitations an easy way to provide them with navigational advice using a mobile phone with a digital map. The researcher put much effort into what he thought was the major challenge: how to explain different routes from one location to another. He carried out the project in close collaboration with a few people. In the process, however, he realized that he had missed two other crucial challenges that became apparent through iterative user testing: understanding exactly where the user is located (including nearby landmarks) when requesting help and exactly where he wants to go. Due to the limitations of GPS information, there is a margin of error in locating the user on the digital map. It is not possible to find out exactly which direction he is facing. Without that information it is quite difficult to know if you should tell him to turn right, left or go straight ahead. Another consideration involves his understanding of the concepts "right" and "left". All this requires knowledge of the user's abilities, strengths and weaknesses. He may know in general where he wants to go ("A shop with a lot of people, lots of cards and where they develops photos for half the ordinary price."), but not the name of the shop.

For people with cognitive limitations it is important that a phenomenon offers a feeling of:

- **S**ecurity
- Con**T**ext
- **E**xperience/Memory
- **P**recision

The four underlined letters form the acronym "**STEP**" and can work as a mnemonic rule in many situations, not only in the design of artifacts but also in reciprocal interactions. The **STEP** method has its origin in the context of cognitive limitations. Its contribution to general design science is in discerning concepts that can guide the design process, its results and their evaluation. Critical questions are: Does this strengthen the users' perceived **S**ecurity? Does it help them refer to (or shape) a sound con**T**ext? Does it build on previous **E**xperiences and shape new relevant ones? And does it have a distinguishable **P**recision?

Example: *Precision in expression of time*. At a group home for adults with cognitive limitations, the staff frequently used the expression "a while" to designate a shorter time period. The problem with the concept "a while" is that it is so inexact. Depending on who was working, "a while" could mean anything from a few minutes to hours. Instead of placing the responsibility on those who used the term, the residents with reduced cognitive abilities were forced to look for possible patterns in how it was used. By introducing a standardized "while clock" it becomes possible for people who live in the group homes to experience precision while it at the same time serving to remind the personnel of the importance of being more specific in their formulation.

An idea fundamental to the **STEP** method introduced by Arne Svensk is that cognitive processes and problems are distributed over people, time and artifacts. They should thus be studied, analyzed and sometimes solved in *actual* interactive situations [Svensk, 2001].

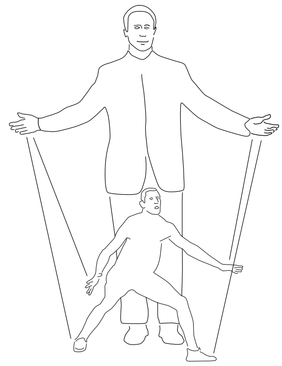
2.3. Engaging users in the design

One cornerstone of fruitful design is the necessity of involving users in the design process. This engagement requires not only that users become active in the process but that developers also engage themselves in gaining a better understanding of use contexts and situations [Krischner et al., 2003; Plato and Jönsson, 2001].

Example: *It is a matter of the experienced whole rather than the parts*. For a robot researcher, it may seem natural that voice control is the best controlling system for a person with a physical disability. The researcher, though, forgets that one of the most important motivations a person may have for really wanting to use a robot can be so that she (or he) *won't* have to say anything, won't have to hear her own voice, won't have to concentrate on giving oral instructions and, instead, will be able to *do* it herself – which means that she can actually think of something else during the time.

There are many ways to involve users in a design process [Preece et al., 2002]. The concept "user-centered design" emerged in the mid-1980s. According to Gould and Lewis the three main principles of user-centered design are: *early focus on users and tasks, empirical measurement and iterative design* [Gould and Lewis, 1985]. Early focus on users and tasks incorporates various methods to examine characteristics of a user group through, for example, user mapping, task analysis, questionnaires or direct observation. These surveying methods are described in the EU accessibility project Userfit [Poulson et al., 1996] or standard human-computer interaction and human factors literature [e.g. Sanders and McCormick, 1992; Helander et al., 1997]. Empirical measurement is the practice of letting future users use simulations and prototypes, and measuring their performance through quantitative feedback including measures of efficiency, number of errors, time to complete tasks, etc. Good descriptions of such test methods may be found in Jeffrey Rubin's *Handbook of Usability Testing* [Rubin, 1994]. Iterative design is a standard component in design methods [Gedenryd, 1998] and means that there should be a cycle of design, testing and measurements that is repeated as often as needed, starting with early prototypes. Usability engineering [Nielsen, 1993] builds on the user-centered approach, but attempts to make the process easier to fit into an engineering perspective by focusing on the usability goals as a measure of when the iterative design process may be stopped.

The *participatory design* approach has its roots in a Scandinavian tradition. Bødker and Iversen [Bødker and Iversen, 2002] suggest an understanding of design and its relation to users and use based on the four following assumptions: 1) *Designing in context*. Designing a computer artifact means designing conditions for the whole use activity. 2) *Communities of practice*. Users and designers have different backgrounds and belong to different communities of practice [Lave and Wenger, 1991]. 3) E*xperiencing future design*. The users need to experience the future computer application in order to place demands for it. 4) T*ranscending practice.* The practice of the users is the starting point for design. At the same time users need to be confronted with, and to experience new ideas in order to transcend their own practice.

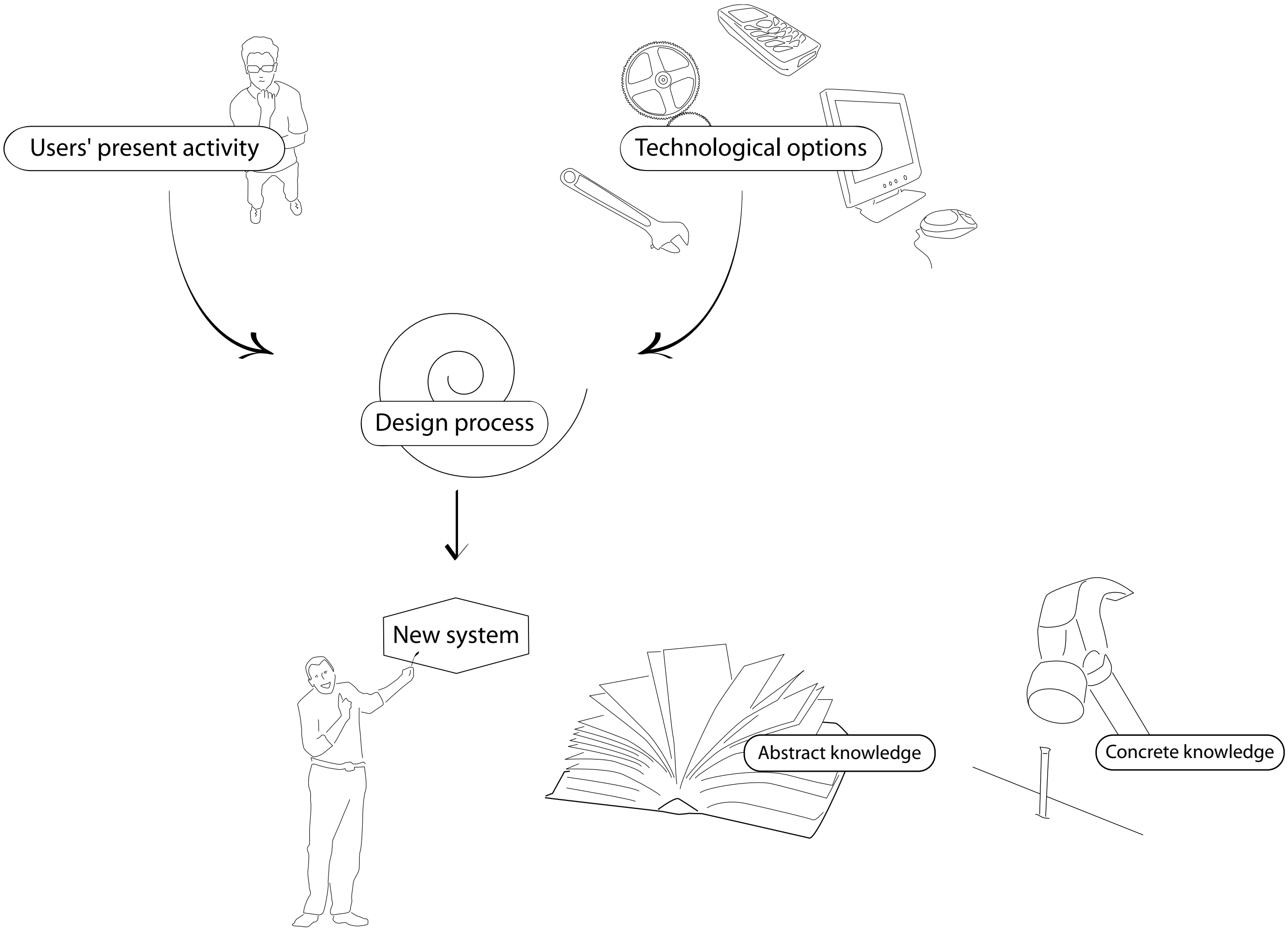


Early practices of the Scandinavian participatory design tradition [Ehn, 1988; Bødker et al., 1987 and 1993] often assumed that any touch of the users' hands in and of itself secured development of meaningful artifacts [Bødker and Iversen, 2002]. Now participatory design has reached a level of maturity that implies that a change in discourse must take place. Two constituting elements of participatory design practice are suggested [Bødker and Iversen, 2002, p. 11]: First, the existence of a shared "where-to" and "why" artifact, and conscious work with this artifact that helps focus the direction of the participatory design. Second, professionalism based on an ongoing reflection and off-loop reflection among practitioners in the participatory design process. We agree in these proposals for a more mature and professional approach to participatory design.

"First, the existence of a shared 'where-to' and 'why' artifact..."

2.4. Designing in context

Contextual design is a more situated method that emphasizes interviews conducted in the context of the user's work, co-designing with the user, building an understanding of work in its context, and summarizing conclusions throughout the research [Wixon et al., 1990]. A variety of methods for gaining an understanding of use situations have been introduced in the participatory design tradition. Ethnomethodological approaches have introduced the idea of videoethnography as one way of understanding use situations [Suchman and Trigg, 1991]. But what does it mean to understand a use situation when working with users? Kensing and Munk-Madsen drew up an early and useful framework for this [Kensing and Munk-Madsen, 1993].



Three areas of discourse and two levels of knowledge in the participatory design process according to Kensing and Munk-Madsen.

They suggest that we consider three different areas of discourse: users' present activity, technological options and the new system during the participatory design process. Furthermore, they suggest that for all three areas of discourse we make a distinction between abstract knowledge and concrete knowledge. Using videoethnography, for example, is a way of acquiring concrete knowledge about the users' present activity, whereas setting up an organizational hierarchy is a way of acquiring abstract knowledge about users' present activity.

We can assume that users already have concrete knowledge about their present activities, for instance bicycling, but not necessarily abstract knowledge. Knowledge remains tacit unless you are able to formalize or abstract structures from concrete situations. You know how to do something, but are not able to explain how.

Designers usually do not have concrete knowledge about users' work, but are often offered formal – abstract – descriptions of it. A situated approach is the best way to avoid the pitfalls of situations involving users with only concrete knowledge and designers with only abstract knowledge. Users and designers can be considered two different *communities of practice*.

2.5. Communities of practice

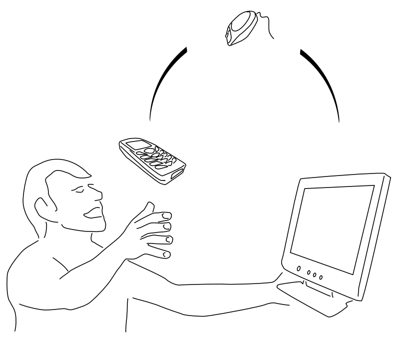
The concept of *communities of practice* was coined by Lave and Wenger [Lave and Wenger, 1991]. Originally it was used in the understanding of situated learning processes in organizations, but has also become quite influential in participatory design as a way of understanding relations between different groups of users in a specific context [Wenger, 1998]. According to Lesser and Storck, a community of practice is "a group whose members regularly engage in sharing and learning, based on their common interests. One might think of a community of practice as a group of people playing in a field defined by the domain of skills and techniques over which the members of the group interact. Being on the field provides members with a sense of identity – both in the individual sense and in a contextual sense, that is, how the individual relates to the community as a whole" [Lesser and Storck, 2001].

"...A COMMUNITY OF PRACTICE IS 'A GROUP WHOSE MEMBERS REGULARLY ENGAGE IN SHARING AND LEARNING, BASED ON THEIR COMMON INTERESTS'."

It is useful to consider designers as one community of practice with a certain set of skills and techniques, and different user groups as other communities of practice with other sets of skills and techniques.

2.6. Experiencing future design

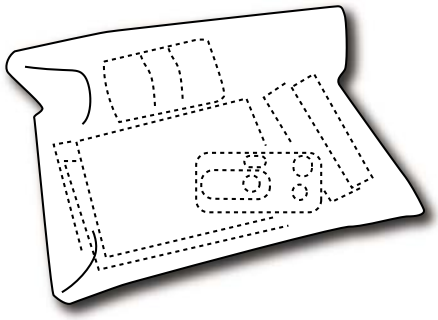
Experiencing the future is essential when it comes to letting users engage in design of artifacts and their contextual use. Users need to get an early "touch and feel" of the artifact and its use context. Mock-ups, prototyping and use scenarios are well-known methods for this [e.g. Kensing and Munk-Madsen, 1993]. A more recent method in this area is video prototypes, where users and designers together direct and film short "trick videos" simulating working designs [Madsen, 2002]. Another way of experiencing the future is to play with early versions of the technology. By letting users play with different building blocks (such as personal digital assistant, a mobile phone, a hand-scanner, etc.), difficulties, new usages, interesting combinations, anxieties, etc., are revealed [Jönsson et al., 2002]. In such a situation it is crucial to ensure that the users feel comfortable with the technology by ensuring them that they cannot harm the device or cause any major problems by trying it out – almost like when children fearlessly press all the keys and click everywhere with the mouse.



2.7. Cultural probes: engaging users and transcending practice

Cultural probes can be used for: contextual design, communities of practice, experiencing future design and transcending practice [Gaver et al., 1999]. To transcend well-established practices and habits based on many years of experience, it is necessary to establish and use methods and means that allow the viewing of well-known situations and environments in a new way. Metaphorical design [Madsen, 1994] and future workshops [Kensing and Munk-Madsen, 1991] are early attempts. Cultural probes can be considered as another method based on the idea of transcending practice. Proposed by Gaver et al., the cultural probes method has it roots in an artistic, design-oriented approach. It has attracted substantial interest in the research community of interaction designers oriented towards conceptual design of interactive digital devices [Crabtree et al., 2002; Gaver and Martin, 2000; Hemmings et al., 2002].

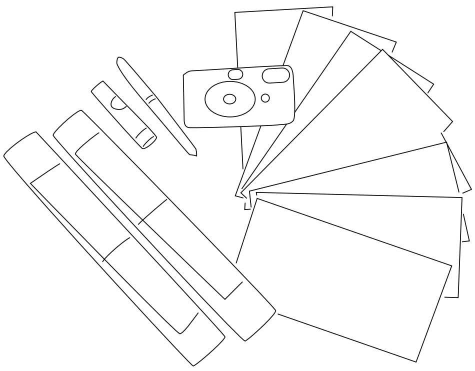
The idea of using probes is to provoke human beings to transcend their usual way of thinking, living and working by providing a probe kit to "think with" in different everyday situations.



Domestic probe package from the Equator Project [Gaver, 2001].

The Equator Project was carried out in the UK and applied design-driven techniques to explore people's lives. Part of the project focused on technologies for the home, seeking to explore the values people have in their lives away from work. To do this, the research group recruited about 20 households through advertisements in the popular press and in shop windows, and distributed "domestic probe" packages, with a variety of provocative tasks to which people were asked to respond. Gaver describes the contents of the probe as follows: "These materials include disposable cameras with requests for pictures (e.g. 'the most uncomfortable place in your home,' 'the view from your kitchen window,' 'something red'), a device for recording a vivid dream when they awake, a glass for listening to interesting sounds around their home*, and a collection of bizarre news articles for them to annotate. The probes are, in some ways, like the projective tests used by psychoanalysts: suggestive but ambiguous, they elicit revealing fragments from participants which inform and inspire our designs" [Gaver, 2001].

(* An ordinary drinking glass to, for instance, hold up to walls and listen. It was packaged in such a way to suggest how it should be used [correspondence with the author].)



A probe from the Mobility and Learning Environments Project.

This is an illustration of a different probe used in a learning environment in the Mobility and Learning Environments Project [Jönsson et al., 2002]. The aim of this cultural probe study was to explore learning processes and learning spaces in a university setting. At an early stage of this community of practice study, we adopted a metaphor for the students as nomads, roaming around the school, camping in the lounge suites, workshops and computer labs. The probe kit, placed in a customized bag, consisted of:

· Ten different colored envelopes containing various assignments
· A disposable camera
· Two maps of K3 (the specific school at the university)
· One map of Malmö City
· A pen
· A glue stick

The following scenario gives an idea of how the assignments worked. A typical day of the project starts at 10:00 when the students receive an SMS message telling them to open the green envelope. The instructions request them to gather as many as possible of the participants in the project, as soon as possible to take a group picture. The idea behind this assignment is to explore collaborative structures and possibilities in the environment. The next message is sent out at 13:00, asking the students to photograph their current location. The idea behind this assignment is to explore preferred working and learning spaces in the environment. The last message of the day, sent at 17:00 tells them to use the enclosed map of the city to show how they have moved in the city during the day. The idea behind this assignment is to track the spaces that students pass during a "school day"; to understand the relation between learning space and learning situations; and to understand the relation between their university environment and private space.

The applications of cultural probes have – as we see it – developed in two main directions, which we categorize as the *inspiration direction* and the *information direction*. The pioneer version of cultural probes is part of the first direction. It was developed at the Royal College of Art, Computer Related Design by Bill Gaver and focused on how the use of cultural probes among participants could inspire the design process. The group consisted of academic/artistic members who were working on how to redesign three different community sites in Norway, Holland and Italy. The idea behind these probes was to provoke inspirational responses from elderly people living at these sites [Gaver et al., 1999].

The information direction of cultural probes has developed out of the design research community oriented towards use of ethnographical methods in the design process. Pioneers in this usage of cultural probes have been members of the Cooperative Systems Engineering Group in the Department of Computing at Lancaster University in the UK, which has extensive experience in the use of ethnography in design [http://www.comp.lancs.ac.uk/computing/research/cseg/index.html].

"...TO LOOK AT THEIR ENVIRONMENT IN A NEW WAY – WITH NEW GLASSES."

When Gaver, Dunne and Pacenti talk about cultural probes as a means for provoking users in order to get inspiration for design, they are talking about the designers' inspiration [Gaver et al., 1999]. But we believe that the "friction" contained in the probe's design can also work as a way of inspiring users to create new use situations and to look at their environment in a new way – with new glasses.

	Inform	Inspire
Users	X	X
Designers	X	X

Our viewpoint: It is not just designers who are informed and inspired but users as well.

In an interactive design process involving people with extensive language limitations, questionnaires and interviews are extremely blunt instruments for capturing people's dreams, needs or aversions. Different kinds of cultural probes in this context are many times preferable because they do not require specific prerequisite knowledge or language abilities. In the Mobility and Learning Environments Project, we have for the last few years introduced a number of probes in a day activity center for people with cognitive limitations. The reactions to these cultural probes have both inspired and surprised those of us who have participated in the process.

Example: *Cultural probes as a source of inspiration*. One of the cultural probes we introduced is the ability to communicate with one another by means of a web camera. During one of the first connections, the sound disappeared so we could only see each other moving our lips. The researcher than telephoned the person at the day activity center and on the screen the two of them could see one another sitting there with the telephone receiver at their ears. From the facial expression of the person at the day activity center, it was obvious that this was a true "Aha!" experience. It took a while before the researcher realized that the surprise was because this was actually the first time the person in question had had the opportunity to see what it was like for the person who was calling. Since that day, the two take turns phoning one another even when the sound works on the computer because the feedback the user receives from the telephone signal provides even more clues to the mystery of telephoning.

3. Rehabilitation engineering and design

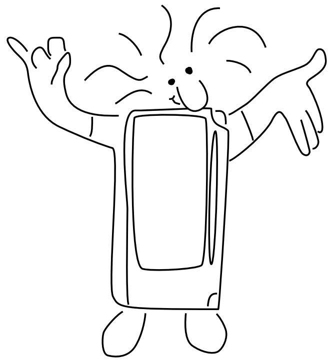
Many of the examples presented so far are taken from Certec, Lund University, Sweden [www.english.certec.lth.se]. More examples will follow. It is in the area of *knowledge generation through technology and design* that we have our strength. We have struggled with theoretical and methodological problems for more than a decade now. Previously published contributions are *Certec's Core* [Jönsson, B., 1997], and *Rehabilitation Engineering and Design Research – Theories and Methods* [Jönsson and Anderberg, 1999].

3.1. Research objectives

The explicit objective of rehabilitation engineering research is that people with disabilities will benefit from the results, sooner or later. These results can consist of prototypes suitable for product development or for continuing use as they are. They can also consist of prototypes as tools for acquiring relevant knowledge. Usually the research results consist of knowledge of needs, of how products should be designed, and of how the process for eliciting the needs and products should be designed. None of this can be achieved unless the researchers are *there* as *situated actors*, with design and technology as tools and with good opportunities for the people involved to provide feedback through their way of using or not using.

"THE EXPLICIT OBJECTIVE OF REHABILITATION ENGINEERING RESEARCH IS THAT PEOPLE WITH DISABILITIES WILL BENEFIT FROM THE RESULTS, SOONER OR LATER."

Example: *Common memory base/mutual understanding*. The high-tech Isaac Project is 10 years old, very alive and still going strong [Jönsson et al., 1998, Jönsson, B. 2004]. One of its most important lessons is, "You cannot know until you have tried" [Jönsson et al., 1998]. We do not measure the results in terms of commercialized technology (that has never been our goal), but in the ongoing developmental leaps in needs, desires, abilities, language and dreams in the participating individuals. Calling them "users" is not very relevant – for the last 10 years they have been inspirers, eye openers, participants, questioners. Our mutual situations have been in a state of constant change. One variable not to be ignored is that along the way we have gained a *common* memory base to proceed from and relate to, which has considerably strengthened the prerequisites for interactivity.



The main objective for acquiring knowledge of the needs of a user is not to establish user requirements for developing a specific product into a commercialized one, but to discover design principles for designing and developing other technological solutions as well. By developing prototypes in close cooperation with users up to a level where they can utilize the prototypes in real situations, it is possible to discover common patterns in user needs. These patterns generate design principles as well as new hypotheses. Of course, different individuals often require different solutions, but with new knowledge it is possible to ask more relevant questions in the design process.

As researchers in the field of rehabilitation engineering, it is important not only to reflect on the needs of the users, but also on the research process itself. How can the process for eliciting user needs be optimized and what kind of knowledge can be created using situated research methods? The acquired knowledge of users' needs, design principles and methods can also be used for developing products outside the rehabilitation field. Often, products designed for extreme situations can be good for situations in general. The additional requirements of people with disabilities may work as eye openers for new solutions.

Knowledge of a user's needs can also be useful in the rehabilitation process that does not involve technology. One result from using technology in the needs analysis process could be the insight that technology should *not* be used at all in the situation.

Recognizing that it is the needs, wishes and dreams that count, not the technology per se, does not mean that we underestimate the influence of artifacts and distributed cognition in daily life. Practically as well as existentially, dependence on well-known artifacts and self-made distributed cognition (on a conscious or unconscious level) is strong, not least for elderly people [Jönsson, B., 2003]. In the very design process, artifacts may serve as probes to reveal new knowledge about and for the user. Technology can be considered a language: it affords a means with which to ask, with which to intervene, and with which to give feedback. Certain aspects may be better expressed through actions than through verbalization [Vygotsky, 1930].

"CERTAIN ASPECTS MAY BE BETTER EXPRESSED THROUGH ACTIONS THAN THROUGH VERBALIZATION."

In the essay, *Technology is Society Made Durable*, Bruno Latour uses the "actant" as a term comprising artifacts as well as humans. The separate actants are not as important as are the relationships between them [Latour, 1991]. Artifacts transcend the will of people who might be far away in time and space. The artifacts and the technology as a whole make society sustainable, acting as implementations of agreements that originally were purely social. Since technology can only develop in dialogue with the culture and has to express values that are at least accepted there [Castells, 2000], it can be regarded as *thoughts made visible and robust*. The stability achieved through technology and artifacts is of special importance for people with disabilities. The actants should not be in charge but at hand, transcending the necessary involvement and help.

Example: *Awareness.* In an examination of a person with a central field visual loss, it was noticed that she unconsciously made use of an eccentric fixation when watching TV. By observing the different ways she used her residual vision and clinically defining the extent of the visual field reduction, she could be told where her vision no longer functioned. Awareness of the nature of her visual reduction meant that she then could consciously utilize different eccentric visual fixations for different functions such as reading and watching TV. This was nothing she had discovered on her own: she needed to be examined with the technical equipment in the lab and observed in order to raise her level of consciousness of existing possibilities in everyday life.

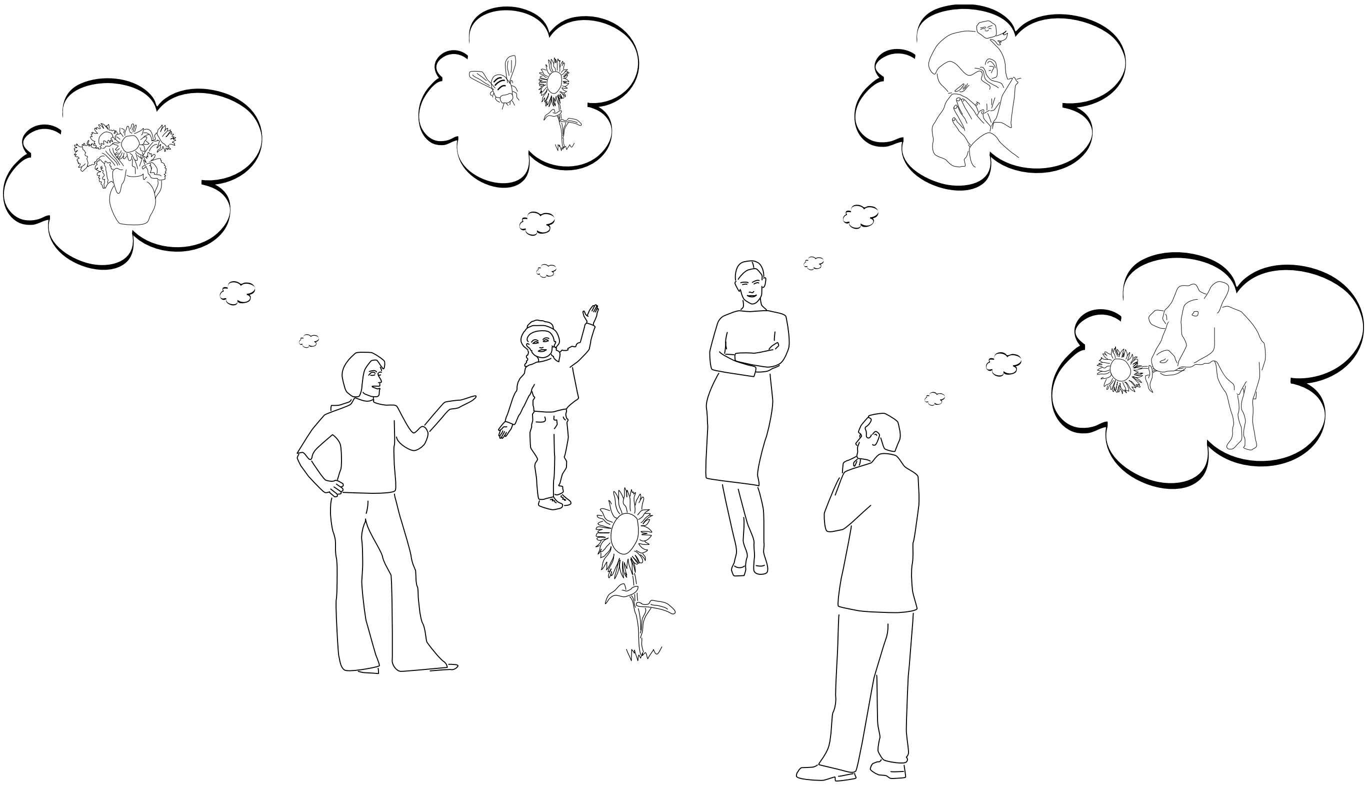
3.2. The lived disability

It is the *lived disability* that rehabilitation engineering should influence. Accordingly, the person is not seen as an object that can be studied, functionally measured and treated. She is, instead, very much a subject: the principle character with a history, future and personal appraisal of what is important and what is less so. However, neither her list of priorities nor her criteria for their fulfillment are accessible from the start. These are shaped through interplay with technology/ technological efforts (models, mock-ups, early prototypes) with designers and other people with similar disabilities.

The critical moment in the design of assistive technology is not about the choice between high and low tech, but rather between the *known* and the *unknown*. Jönsson and Anderberg express it as follows: "… it may be appropriate to question, at the very outset, whether the solution should imitate fully the solution for a non-disabled person (the parrot method), have the same purpose but a different form (the chameleon method), or be completely different and only retain its fundamental characteristics, its very core (the poodle method)" [Jönsson and Anderberg, 1999]. The parrot method is most common, because it is natural to build on an established, working technology. But you have to make sure the technology solves the right problem. You do this by analyzing and tangibly defining the function; the difficulties thus revealed can indicate that entirely different tools are needed than the ones that were thought from the beginning. The best solution may not be to imitate the "normal" form but to find one that is fundamentally different.

". . . IT MAY BE APPROPRIATE TO QUESTION, AT THE VERY OUTSET, WHETHER THE SOLUTION SHOULD IMITATE FULLY THE SOLUTION FOR A NON-DISABLED PERSON (THE PARROT METHOD), HAVE THE SAME PURPOSE BUT A DIFFERENT FORM (THE CHAMELEON METHOD), OR BE COMPLETELY DIFFERENT AND ONLY RETAIN ITS FUNDAMENTAL CHARACTERISTICS, ITS VERY CORE (THE POODLE METHOD)."

It is not necessarily so that a person's *lived change in function* is best expressed through words or through what are called qualitative methods. Documentation of what people actually *have* their technology for and the observable *effects* of this can sometimes provide more relevant insights. This is an approach that fits well with the designer's role as *actor* – he often shows how he thinks by means of his actions. To then interact with other people (users) based on the assumption that they also *show their thoughts through their actions* contributes to a good balance and interaction.



Example: *Change of perspective.* If professional expertise is to work in tandem with the lived experiences of the person involved, it requires that both parties have knowledge that overlaps, to a certain extent. It is hard to believe that so little analysis has been done on what difference the kind of knowledge the person has about the experienced disability or illness makes. In his work on *My Medical Images*, Henrik Enquist offers insight into how a person might consider his own medical pictures (of X-rays, for example) if you shift the purely clinical-diagnostic function of medical pictures to that of the person's pictures of his own body [Enquist, 2004].

3.3. A World Health Organization background

It was a big step forward when the World Health Organization (WHO) relinquished its previous disability classification system, the *International Classification of Impairment, Disability and Handicap* (*ICIDH*), and came up with the *International Classification of Functioning, Disability and Health* (*ICF*)[WHO, 2001]. Basing the new classification system on function rather than disability – starting with the functioning rather than the non-functioning – constituted a 180 degree turnaround.

In addition, WHO has a diagnostic classification, the *International Statistical Classification of Diseases and Related Health Problems* (*ICD-10*) [WHO, 1992]. While the purpose of *ICF* is to classify functions and functional possibilities from the perspective of health, ICD focuses on *diagnoses of illnesses*. Or more to the point: "In short, ICD-10 is mainly used to classify causes of death, but ICF classifies health" [www3.who.int/icf/beginners/bg.pdf].

"In short, ICD-10 is mainly used to classify causes of death, but ICF classifies health."

For rehabilitation technology and design, *ICF* is the best one to follow. An additional requirement, though, is that it is only the functions that the people affected *wish* to improve that are of interest. The focus is always on the *desired function* just as in *Our Own Devices* [Tenner, 2003].

"THE FOCUS IS ALWAYS ON THE *DESIRED FUNCTION...*"

3.4. Useworthiness

In his doctoral dissertation, *The Useworthiness of Robots for People with Physical Disabilities*, Håkan Eftring defined the useworthiness concept as follows: "Useworthiness is the individual user's assessment of the extent to which the technology meets the user's high-priority needs" [Eftring, 1999, p. 23].

The purpose of the concept of *useworthiness* is to focus on the importance of a product in the user's life situation, thereby gaining increased knowledge of the needs of the user. The related concept of usability [Nielsen, 1993; Lindgaard, 1994; Löwgren, 1993; ISO 9241, 1997] is more focused on the user interface, i.e. the ease and efficiency with which a product can be used, and to some extent on the functionality and versatility of the product, i.e. the tasks for which the product can be used. Useworthiness may be related to usability in rehabilitation engineering and design as effectiveness is related to efficacy in the medical area [Marley, 2000].

No one else can determine what is worth using for the person concerned. This may seem like a disadvantage if one wants to develop useworthy technology. However, by gathering experience of what different people find worth using it is possible to form a general idea of what many people who have similar interests and functional limitations, who are of the same age, etc., find worth using, and to develop technology to suit their requirements. In each specific situation, one must always engage in a discussion on the needs of the individual user.

From the medical world, Marley describes the differences between efficacy, effectiveness and efficiency [Marley, 2000].

Efficacy
"The extent to which a drug has the ability to bring about its intended effect under ideal circumstances, such as in a randomized clinical trial."

Effectiveness
"The extent to which a drug achieves its intended effect in the usual clinical setting." This can be evaluated through observational studies of real practice, allowing practice to be assessed in qualitative as well as quantitative terms. It can also be assessed by asking the patient,

"Does the medicine help?" and systematically including patients' perceived experiences with those of professionals in determining the most appropriate medication [Apoteket AB et al., 2003].

Efficiency

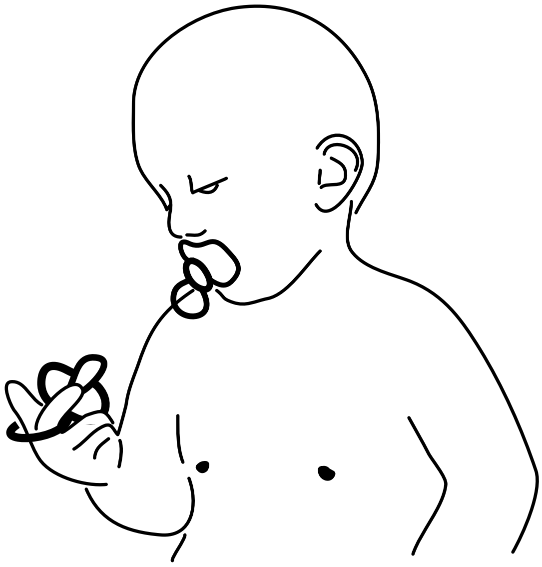
Efficiency depends on whether a drug is worth its cost to individuals or society. The most efficacious treatment, based on the best evidence, may not be the most cost-effective option. It may not be acceptable to patients. In every country, rationing of health care is a reality. There is no country, however wealthy, that can afford to deliver all the health care possible to the whole of its population at all times. Rationing may be implicit or explicit, but it will happen. Good effectiveness and efficiency studies will make this rationing more informed.

Example: *Cost effective for whom?* So far, health economics has not integrated useworthiness with cost aspects. But there are examples of efforts in this direction: Camilla Nordgren's study *Economic Consequences of Traumatic Spinal Injury* [Nordgren et al., 2003]. A traumatic spinal cord injury has extensive consequences for the injured person. After an initial period of hospitalization, a time of rehabilitation follows. Then the person has to learn to live the rest of his or her life under a new set of conditions [Brattberg, 2004]. This change and these conditions involve economic expenses to the injured person, the person's family and society. A comparison from the patient's point of view on useworthy-based efficacy (cost effectiveness) must include direct costs, such as those for institutional and non-institutional care, rehabilitation (including rehabilitation engineering), various subsidies and allowances such as sickness benefits, temporary disability pensions, disability benefits, car allowances and personal assistant allowances, as well as indirect costs such as lost income.

3.5. Redundancy

Redundancy means *excessive*. Excessiveness in rehabilitation engineering and design might be necessary, fruitful, liberating as well as unnecessary and confusing. That is one reason for discussing redundancy here. Another is that researchers involved often have their backgrounds in different sciences and carry deep-seated and partly unconscious attitudes towards excessiveness of different kinds. One researcher may be very positive to a certain kind of redundancy, another strongly negative and opposing. Cross-disciplinary work requires that this be brought to light and that it becomes the basis of constructive discussions, instead of everlasting mutual misunderstandings and negative judgements.

It may just be different views of the need for *redundancy* that is the reason behind a good part of C.P. Snow's classical division between the natural sciences and the arts [Snow, 1993]. The same may be the case for the division between technology and health care/caregiving. An important reflection outside of the scientific sphere is that it may very well be the aspiration of the natural sciences for objectivity and minimal redundancy that makes recruiting to the disciplines increasingly more difficult in step with the culture becoming more individually fixated and thus more varied.



The natural sciences contribute extensively to rehabilitation engineering; so do the arts. The natural sciences differ from other sciences through their attempts to *minimize* redundancy. The arts, on the other hand, with their focus on the individual go in the opposite direction. They strive to utilize a high, not a low degree of meaningful redundancy: the joy of language, large vocabularies and a personal tone that calls attention to and highlights the individualized in the individual. The technical-scientific domain assumes that the world is a vast, but finite entity, which can be accounted for down to the last iota. The literary domain assumes that core understanding of the world comes from the minds of an infinite procession of ghosts extending to the horizon of our known history and beyond.

This really stands to reason and does not need to cause any dissension if it were not for the tendency we humans have for comparing and judging. From the natural sciences' stringent point of view, accounts of a more descriptive than normative nature appear to be entirely too redundant to in any way comprehend. From the arts' point of view, on the other hand, the language of the natural sciences appears meager. Generosity can increase if we realize that understanding is a gradual process. Conscious repetition and variation may be more effective than brevity. Generosity can likewise increase if we direct attention to different genres. Genres of fact and genres of fiction exist – redundancy is needed in both, to different extents. A detective novel without a lot of redundancy would not make sense; neither would science fiction. Music is another example where the difference in redundancy is great between the theme in pure music (music without lyrics) and the redundancy in one of Mozart's operas.

Example: *How much is enough?* Archduke Ferdinand of Austria once offered Mozart a qualified compliment on his work: "Beautiful music," he declared, "but far too many notes." "Yes, your Majesty," the composer replied, "but not one more than necessary."

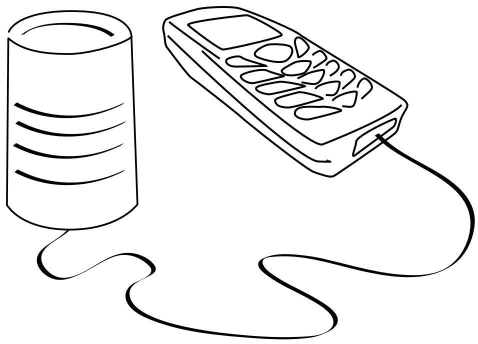
Redundancy in the technical world

In technical contexts, redundancy is an important factor to be systematically increased or decreased for a variety of reasons. Sometimes, as in information theory, the ambition can be the least possible redundancy in a given quality factor. It is possible, for example, to remove much in a spoken message (bandwidth limitation, and noise) without losing the sense (meaning, content, point, significance). This is possible due to the human endeavor to always decode both verbal and visual messages (i.e. highly compressed images) to something meaningful, without losing the contents.

Too much reduction in redundancy, however, results in an increased risk for misunderstanding and error and that life and diversity can disappear from communication. The core message can be robust enough to tolerate interference, but many of the finesses will disappear.

In many contexts, increased redundancy is systematically introduced in order to facilitate error detection (control figures in social security numbers serve this function), or to increase reliability and error tolerance. In the computer world, it is common that one or several functions are duplicated. Normally, only one is used, but in error situations the other takes over and the defective one can be repaired without disruption. The double brake system on cars is another example of redundancy. The presence of technical components can be unnecessary in a normal situation but provide better opportunities for error detection, increased error tolerance and reliability in emergency situations as well. Extra high reliability demands are placed on technology with which people with disabilities are to interact.

Example: *Redundancy and preferences*. In the Windows operating system there are three optional ways to copy and paste: via the edit menu, using two keyboard shortcuts, and the drag and drop function. Whether this redundancy is the result of a conscious design implementation or not, it in effect takes into account the various preferred behaviors of the human end users. This increases the generalization of the function by meeting the preferences and abilities of different users as well as offering variety to the individual. This redundancy in preferences could be applied to a wide range of design areas, making the final result useworthy for a greater number of people.



Example: *Too little redundancy*. Digital transmission of telephone calls. Digitizing and optimization of sound information in mobile phone communication results in parts of the frequency band being removed. At the same time, the call is divided up into shorter segments or packets of information that are sent in a random order. In the transmission process, the packets that don't manage to arrive in time are discarded. When the message is reassembled at the other end, it is in principle another voice that is heard. The original voice has been lost and with it a good part of what is personal in the conversation has disappeared, which could be of critical importance for the listener to really understand the call.

Redundancy in cognitive rehabilitation

Strong demands for freedom from variation can be synonymous with low redundancy. If a person has learned to associate his newly cleaned room with the odor of Ajax, he may become upset if the staff exchanges it for Botanique. Routines are all good and well, but when it comes to learning, things can be different.

There is an assumption that everything has to be done in the same way when you teach a person with cognitive limitations, that is, with extremely low redundancy. It is very seldom, however, that you can accomplish this, often resulting in that what is best can be the enemy of what is good. This is particularly the case if you adjust to the weakest link in the personnel and state that if just one of them can't do this, no one else is allowed to either. This becomes an effective obstacle to development.

When it concerns spoken directions/information to people with limited short-term memory or language disabilities, redundancy should be low. The person who every Saturday and Sunday asks a hundred times if the streetlights are going to be turned on and receives answers such as: "Not now," "Tomorrow," "Tonight," "Later," "When it gets dark," "Stop bothering," "It's light now." – is given no reasonable chance to associate his question with all of these answers.

Redundancy in rehabilitation engineering

There is a great need for excessive redundancy in rehabilitation engineering. One such example can be, at least initially, to make use of as many senses as possible (e.g. by using both sound and pictures), even if one of them is probably sufficient. To start broadly in order to later subtract functions is often particularly constructive. The more clues there are in the setting, the more chances the person has to find what can help him or her to think better.

A sparsely furnished room offers no associations. But a unique day activity center for adults with cognitive limitations like the Pictorium, is filled from floor to ceiling with different sorts of "mental tools" ranging from fragrances to pictures which afford several different entrance points [http://www.english.certec.lth.se/isaac/intro.html].

Vygotsky writes in *Mind and Society* about the difference between chimpanzees and two-year-old children [Vygotsky, 1930]. Chimpanzees can only make use of the mental assistance that exists within view, while the child through language can also receive support from people and things that do not exist in his field of vision. For people with cognitive limitations or for those in extremely stressful or conflict-filled situations, it can be difficult to utilize that which is not present in the here and now. One way to solve this is to provide, through technology, rituals/routines that are initiated in a particular situation leading to conditioning.

Example: *Technology as support for routines*. At the Pictorium Day Activity Center in Lund, they have created a distinct and clearly demarcated area that they call the Emergency Spot where a person can go to sort out things that have to do with physical injuries, accidents and related problems. All that the people attending the center need to know is that if they for any reason feel discomfort, they are to automatically go to the Emergency Spot to get advice and support. The actual physical setting is extra important as a reminder for those who are unable on their own to initiate the process of finding relief for their pain. Often times, it is enough to just sit down on a chair in the Emergency Spot to get, through digital pictures and artifacts, the thought support needed to go on to the next step, which can range from asking a friend to come and look at an injury to asking the supervisor for help in calling a nurse.

"...REDUNDANCY IN THE TECHNOLOGY CAN COMPENSATE FOR THE HUMAN BEING'S MOMENTARILY REDUCED REDUNDANCY."

Increased redundancy can be a means of increasing technological reliability. A well thought out and carefully prepared redundancy can also mean that a crisis situation can be sorted out, even when a disabled person is incapacitated by it. In such a situation, the redundancy in the technology can compensate for the human being's momentarily reduced redundancy.

4. Situated research

The researcher's opportunity and ability to be situated while designing is of great importance. The same goes for his or her ability to learn and invent from the situation and to activate and integrate knowledge from previous situations/design processes/technical knowledge.

The situated is not only synchronous but asynchronous as well. One of the most important aspects of the situated is its strong triggering of memories from earlier design situations: you get so close to a situation that associations to other similar ones are almost unavoidable.

Example: *Witnessing when it happens*. The participants at a day activity center were watching a home video of themselves. One of them stood in the background and did not appear to be particularly interested except for two short scenes. In the first, he was in the picture a few seconds washing dishes and in the other he was showing his wallet and keys. On both occasions as he was watching the video, he demonstrated by gestures, mime and sounds that these scenes affected him in an entirely different way than anything else that was on the video. Since the personnel and a researcher (who happened to be visiting on that occasion) had for a long time been unsure of his ability to interpret pictures, these reactions provided an indication that he most likely was able to recognize himself and his possessions in pictures. Without knowledgeable observers being present at exactly that moment, it would have been much more difficult to make this connection.

Example: *Situatedness is not enough.* Observations and participation are necessary but not sufficient conditions. It is not enough to say: "I was there and saw with my own eyes!" because what a person sees depends on his or her perspective, previous experiences and knowledge (obvious in hermeneutics and phenomenology but not always so in technology or medicine). A clinical department head and a chief physician at a psychiatric clinic who had worked there a long time saw something entirely different in a patient than a teacher who came on the scene several years later. Their separate views of reality from their respective worlds differed infinitely. In the one, the patient in question was dangerous and impossible to be near for any extended period of time; in the other it was possible to be alone with her in a locked room. They were all working there as sources of first-hand information, but their conceptual frames of reference were so different that the experiences they had were quite disparate.

A third researcher from the outside had yet another interpretation. When she tried to grasp the basis on which technology could be introduced, it became obvious that it was the situation rather than the patient who was sick. When these new ideas were introduced into the system, the old ways of thinking gave way entirely [Mandre, 1996a, 1996b, 1997]. "Experience won't get you very far without reflection," while at the same time, "Reflection won't get you very far without experience" [Jönsson, B. 2001].

4.1. Abduction

Situated research is closely connected to the acknowledgement of *abduction* as a fruitful method for scientific work. Abduction starts with empirical facts as does induction but accepts that (earlier) theories determine what facts are observed and how they are interpreted. During the research, sudden discoveries or new patterns for interpreting empirical facts may lead to new hypotheses. Theories as well as observations must then be reinterpreted [Alvesson and Sköldberg, 1994; Niiniluoto, 1999].

"Abduction demands that you strive to describe not only the changed views but also what characterizes the 'new glasses' for observation and analysis compared to the old ones."

Abduction demands that you strive to describe not only the changed views but also what characterizes the "new glasses" for observation and analysis compared to the old ones. Cultural probes (see section 2.7 and chapter 5) can be an excellent means in abduction since the outcome of cultural probe studies urges reinterpretation and reflexivity.

In reality, we think that abduction is frequently used in the natural as well as the social sciences, even if it is not always recognized. It is still more common in rehabilitation engineering and design due to the large probability that a situated, intense, creative and concrete human-related process yields an unexpected result and urges a reinterpretation of the starting point and initial hypothesis. Old thought patterns may be questioned and so the spiral of abduction is initiated.

The genius and experiences of a skilled design researcher are preconditions for a fruitful outcome of abduction in rehabilitation engineering. A relevant and fruitful association at the right moment, a threaded pattern guiding thought processes, and a clever preliminary hypothesis are necessary – if not, it is a waste of time, especially for the disabled person. But however brilliant the designer might be, the need to listen to how reality "talks back" is as necessary as is the ability to gain new ideas from reflection.

According to Niiniluoto, "The general form of this 'operation of adopting an explanatory hypothesis' is this:

The surprising fact C is observed;

But if A were true, C would be a matter of course,

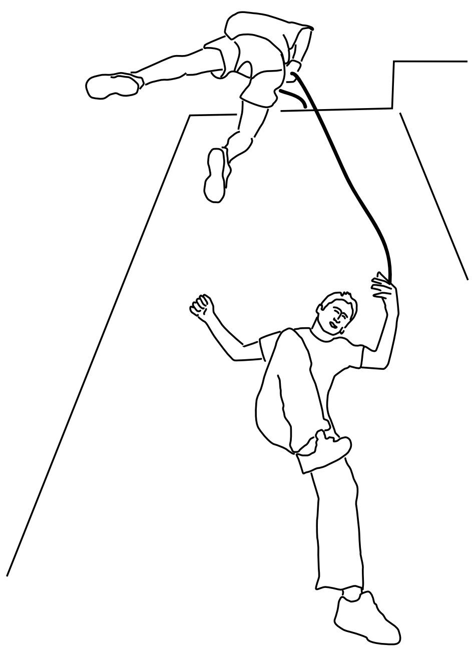
Hence, there is reason to suspect that A is true.
[Peirce, 1931-35, Paper 5.189). This schema shows how a hypothesis can be 'abductively conjectured' if it accounts 'for the facts or some of them.' . . . Moreover, the conclusion is not A itself, but the assertion that 'there is reason to suspect that A is true'" [Niiniluoto, 1999, p. 5, online version].

Niiniluoto comes to the following conclusion about the necessity of abduction: "What is the best way of arguing that our abductive inferential practices, though fallible, are and have been to some extent truth conducive? Just to postulate an inborn human capacity to hit upon true hypotheses, like Galileo's *il lumen naturale*, is hardly convincing. It is more promising to argue that abductive inferences (in particular, our perceptual judgments) are largely reliable within our everyday life, and that this fact about the human species can be given a naturalistic evolutionary explanation: 'All human knowledge, up to the highest flights of science, is but the development of our inborn animal instincts,' as Peirce put it [Peirce, 1931-35, Paper 2.754]" [Niiniluoto, 1999, p. 13, online version].

An obvious reason why skilful applications of abduction are so important in rehabilitation engineering and design is the time aspect. As previously mentioned, children with disabilities are aging at the same speed as able-bodied ones. Solutions that appear two years later are no longer "solutions" to their problems. The same goes for many adults: their needs, wishes and dreams are situated in time and space. They may not be demanding instant solutions, but letting too much time lapse can make the results useless for the person(s) involved.

4.2. Where the action is

It is not just a matter of *being there*, of being *situated,* but also of grasping the action *in its context*; not to immediately intellectualize it [Mandre, 1999, 2002]. This is comparable to the methods of ethnology as described by Håkan Jönsson [Jönsson, H., 2000]. Action goes for both the designer and the participants – the central persons. The question that faces a research project is, "What do we have to *do* in order to find out?" rather than, "What *is* the situation?" By acting, you can capture at an early point many of the practical problems and conditions that you would otherwise have missed [Suchman, 1987]. The technology itself can serve as a catalyst and can provoke reflection, answer existing questions while at the same time raising new ones [Jönsson, B., 1997].



Technology can be designed so that it affords new, exciting possibilities, not just so that is answers the conscious needs you are already aware of.

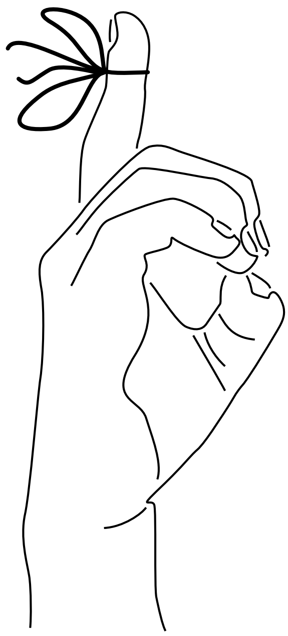
Example: *Technology as a challenger/teaser.* A physically impaired woman wanted to have a robot arm for a variety of reasons. One was that she knew that with its help she would be able to come up with many *new* areas of use as well as ways of using it. The moment of triumph was knowing that she would come up with something *later* on [Eftring, 1999].

Example: *Learning potential.* An "hour rule" time telling device is more exciting than a door opener. A door opener can be used for opening doors. Period. But an hour rule can have all kinds of imagined and unimagined uses: structuring, planning, sequencing, etc. Both examples are closely associated with learning and empowerment. Technology that leads to something else is exciting; people learn and change, reshape the technology and are reshaped by it [Svensk, 2001].

Edwin Hutchins started to use the concept *distributed cognition* in the middle of the 1980s to indicate that the thinking of individuals arises out of an interaction with other people and objects. Hutchins has studied cognitive processes in the cockpits of airplanes and on the navigation bridges of navy ships. He demonstrated that the final result of the actors' cognitive cooperation could not be derived from any single actor but was the product of their interaction. But Hutchins goes even further than that when he attempts to explain cognitive processes. Thinking is so dependent on cultural and social phenomena that it cannot be studied under artificial conditions in a laboratory but only in real situations, which is apparent from the title of his most well-known book, *Cognition in the Wild* [Hutchins, 1996].

"THINKING IS SO DEPENDENT ON CULTURAL AND SOCIAL PHENOMENA THAT IT CANNOT BE STUDIED UNDER ARTIFICIAL CONDITIONS IN A LABORATORY BUT ONLY IN REAL SITUATIONS..."

Example: *Media as mediator.* People often learn the best by meeting others with similar problems. When you can identify with someone else, you do not feel alone. If in addition you can meet others who have similar problems but who have come further – good role models – you gain hope in the possibility of achieving a good quality of life yourself. The internet is a superb meeting place for these kinds of conversations. There you are able to think first and talk later. It becomes a more reflective discussion compared to the normal ones that occur in the same place and at the same time. Many abductive elements are included in this kind of conversation, both during and after [Brattberg, 2003].



A phenomenologically based contribution in the interaction design area is Paul Dourish's book *Where the Action is: The Foundations of Embodied Interaction* [Dourish, 2001]. Dourish comes from a computer science background but contributes in this work to new perspectives on the philosophy of science and methodological approaches for interaction design.

"Embodied interaction" is an approach to interacting with software systems that emphasizes skilled, engaged practice rather than – as we often see in computer-based practice – disembodied rationality. Dourish bases his analysis on movements in the human-computer interaction and interaction design areas, referred to as "tangible computing" and "social computing". Dourish formulates his ideas in contrast to the narrow cognitive perspective that has dominated the thinking of computer systems.

He claims that this positivist, Cartesian cognitivist approach makes a distinction between the mind as the seat of consciousness and rational decision-making with abstract representations of the world, and the objective, external world as a largely stable collection of objects and events that can be observed and manipulated according to the internal mental states of the human [ibid., p. 18]. The phenomenological approach suggests in contrast to this division that our experience of the world is closely tied to the reality of our bodily presence in the world. The same argument holds for our social actions: A conversation between two people is dynamically constructed in response to the present action rather than being abstractly planned in advance.

Dourish uses this criticism of "Cartesian cognitivism" as the grounds for establishing the idea of embodiment. When he talks about embodiment it should not be understood as a simple, physical reality. Instead embodiment "denotes a form of participative status. Embodiment is about the fact that things are embedded in the world, and the way in which their reality depends on being embedded" [ibid., p. 18]. Dourish presents three arguments for why this concept of embodiment is relevant for interaction design.

First, because interaction designers need to understand that interaction is closely connected to the context in which it occurs, they must develop sensitivity to settings, and understand how interaction is embodied within these settings.

"...INTERACTION DESIGNERS MUST DEVELOP SENSITIVITY TO SETTINGS, AND UNDERSTAND HOW INTERACTION IS EMBODIED WITHIN THESE SETTINGS."

Example: *Technology in context increases precision.* A person with a physical disability thought her wheelchair-mounted robot arm was too slow. This information cannot just be pulled out of context and result in the robot being supplied with stronger and heavier motors (something that probably would make the robot less useful). "Too slow" can refer to speed but it can also refer to acceleration. It was, in fact, "too slow" when she tried to fry meatballs: they slipped away when she attempted to turn them with a twist of the robot arm. In this case, it was the acceleration that was too slow. It was also "too slow" when she was going to stir the sugar in her teacup. In this case, it was the speed that was too low. But neither of these needed to be remedied with stronger motors: both the twisting and the stirring problems could be solved technically with an improved construction of the grip device.

Second, this embodiment approach reflects a more general approach to considering work activities and artifacts in concrete terms rather than abstract ones.

Example: *Technology as an eye-opener.* During a fire drill in a group home for people with developmental disabilities, a staff member held a lit cigarette under the smoke detector and asked the residents what they were supposed to do when the alarm went off. One of the residents got up and leisurely walked over to the newspaper basket, picked up a newspaper, went back and waved it under the smoke detector. It turned out that every morning when they toasted bread, the smoke detector went off. A staff member usually fetched a newspaper and waved it under the smoke detector to stop the alarm.

Example: *Concrete and logical situated understanding.* One Saturday morning at 7 o'clock a man rushed out from his apartment down to the bus stop. By chance, his personal assistant happened to be walking by just then and she saw that he stood for a while waiting for the bus. When it was about 10 meters from him, he rushed back into his apartment. Why did he do that? When she asked him a little later he told her that he was looking at the number of the bus; if there was only one digit, it was a workday, but if there were two digits he was free. Today there were two, which meant that he was off. During his 16 years in special education he had repeatedly practiced the days of the week without any real understanding. Now he had discovered a method on his own for determining if it was a workday or a weekend by looking at the number on the bus.

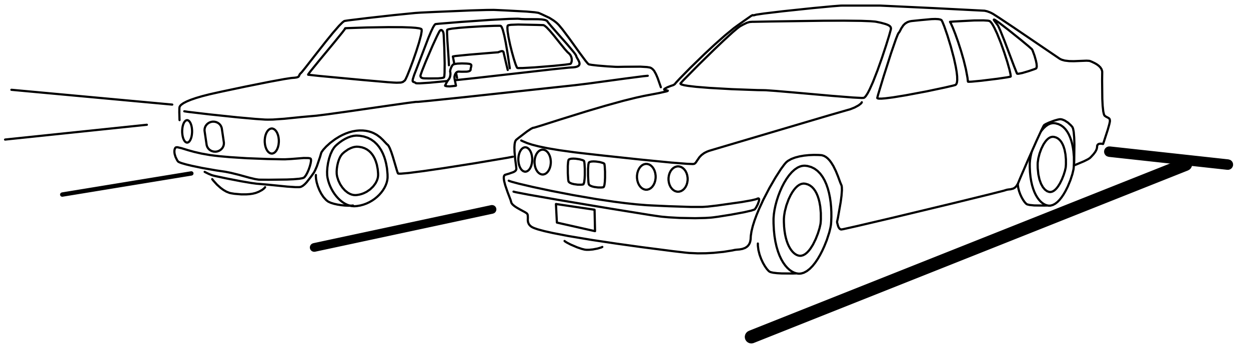
Third, artifacts of daily interaction can play different roles through their direct embodiment in the world we occupy.

Example: *Visibility as a tool for empowerment.* In addition to the bulletin board with pictures of the staff members who were working that day, a group home also had one with pictures of those who were not. Early one morning, a young man sneaked up and moved the picture of Max from the working bulletin board to the one with those who were off for the day. Then he went back to bed with a satisfied expression on his face. He was unable to talk, but the pictures afforded him the opportunity to clearly show that he did not like Max. He had tried to express it in other ways before, but neither Max nor the rest of the staff had understood. For the personnel, the use of pictures was primarily a way to give information; for the resident in question, it also became a way to make a point and to wish.

4.3. Constraints

During our work with knowledge-based systems and tools for visualization of knowledge structures, we have come to focus on the importance of constraints [Magnusson and Mandre, 2004]. Constraints may sound negative, but in fact they are often a necessary condition for much of the activity we humans engage in. Well-selected content constraints constitute a support not only in problem solving but in such things as creative/artistic activities as well [Gedenryd, 1998]. In order to deal with problems, we simply have to limit ourselves. External constraints can be an added value in this situation because we need not put energy into keeping track of them and instead can focus on what is important in the current context. And constraints may not only concern content; they are just as important when it comes to structural or dynamic factors. In this way, constraints tie in naturally with the reflection in and on action described by Schön [Schön, 1983].

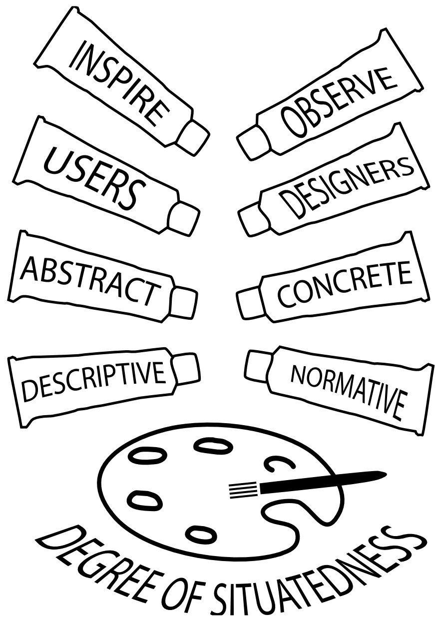
In a situated approach, the actual context automatically provides a set of external constraints relevant for the situation in question. A non-situated approach may cause the designer or the researcher to ignore constraints in the situation. Non-situated approaches also force the designer or researcher to spend time and energy trying to find and uphold the appropriate constraints. The full complexity of reality will rarely be found even in a detailed description. This is particularly true for the evolution of constraints – i.e. the fact that the situation and thus the constraints will evolve during the design process.



5. Transcending practice – methodological considerations for engaging users in design

The most crucial in a design process is, perhaps, to transcend well-established practices and habits based on many years of experience. To do this it is necessary to establish and use methods and means that allow the viewing of very familiar situations and environments in a new way (to make the familiar strange and the strange familiar).

Example: *Expert systems*. In the Svarne Project, a decision support program was developed to help staff members analyze the causes of violent behavior in group homes for adults with cognitive limitations. The aim of the project was to investigate if and how expert system technology could be used for making visible what is often referred to as soft or tacit knowledge. To elicit the knowledge needed to build the program, successive prototypes of the program itself were used. In this manner, familiar knowledge was presented in an unfamiliar way, and it was apparent that this new form of representation (the decision support program) was a very effective tool for generating discussions and eliciting more information. Svarne was, in fact, making familiar situations look strange. And by doing so forced the participants in the project to reflect over and articulate the knowledge they possessed [Magnusson and Svensk, 1997].



Relevant dimensions when working with users on designing qualities of future artifacts.

When narrowing the range of methods and theories that we have found relevant and useful in design, we have identified several dimensions of enquiry, which have been important in most of our design projects and in methodological discussions. We address nine of these in the following discussion as if they were five: inspire-observe, users-designers, abstract-concrete, descriptive-normative and, finally, the degree of situatedness. These five dimensions are based in part on the framework of Kensing and Munk-Madsen [Kensing and Munk-Madsen, 1993] and on our inspiration from working with cultural probes. Degree of situatedness could be considered a meta-dimension, which to some extent is dependent on the other four.

5.1. The inspire-observe dimension

When designing qualities of future artifacts we need to be informed, but also to be inspired. A majority of the methods in the design area have focused on how to inform the designers. Or, rather, the role of the users in the design process has often been to inform the designers by answering their questions or being observed in relation to their current work or life situation. On the other hand, inspiration for a new design or another way of living or working has often been considered the designers' domain or authority. This dimension is closely related to the discussion of whether we as researchers (and designers) should be allowed to or on purpose affect or influence the situation we study. As mentioned in chapter 2, the information direction of cultural probes has developed from the design research community oriented towards use of ethnographical methods in the design process. In this way the researchers do not affect the users by being present and watching them, but instead collect needed information in parallel by "disturbing" the users' habits and procedures through the "friction" caused by probes; by giving the users a verfremdung[1] effect in their own life or work situation, which in turn can be a source of inspiration for design. The initial application of cultural probes [Gaver et al., 1999] focused on "disturbance" or provoking daily living as a means for inspiration.

5.2. The users-designers dimension

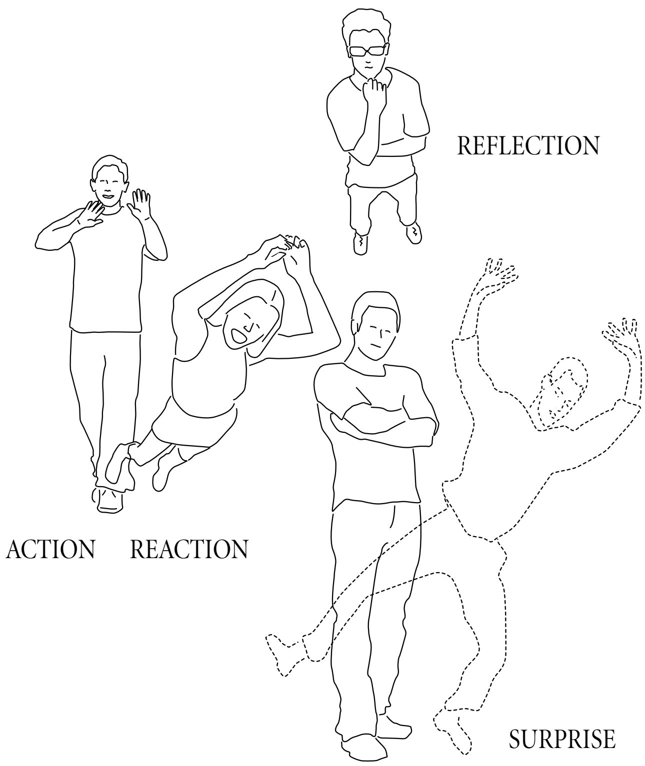
The users-designers dimension is related to the question of communities of practice as described in chapter 2. We believe that it is important to realize, acknowledge, and accept different perspectives and understandings of the use-context design. Probably the most important question here is to consider designers as one community of practice, and different user groups as others with other sets of skills and techniques. A recurring issue in different design traditions and schools has been whether the designer should be autonomous and act as an expert in understanding different communities of practice's needs and wishes when designing use qualities of future artifacts [Gaver et al., 1999].

[1] The "alienation effect" central to the dramatic theory of Bertolt Brecht's theatre, i.e. techniques designed to distance the audience from emotional involvement in the play.

While we believe that it is crucial for the designer to understand different communities of practice, we are convinced that we as designers also need to create “friction” and “surprises” in the users’ understanding of their own situation, as well as in the designers’. As mentioned earlier about the cultural probes method, the “friction” contained in the probes’ design can work to inspire users to discover and explore new use situations and to look at their own situation in a new way – with new glasses.

The essence of this dimension is the understanding of the need for creating understanding among the designers as well as users.

“THE ESSENCE OF THIS DIMENSION IS THE UNDERSTANDING OF THE NEED FOR CREATING UNDERSTANDING AMONG THE DESIGNERS AS WELL AS USERS.”



5.3. The abstract-concrete dimension

The abstract-concrete dimension in design was introduced by Kensing and Munk-Madsen [Kensing and Munk-Madsen, 1993]. As academics, we are not only used to coming up with abstract representations in almost all areas, but are also forced to do so as a demonstration of systematic and high-level understanding of a specific problem. Daily life experiences and concrete observations rarely count on their own. We believe that the concrete and the abstract are complementary, and that we should be much more aware of reaching for and understanding on both levels during the design process. Not only should we as designers develop both forms of knowledge, the users should also be allowed to create both an abstract and a concrete understanding of the future use qualities and technological options.

“...THE USERS SHOULD ALSO BE ALLOWED TO CREATE BOTH AN ABSTRACT AND A CONCRETE UNDERSTANDING OF THE FUTURE USE QUALITIES AND TECHNOLOGICAL OPTIONS.”

5.4. The descriptive-normative dimension

Somehow this dimension is an overall issue related to the three former dimensions. It is a crucial issue which we as designers and researchers are constantly confronted with. It is closely related to the issue of *change*. Basically change can be initiated in two ways: either as a reaction to a situation we do not like, or by acting towards a desire or an imagined situation. Strategies for change often have their foundation in problem solving, which seems to exclude desire as a valid initiator of change. In problem solving the focus is on "that-which-is (description and explanation), versus that-which-ought-to-be (ethics and morality), without consideration for that-which-is-desired (desiderata)" [Nelson and Stolterman, 2003, p. 133]. While the first two correspond to a descriptive and a normative change strategy respectively, the concept of desiderata is an inclusive whole of aesthetics, ethics and reason. Desiderata is about what we intend the world to be – the voice of design.

5.5. The degree of situatedness

"THE GREATER THE DIFFERENCE BETWEEN THE DESIGNER'S AND THE USER'S WORLDS OF CONCEPTS, THE GREATER THE NEED FOR A USER-ADJOINING DESIGN PROCESS..."

The greater the difference between the designer's and the user's worlds of concepts, the greater the need for a user-adjoining design process, and the greater the applicability of the sentence, "You cannot know until you have tried" [Jönsson et al., 1998]. This is rather impressive when designing communication facilities for differently abled people. A communication artifact resulting from a design process is supposed to represent distributed cognition not only to the designer but to the differently abled user as well. This strengthens the need for situatedness in the design process.

To sum up

To be *situated* in the design process can be understood through the five dimensions just presented. You need to immerse yourself into concrete experiences – not only base your understanding on abstract understanding. You need to accept and acknowledge the existence of different communities of practice. You need to allow disturbances to enter into the users' and your own worldview, to be inspired and not only informed through observation. You need to accept desire as an initiator of change. Desire can only be discovered by engaging users in the design process and engaging yourself in the situation of the users – being situated.

6. Scientific positioning of design and rehabilitation engineering

In rehabilitation engineering and design, the researcher is supposed to *lean forward* rather than *lean backward*, to be a *practitioner* but a reflective one [Schön, 1983]. Although seldom mentioned or brought up to a conscious level, technology and design involve *action research*. Actions, inventions and interventions are at the very core of technological and design work.

Action research is sometimes considered questionable in social sciences. There is a fear that the researcher might be involved to such a degree that he or she is no longer "objective", and that the situation is so biased that it can no longer be scientifically studied. However, *not* being an action researcher in rehabilitation engineering and design, not aiming to improve situations, solve problems, strengthen capabilities, enable functioning – at least in the long run – could be considered unethical in the context discussed here.

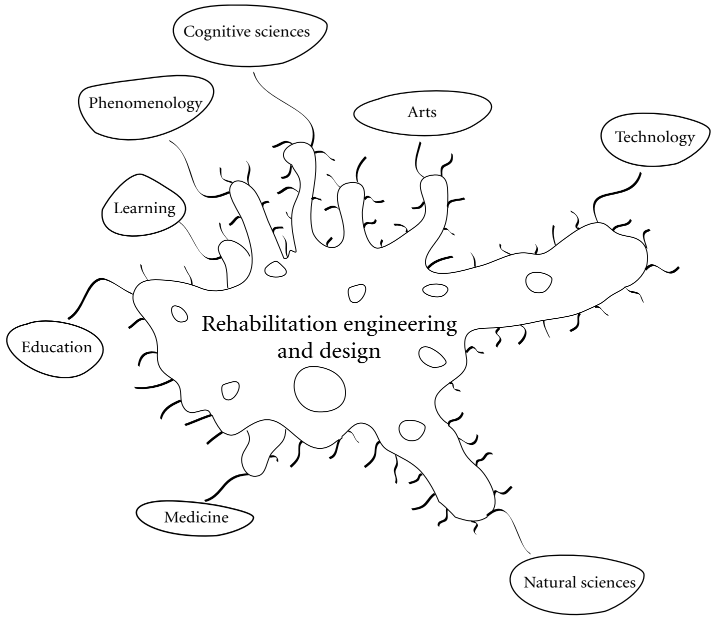
We are aware of the obvious risks involved when the researcher defines the human problems himself and solves them himself, merely from a technological point of view, without being enough of a listener, observer, provoker, analyzer. But that is not a problem that can be solved by suppressing technological aspects of technological efforts or forcing design processes to work with words rather than cultural probes, mock-ups and interactions. Neither can it be solved by dictating that the process has to apply quality criteria from behavioral, cognitive, natural and social sciences.

To navigate between Scylla and Carybdis, between being an intense listener and reflector on the one hand, and an interpreter, inventor and technological action researcher on the other, is as delicate as it is important. But that is exactly why we need to invent, discuss and reinvent balances specific to the design area from which to relate to other sciences. While doing so, we do not want to be ignorant; nor do we want to be mere imitators. There is no reason to be too humble – we have our quality criteria as the natural and social sciences have theirs. Ours are linked to the interaction with the user, through cultural probes, sketches, mock-ups, prototypes, material or immaterial artifacts; and observing and intervening in the actual usage. It is possible to use emerging technology early in the design phase to reveal new knowledge about the user. Of course, a process of this kind influences the persons involved, but that is nothing negative. On the contrary, it is a built-in part of the process and a cornerstone of the research. It is part of the *aim* of the iterative design process. Including the user with the designer and researcher in the design process is "a goal, not a foul."

6.1. Relationship to other sciences

Regardless of theoretical or methodological standpoint, the only research result worthy of the name is *new knowledge*. Accordingly, in a research project it is seldom the entire process or the project result as such that is the actual research result; the new knowledge generated in the project often constitutes a rather minor portion. But it is essential to identify and define this knowledge and relate it to what already exists. This is quite a delicate task, especially when the research is carried out, in part, in the domain of phronesis (explained in 6.3).

In analyzing whether the emerging knowledge is new and scientific, it helps considerably if the methods involved are standard for the related scientific fields. However, this is not always possible. The phenomenology of Husserl's time as well as grounded theory and to some extent abduction (see section 4.1) mean that the phenomenon that is the object of investigation can and should be the controlling one [Husserl, 1901]. There is no one "phenomenological method" that can be used in all situations.



The disadvantages with inventing your own methods are manifest – much is required for the results to be considered credible. At the same time, the advantages are also manifest: it is through them that you achieve proximity to the reality being investigated. The researcher is forced to take more responsibility for the knowledge building than if he or she follows established methods.

In one recent doctoral dissertation, two main questions were explored: "How can tools help organize tasks to make them cognitively easy to perform?" and "How do artifacts, and the strategies for using them, develop over time in cognitively beneficial ways?" In order to find the answers, the author went outside of the prevailing methods, which required a careful accounting of the methods used – their strengths and why they had been necessary [de León, 2003].

6.2. Natural sciences

Scientific knowledge in the natural sciences fulfills many of the needs of design. It is *concrete*. It *derives* its fundamental basis from (experimental) investigations (induction) or *relates* to the concrete through *comparing* reality with deductions from invented theories. However, one of the quality criteria of the natural sciences differs from ours: the natural sciences seek to be objective *and* general, from the first moment, while we seek to be *situated* and to work with something that is *relevant* for at least the one person in question, in *her* daily life. Sometimes (often) the design results from rehabilitation engineering can also be of value on a more general level, but that comes later.

Objectivity *needn't* be tied to generality – even though it has classically been the case in the natural sciences, such as in the cosmos or microcosmos. It is also possible to be objective in individual cases without the intention of generalizing the results, but rather with that of making the objective method accessible to many.

Example: *Verifiable communication*. What can you elicit from a person by only using the technical – for the person's sake? Emma is 19 years old. Ten years ago she sustained a severe head injury when she was kicked by a horse. She is unable to speak and her mobility is extremely limited. She is able to move the little finger on her right hand with difficulty. Her parents contacted the division of rehabilitation engineering some time ago asking for a device that would enable Emma to express "Yes" or "No."

Human decoding of Emma's little finger movements proved to be extremely subjective: most probably the answer was often what the person asking wanted it to be. The Minimeter was developed. It consists of a TV camera mounted on top of a personal computer that focuses on the user's face. Specially designed software decodes facial expressions. The Minimeter, with two equivalent yet distinct head movements generated by Emma (turning her face to the right or left) for "Yes" and "No" was objective – the user was not able to "cheat" on the answer. Here are some examples: We asked Emma different questions, some of which the answers could be clearly verified and some that were expressions of her preferences. An example of the latter was: "Would you like to take a break, Emma?" If she answered "Yes," we took a break, otherwise not – Emma decided and took the consequences of her answers. We asked: "Would you like chocolate pudding when you get home?" She answered, "Yes," and was given the pudding accordingly. This question continued to be asked at the end of each training session – and she always answered, "Yes." After a number of times, she unexpectedly answered, "No." **Those present in the room reacted strongly; they thought there was something wrong with the equipment – the answer wasn't "right"**. She was asked the question again and answered, "No." After an additional five minutes she was asked the following question: "Are you tired of chocolate pudding, Emma?" She answered, "Yes." Emma's control of the software through the Yes/No response was objective. The equivalent movements for "Yes" and "No" along with feedback in the form of a round globe on the screen that changes color and follows Emma's slightest head motions, shows continuously where Emma is going. She can change her mind several times before the answer is finally given. She can work entirely at her own pace [Breidegard, 2004].

Example: *The owner of the problem*. The very early stages of the periodic cycles of schizophrenia or depression can be difficult to detect for the person involved as well as for those around her. And if they notice a change and communicate their observations, it can be easily brushed aside. But if in the use of an artifact, a keyboard for example, distinctive features indicating the onset of a cycle can be detected, simple feedback from the artifact to the person involved can warn her of the imminent onset and in the best scenario, contribute to the cycle being milder or interrupted. Feedback of this type is guaranteed to be objective but is *not* generally applicable: different individuals have different patterns of change.

Example: *The importance of relevant feedback*. It is quite easy for people to ignore for a long time the signals from their bodies indicating high levels of muscle tension. Simple, portable biofeedback equipment, preferably hidden from view, can provide an objective indication that it is time to stretch. Then it becomes an individual matter as to the level at which the apparatus should set off an alarm. It is also highly individual how the person learns by using the device to reestablish contact with her body though natural feedback.

Example: *Technology as a discloser.* Being observant of what is not happening in everyday life can be difficult to the point of impossible. Technical documentation can help. If someone in a group home asks for assistance in paying the telephone bill and you discover that there is not a single local call to pay for, you should react. Is it because he doesn't have any friends or acquaintances? Does he understand how to use the phone? Is there any other reason as to why he doesn't call?

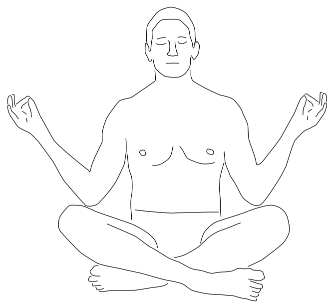
Example: *Virtual reality more real than actual reality?* For some people with autism, communication with other people isn't sufficient, not even that which includes pointing at the real object. It may require a detour by means of artifacts so that the concrete can be made real for the person involved. During an outing in the woods, a special education teacher placed her hand on a stone at the same time as she asked a pupil with autism to sit on it. The pupil did not seem to understand at all what she meant. She then took a photo of the stone with a digital camera and showed the display screen to the pupil while at the same time asking him to sit down on the stone. He did so immediately (Plato and Jönsson, 2001; Jönsson, 2004).

If something can be described with fixed concepts, generalizations and universal theories, a great deal is gained. Large areas of rehabilitation engineering and design can be dealt with within the framework of epistemology and can thus pride itself upon:

- its ability to systematize and accumulate
- its ability to articulate new questions
- its openness and transparency even in its handling of methods and data
- its capacity to generalize on the basis of experience gained
- its openness to other perspectives which may make the results look different

"THE ARISTOTELIAN AGENT IS A PERSON WHOM WE TRUST TO DESCRIBE A COMPLEX SITUATION WITH FULL CONCRETENESS OF DETAIL AND EMOTIONAL SHADING, MISSING NOTHING OF PRACTICAL RELEVANCE."

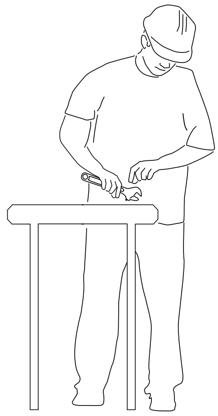
In all these instances, epistemology strives for universality, context-independence and non-relativism. This is advantageous – *provided that it is possible and relevant*. If not, *the priority of the particular* [Nussbaum, 1990; Gillberg, 1999] must apply, i.e. we enter the domain of phronesis. Here, the ideal is the Aristotelian agent, characterized as follows by Minna Gillberg: "The Aristotelian agent is a person whom we trust to describe a complex situation with full concreteness of detail and emotional shading, missing nothing of practical relevance" [Gillberg, 1999, p. 22].



Aristotle describes the following three approaches to knowledge:

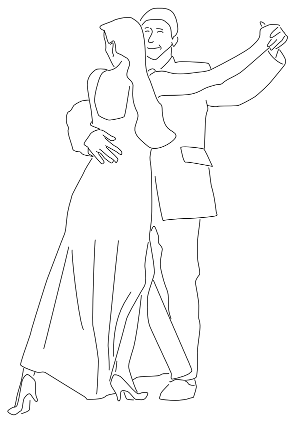
- Episteme
- Techne
- Phronesis

A brief look at these words tells us that the first two are still alive and well: episteme (epistemology, the theory of knowledge) and techne (technology).



6.3. Phronesis

Phronesis, however, is a word for which we have no active, contemporary equivalent. Phronesis is about values and reality, about people and their actions. In the last decade we have seen renewed interest in phronesis, particularly in the social sciences. Sometimes it is also used in design contexts. See, for example, Pelle Ehn's preface to Löwgren and Stolteman's, *Design av informationsteknik – materialet utan egenskaper* [Löwgren and Stolteman, 1998].



Phronesis is thus not scientific in the episteme sense, since epistemology mainly deals with scientific knowledge that is universal, constant in time and space, context-independent and based entirely on analytic rationality. The knowledge relativism that is an integral part of phronesis is thus almost unforgivable in an epistemological approach. However, the connection between techne, the reflecting knowledge of concrete action, and phronesis is better developed. But phronesis has characteristics of it own, for instance, the necessity of an inbuilt aim to do good. It also involves the Aristotelian agent: a person you trust and whose competence you dare rely upon [Aristotle, 1993].

In an interesting section on methodology in her doctoral dissertation, *From Green Image to Green Practice,* Minna Gillberg [Gillberg, 1999] writes: *"A phronetic research approach should focus on practice, because human action cannot be understood or judged through generalizations, static concepts or universal theories only, but rather to be found in the practical knowledge which builds on human experience. Therefore we must study practice, the concrete particulars of reality (the priority of the particular) that are complex and constantly changing"* (pp. 21-22).

"THEREFORE WE MUST STUDY PRACTICE, THE CONCRETE PARTICULARS OF REALITY (THE PRIORITY OF THE PARTICULAR) THAT ARE COMPLEX AND CONSTANTLY CHANGING."

6.4. Science based on statistics versus science based on case studies

Case studies should not be considered merely pathfinders for later statistically based studies [Ramachandran and Blakeslee, 1998]. Case studies have significant advantages that cannot be found in statistical studies and vice versa. The field of rehabilitation engineering and design is mainly case-study based. This is not only because of the difficulties in finding enough subjects in the same "category"; it is also (mainly) connected to the "situated": that it is the human being *in* her environment *together* with those around her that is the focal point.

6.5. Grounded theory

The task of a researcher in the grounded theory context is mainly to understand what is happening and how the players manage their roles. The researcher gains understanding through observations, conversations and interviews. Data collection, note taking, coding and sorting are all part of the work before writing; categories and theories are supposed to emerge during the process. Grounded theory is distinguished in that it is explicitly emergent and does not test hypotheses. The aim, as Glaser explains, is to *discover the theory implicit in the data* [Glaser, 2003].

Although it is hard work to stick to grounded theory in research, it might be said to have more of a *lean backward* than a *lean forward character*. Therefore, grounded theory can never form a thorough basis for rehabilitation engineering and design, even if ideas/theories/solutions emerge from the situation in that context as well; not only from the actual situation but from many earlier situations in which the designer has been involved. This means that the design researcher may have the major part of the initiative – to begin with. However, the initiative goes back and forth. The researcher confronts the users with the results of his assertions and inventions in the form of a new sketch, mock-up, prototype, etc.

Due to its leaning forward and action orientation, design research is subject-compliant in another way than the social sciences. Although the social sciences might seemingly start more humbly through mere observation and data collection, after a while they can have deviated from the subjects into the concepts of their sciences – without visible and tangible opportunities to retest on the subjects whether their categories and theories make sense or not.

6.6. Phenomenology

Phenomenology is both a philosophy and a method, a 100-year-old movement with many followers. Phenomenology has positioned itself on both the ontological level, representing a way to relate to the world, and on the epistemological level, representing a way to relate to knowledge so that it becomes a usable tool for us. It is, however, important to point out that phenomenology is not and has never been anything uniform, which is why it is relevant to speak of a phenomenological movement [Bengtsson, 1999].

In rehabilitation technology and design, we think it is important to go back to two of the fundamental concepts in phenomenology, *phenomenon* and *lifeworld.* Phenomenon in this context does not stand for the occurrence in and of itself, but for the occurrence *experienced by someone*. The word "phenomenon" means "that which shows itself" and it is implicit in the definition that there is someone who it is shown to. Our focus on the experienced person, the individual with the disability, thus becomes obvious from a phenomenological perspective. It is the phenomenon as it appears to her that we want to call attention to; how she experiences her world and the special conditions that we, if we understand them, can help to improve and enhance with an assistive aid. "*We want to go back to the things themselves,*" says Edmund Husserl, phenomenology's founder, in his 1901 publication *Logische Untersuchungen* [Husserl, 1901, Volume II, p. 7]. The objects are phenomena we would like to investigate, i.e. the objects *as they are experienced by someone*.

Example: *To choose requires options.* Hanna has a nerve-muscle disease that severely restricts her mobility. At 1½ years of age, she receives her first standing support device. She is to stand up at least one hour a day in order to exercise her muscles and put pressure on her skeleton. In the process of standing, she discovers after a few days that there is a lot to see from her new, upright position. Hanna discovers things in other parts of the room that catch her attention. Without the support of her mother's arms she is suddenly on her own in the world. Hanna wants to go over to the objects that she sees at the edge of her horizon. There is nothing between her and them. Her mother lifts the stationary, standing supporter forward to the things that attract Hanna's attention. "There! There!" Hanna says and points. Then she quickly focuses on something else; she just stops for a short time at each object and then wants to move on to the next. Is she really managing to experience the objects, her mother wonders? This continues until her mother suddenly realizes what is happening: her daughter is truly enjoying the feeling of moving around in an upright position! This results in a motorized standing support device that offers Hanna the opportunity to move around in an upright position on her own.

Phenomenology is a philosophy of experience. Knowledge exists in experience and knowledge is created from experience. Phenomenology must seek out the place where the phenomenon is revealed, where it emerges for the experiencing subject in his or her natural context [Bengtsson, 1999]. Accordingly, working very closely with the disabled person in his or her natural setting is reasonable from this perspective.

The *lifeworld*, the lived world, is the other indispensable concept and is strongly associated with that of phenomenon. The lifeworld is the world we already find ourselves in, are familiar with and take for granted. It is pre-reflexive and pre-scientific and it both influences us and is influenced by us. We exist in this world with our bodies, which, in the philosophy of the French phenomenologist Maurice Merleau-Ponty, is an integrated whole that he calls "the lived body". "*The body is the vehicle of being in the world*" [Merleau-Ponty, 1962, p. 82]. "*The body is the general medium for having a world*" [ibid., p. 146]. Our own lived bodies are the starting point and basis for all our experiences and encounters. Without our lived bodies there would be no perspective. In rehabilitation engineering and design, this is a very fruitful point of departure in which we work to facilitate life for people who many times have an altered sense of body due to illness or injury. Their lived bodies will obviously form the basis of their experiences and phenomena as they present themselves. This is of great importance to seize upon if our goal is to come up with good and useworthy (see section 3.4) aids. In the example from Hanna's life, she was able to gain an increased physical competency by standing and through that she could discover and display her need for upright, autonomous mobility. Analogously, it is easy to understand that an aid in the best of cases does not just fulfill the function it is meant to (to stand up in the example of Hanna); it can reshape the person's existence and existential terms (Hanna achieved an autonomous, upright mobility). This aspect should be involved in future body technology [Tenner, 2003].

Phenomenology's desire to allow the phenomena, the things that appear to be the controlling factors, in our opinion is close to

Norman's *affordance* [Norman, 1988], a concept that surfaced 80 years later. A significant difference is that phenomenology does not just indicate the phenomena, the individual things and how they emerge, but also the lifeworld as the point of departure. Affordance is a concept that originally was used in psychology to describe how objects, people, situations and so forth, offer or afford opportunities for possible interactions to an observer. It is these offerings in the first place that we perceive when we are confronted with phenomena.

7. The need for further conceptual work

The design sciences are young and so is rehabilitation engineering. Consequently, there is only a limited element of standardization so far. This occasions a certain amount of unnecessary confusion of concepts. "Affordance" versus "phenomenon" in the "lifeworld" for instance – what is the difference?

We do not mean to say that these concepts are identical, and we leave it to the reader to consider some of the many overlaps to be found among the concepts brought together in this paper. To us, it is obvious that far too little work has been invested in relating different, older scientific concepts to new ones in the field of design. The confusion does not encompass only the relationship between the old and the new concepts, but also between old concepts when applied in design contexts. It becomes obvious how different concepts emanate from different fields and communities of practice, which have not been so solidly brought together as now in the design sciences.

In our opinion, the design sciences would profit considerably from working out standardized, agreed-upon concepts. It could be that some would be identical to older ones from other sciences. If so, there is a need for clarifying examples from implementations in the world of scientific design, collected in key articles. The redundancy that currently exists because of the confusion in concepts is more embarrassing than helpful and thought provoking.

There is a need for *consensus* from a *recognized body* for achieving mutual understanding in given contexts. In the International Organization for Standardization/International Electrotechnical Commission's (ISO/IEC) Guide 2, this is described in the following manner: "A standard is defined as a *document*, established by *consensus* and *approved by a recognized body*, that provides for common and repeated use, rules, guidelines and characteristics for activities or their results aimed at the achievement of the optimum degree of order *in a given context*" [ISO/IEC, 1996]. (Our italics.)

References

Alvesson, Mats and Sköldberg, Kai. 1994. Tolkning och reflektion (Interpretation and reflection). Studentlitteratur, Lund, Sweden.

Apoteket AB, Fed. of Swedish County Councils, Swedish Prescription Drug Benefits Board, Swedish Assoc. of Neurologically Disabled. 2003. Does the medicine help? Usefulness of prescription drugs from the patient's point of view. Apoteket AB, Printed Materials Dept., Stockholm, Sweden.

Aristotle. 1993. Den Nikomachiska etiken (Nikomachean Ethics). Translated to Swedish by Mårten Ringbom. Bokförlaget Daidalos AB, Göteborg, Sweden.

Bengtsson, Jan. 1999. Med livsvärlden som grund. Bidrag till utvecklandet av en livsvärldsfenomenologisk ansats i pedagogiken (With the lifeworld as a basis. Contributions to the development of a lifeworld-phenomenological effort in pedagogy). Studentlitteratur, Lund, Sweden.

Brattberg, Gunilla. 2003. Rehabiliteringspedagogik för arbete med långtidssjukskrivna i grupp (Rehabilitation pedagogy for working with groups of people on long-term sick leave). Värkstaden, Stockholm, Sweden.

Brattberg, Gunilla. 2004. Väckarklockor (Alarm clocks). Värkstaden, Stockholm, Sweden.

Breidegard, Björn. 2004. The New Minimeter. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/minimeter/index.html (May 2, 2004).

Bødker, Susanne; Ehn, Pelle; Kammersgaard, John; Kyng, Morten; Sundblad, Yngve. 1987. A Utopian Experience. In Gro Bjerknes, Pelle Ehn and Morten Kyng (eds.), Computers and Democracy: A Scandinavian Challenge. Avebury, Aldershot, UK.

Bødker, Susanne; Grønbaek, Kaj; Kyng, Morten. 1993. Cooperative Design: Techniques and Experiences from the Scandinavian Scene. In Douglas Schuler and Aki Namioka (eds.), Participatory Design: Principles and Practices, pp. 157-76. Lawrence Erlbaum Associates, Hillsdale, NJ, USA.

Bødker, Susanne and Iversen, Ole Sejer. 2002. Staging a Professional Participatory Design Practice: Moving PD beyond the initial fascination of user involvement. Proceedings, Second Nordic Conference on Human-Computer Interaction, pp. 11-18. ACM Press, New York, NY, USA. Available online at: http://doi.acm.org/10.1145/572020.572023 (May 2, 2004).

Castells, Manuel. 2000. The Information Age: Economy, Society, and Culture. 1st volume (of 3), The Rise of the Network Society (1996, revised edition 2000). Blackwell Publishers, Oxford, UK and Malden, MA, USA.

Crabtree, Andy; Hemmings, Terry; Rodden, Tom; Cheverst, Keith; Clarke, Karen; Dewsbury, Guy; Roucefield, Mark. 2002. Probing for Information. The 2nd EQUATOR Conference, pp. 1-8. Careys Manor, Brockenhurst, UK.

de León, David. 2003. Artefactual Intelligence: The Development and Use of Cognitively Congenial Artefacts. Doctoral dissertation. Cognitive Studies, 105, Lund University, Sweden.

Dourish, Paul. 2001. Where the Action Is. The Foundations of Embodied Interaction. The MIT Press, Cambridge, MA, USA.

Eftring, Håkan. 1999. The Useworthiness of Robots for People with Physical Disabilities. Doctoral dissertation. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/useworthiness/ (May 2, 2004).

Ehn, Pelle. 1988. Work-Oriented Design of Computer Artifacts. Swedish Center for Working Life, Stockholm, Sweden/Almqvist & Wiksell International, Falköping, Sweden. (Also distributed by Lawrence Erlbaum Associates, Hillsdale, NJ, USA.)

Enquist, Henrik. 2004. Perceptual Difference of Medical Images. To be published.

Gaver, William. 2001. Designing for Ludic Aspects of Everyday Life ERCIM News, no. 47. Oct. 2001. Available online at: http://www.ercim.org/publication/Ercim_News/enw47/gaver.html (May 2, 2004).

Gaver, William; Dunne, Anthony; Pacenti, Elena. 1999. Design: Cultural Probes. Interactions, vol. 6, no. 1, pp. 21-29. ACM Press, New York, NY, USA. Available online at: http://doi.acm.org/10.1145/291224.291235 (May 2, 2004).

Gaver, William and Martin, Heather. 2000. Alternatives: Exploring Information Appliances through Conceptual Design Proposals. Proceedings, Conference on Human Factors in Computing Systems (CHI) 2000, pp. 209-216. ACM Press, New York, NY, USA. Available online at: http://doi.acm.org/10.1145/332040.332433 (May 2, 2004).

Gedenryd, Henrik. 1998. How Designers Work – Making Sense of Authentic Cognitive Activities. Doctoral dissertation. Cognitive Studies, Lund University, Sweden. Available online at: http://asip.lucs.lu.se/People/Henrik.Gedenryd/HowDesignersWork/ (May 2, 2004).

Gillberg, Minna. 1999. From Green Image to Green Practice. Doctoral dissertation. Dept. of Sociology, Sociology of Law, Lund University, Sweden. Abstract available online at: http://www.lub.lu.se/cgi-bin/show_diss.pl?db=global&fname=soc_179.html (May 2, 2004).

Glaser, Barney G. 2003, October. Naturalist Inquiry and Grounded Theory. Forum: Qualitative Social Research. On-line Journal, 5 (1), Art. 7. Available at: http://www.qualitative-research.net/fqs-texte/1-04/1-04glaser-e.htm (May 2, 2004).

Gould, John D. and Lewis, Clayton. 1985. Designing for Usability: Key Principles and What Designers Think. Communications of the ACM, vol. 28, issue 3, pp. 300-311. ACM Press, New York, NY, USA. Available at: http://doi.acm.org/10.1145/3166.3170, http://doi.acm.org/10.1145/3166.3170 (May 2, 2004).

Helander, Martin G.; Landauer, Thomas K.; Prabhu, Prasad V. (eds.)1997. Handbook of Human-Computer Interaction, 2nd edition. Elsevier Science Inc., New York, NY, USA.

Hemmings, Terry; Clarke, Karen; Crabtree, Andy; Rodden, Tom; Rouncefield, Mark. 2002. Probing the Probes. Proceedings, 7th Biennial Participatory Design Conference, pp. 42-50, June 23-25, Malmö, Sweden.

Husserl, Edmund. 1901. Logische Untersuchungen (Logical Investigations). Available online in German at: http://www.princeton.edu/~batke/phph/husserl/lu/ (May 2, 2004).

Hutchins, Edwin. 1996. Cognition in the Wild. The MIT Press, Cambridge, MA, USA.

ISO (International Organization for Standarization). 1997. ISO 9241-1:1997, Ergonomic Requirements for Office Work with Visual Display Terminals (VDTs) – Part 1: General Introduction. Geneva, Switzerland. Ordering information available at: http://www.iso.ch/iso/en/ISOOnline.frontpage (May 2, 2004).

ISO/IEC (International Organization for Standardization/International Electrotechnical Commission). 1996. ISO/IEC Guide 2:1996, Standardization and Related Activities – General Vocabulary. Geneva, Switzerland. Ordering information available at: http://www.iso.ch/iso/en/ISOOnline.frontpage (May 2, 2004).

Jönsson, Bodil. 1997. Certec's Core. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/certecscore/ (May 2, 2004).

Jönsson, Bodil. 2001. Läraren, lärandet och informationsteknologin (The teacher, learning and information technology). Datorn i Utbildningen, no. 5. Stockholm, Sweden. Available online in Swedish at: http://www.diu.se/nr5-01/nr5-01.asp?artikel=s6 (May 2, 2004).

Jönsson, Bodil. 2003. Elderly People and Design. Dept. of Design Sciences, LTH, Lund University, Sweden. Available online at: http://www.design.lth.se/aldreochdesign/elderlypeopleanddesign_screen.pdf (May 2, 2004).

Jönsson, Bodil. 2004. Enabling communication: pictures as language. In Malcolm MacLachlan and Pamela Gallagher (eds.), Enabling Technologies. Body Image and Body Function, pp. 33-57. Churchill Livingstone, Edinburgh, UK.

Jönsson, Bodil and Anderberg, Peter. 1999. Rehabilitation Engineering and Design Research – Theories and Methods. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/theory.html (May 2, 2004).

Jönsson, Bodil; Philipson, Lars; Svensk, Arne. 1998. What Isaac taught us. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/whatIsaac/ (May 2, 2004).

Jönsson, Bodil; Svensk, Arne; Cuartielles, David; Malmborg, Lone; Schlaucher, Pierre. 2002. Mobility and Learning Environments: Engaging people in design of their everyday environments. Certec, LTH, Lund University and Malmö University, Creative Environments, Sweden. Available online at: http://www.certec.lth.se/doc/mobility1/MobilityLearningReport021215.pdf (May 2, 2004).

Jönsson, Håkan. 2000. Certecs användarforskning ur ett etnologiskt perspektiv (Certec's user research from a ethnolgical perspective). Certec, LTH, Lund University, Sweden. Available online in Swedish at: http://www.english.certec.lth.se/dok/certecsanvandarforskning/ (May 2, 2004).

Kensing, Finn and Munk-Madsen, Andreas. 1991. Generating Visions: Future Workshops and Metaphorical Design. In Joan Greenbaum and Morten Kyng (eds.), Design at Work: Cooperative Design of Computer Systems, pp. 155-168. Lawrence Erlbaum Associates, Hillsdale, NJ, USA.

Kensing, Finn and Munk-Madsen, Andreas. 1993. PD: Structure in the Toolbox. Communications of the ACM, vol. 36, issue 6, pp. 78-85. ACM Press, New York, NY, USA. Available online at: http://doi.acm.org/10.1145/153571.163278 (May 2, 2004).

Kirschner, Paul A.; Buckingham-Shum, Simon J.; Carr, Chad S. 2003. Visualizing Argumentation. Software Tools for Collaborative and Educational Sense-Making. Springer-Verlag, London, UK.

Latour, Bruno. 1991. Technology is Society Made Durable. In J. Law (ed.), A Sociology of Monsters. Essays on Power, Technology and Domination (Sociological Review Monograph), pp. 103-131. Routledge, New York, NY, USA and London, UK.

Lave, Jean and Wenger, Etienne. 1991. Situated Learning: Legitimate Peripheral Participation. Cambridge University Press, New York, NY, USA.

Lesser, Eric L. and Storck, John 2001. Communities of Practice and Organizational Performance. IBM Systems Journal, vol. 40, no. 4. Available online at: http://www.research.ibm.com/journal/sj/404/lesser.html (May 2, 2004).

Lindgaard, Gitte. 1994. Usability Testing and System Evaluation: A guide for designing useful computer systems. Chapman & Hall, New York, NY, USA.

Lundequist, Jerker. 1995. Design och produktutveckling. Metoder och begrepp (Deisgn and product development. Methods and concepts). Studentlitteratur, Lund, Sweden.

Löwgren, Jonas. 1993. Human-Computer Interaction: What every system developer should know. Studentlitteratur, Lund, Sweden.

Löwgren, Jonas and Stolterman, Erik. 1998. Design av informationsteknik – materialet utan egenskaper (Design of information technology – the material without properties). Studentlitteratur, Lund, Sweden.

Madsen, Kim H. 1994. A Guide to Metaphorical Design. Communications of the ACM, vol. 37 (12), pp. 57-62. ACM Press, New York, NY, USA.

Madsen, Kim H. 2002. Video Prototyping. Centre for Pervasive Computing, Århus N, Denmark. Summary available at: www.pervasive.dk/projects/vidProt/vidProt_summary.htm (May 2, 2004).

Magnusson, Charlotte and Mandre, Eve. 2004. The Social Simulator Project. Submitted for publication.

Magnusson, Charlotte and Svensk, Arne. 1997. Kunskap på burk. SVARNE projektet och dess utveckling. (Canned knowledge. The SVARNE project and its development). Certec, LTH, Lund University, Sweden. Available online in Swedish at: http://www.certec.lth.se/dok/kunskappa/

Magnusson, Peter R. 2003. Customer-Oriented Product Development: Experiments Involving Users in Service Innovation. Doctoral dissertation. EFI, The Economic Research Institute, Stockholm School of Economics, Sweden.

Mandre, Eve.1996a. Free Freya. Part 1. Before Becoming Computerized. 2:96, Certec, LTH, Lund University, Sweden. http://www.english.certec.lth.se/doc/freefreya1/ (May 2, 2004).

Mandre, Eve. 1996b. Free Freya. Part 2. Explosive Development. 5:96. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/freefreya2/ (May 2, 2004).

Mandre, Eve. 1997. Free Freya. Part 3. A Year of Education in the Psychiatric Care Services. 1:97. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/freefreya3/ (May 2, 2004).

Mandre, Eve. 1999. Designing Remedial Education. Licentiate thesis. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/designingremedial/ (May 2, 2004).

Mandre, Eve. 2002. From Medication to Education. Doctoral dissertation. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/frommedicationto/frommedicationto.pdf (May 2, 2004).

Marley, John. 2000. Efficacy, Effectiveness, Efficiency. Editorial from the Australian Prescriber, vol. 23, no. 6, pp. 114-5. Available online at: http://www.australianprescriber.com/magazines/vol23no6/pdfs/p114-115.pdf (May 2, 2004).

Merleau-Ponty, Maurice. 1962. Phenomenology of Perception. Routledge, New York, NY, USA and London, UK.

Nelson, Harold G. and Stolterman, Erik. 2003. The Design Way. Educational Technology Publications, Englewood Cliffs, NJ, USA.

Nielsen, Jakob. 1993. Usability Engineering. The Academic Press Inc., San Diego, CA, USA.

Niiniluoto, Iikka. 1999. Defending Abduction: Philosophy of Science. Vol. 66, Supplement. Proceedings, 1998 Biennial Meetings of the Philosophy of Science Association. Part I: Contributed Papers. (Sep. 1999), pp. S436-S451. Available online at: http://www.umkc.edu/scistud/psa98/papers/niiniluoto.pdf (May 1, 2004).

Nordgren, Camilla; Levi, Richard; Ljunggren, Gunnar; Seiger, Åke. 2003. Societal Services after Traumatic Spinal Cord Injury in Sweden. J.Rehabil.Med., vol. 35, pp. 121-126.

Norman, Donald. 1988. The Psychology of Everyday Things, Basic Books, New York, NY, USA.

Nussbaum, Martha. 1990. Love's Knowledge. Essays on Philosophy and Literature. Oxford University Press, Oxford, UK.

Ondrus, Helena. 2003. Tid, Tidvis, Tidvisare x 12, Tidvisast. Master's thesis. Industrial Design Program, Dept. of Design Sciences, LTH, Lund University, Sweden.

Peirce, C. S. 1931-35. Collected Papers 1-5, ed. by C. Hartshorne and P. Weiss. Harvard University Press. Cambridge, MA, USA.

Plato, Göran and Jönsson, Bodil. 2001. Art and Science – A different convergence. Certec, LTH, Lund University, Sweden. Available online at: http://www.certec.lth.se/doc/artandscience/artandscience.pdf (May 2, 2004).

Poulson David; Ashby, Martin; Richardson, Simon. 1996. USERfit: A practical handbook on user-centred design for Assistive Technology. ECSC-EC-EAEC, Brussels-Luxembourg. Portions available online at: http://www.stakes.fi/include/1-4.htm (May 2, 2004).

Preece, Jennifer; Rogers, Yvonne; Sharp, Helen. 2002. Interaction Design. John Wiley & Sons, Inc., New York, NY, USA.

Ramachandran, Vilayanur S. and Blakeslee, Sandra. 1998. Phantoms in the Brain. Probing the Mysteries of the Human Mind. William Morrow & Company, Inc., New York, NY, USA.

Rubin, Jeffrey. 1994. Handbook of Usability Testing. John Wiley & Sons, Inc., New York, NY, USA.

Sanders, Mark S. and McCormick, Ernest J. 1992. Human Factors in Engineering and Design. McGraw Hill International Editions.

Schön, Donald. 1983. The Reflective Practitioner. How Professionals Think in Action. Basic Books, New York, NY, USA.

Snow, C. P. 1993. The Two Cultures. Cambridge University Press, New York, NY, USA.

Suchman, Lucy A. 1987. Plans and Situated Actions: The problem of human-machine communication. Cambridge University Press, New York, NY, USA.

Suchman, Lucy A. and Trigg, Randall H. 1991. Understanding Practice: Video as a medium for reflection and design. In Joan Greenbaum and Morten Kyng (eds.), Design at Work: Cooperative Design of Computer Systems, pp. 65-89. Lawrence Erlbaum Associates, Hillsdale, NJ, USA.

Svensk, Arne. 2001. Design for Cognitive Assistance. Licentiate thesis. Certec, LTH, Lund University, Sweden. Available online at: http://www.english.certec.lth.se/doc/designforcognitive/designforcognitive.pdf (May 2, 2004).

Svenska Dagbladet. 2003. Hennes uppfinning var guld värd i Paris: Elisabeth Linderot, Shoppinetten (Her invention was worth its weight in gold in Paris: Elisabeth Linderot, the Shopinette). Available online at: http://www.svd.se/dynamiskt/naringsliv/did_6310306.asp, http://www.svd.se/dynamiskt/naringsliv/did_6310306.asp (May 2, 2004).

Tenner, Edward. 2003. Our Own Devices – The Past and the Future of Body Technology. Random House, Inc., New York, NY, USA.

Vygotsky, Lev S. 1930. Mind in Society. Harvard University Press. Cambridge, MA, USA.

Wenger, Etienne. 1998. Communities of Practice: Learning, Meaning and Identity. Cambridge University Press, New York, NY, USA.

Wixon, Dennis; Holtzblatt, Karen; Knox, Stephen. 1990. Contextual Design: An Emergent View of System Design. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Empowering People. Seattle, WA, USA, pp. 329 – 336. ACM Press, New York, NY, USA.

WHO (World Health Organization). 1992. International Statistical Classification of Diseases and Related Health Problems (ICD-10), 10th revision. Geneva, Switzerland. Ordering information: http://www.who.int/whosis/icd10/ (May 2, 2004).

WHO (World Health Organization). 2001. International Classification of Functioning, Disability and Health (ICF). Geneva, Switzerland. Ordering information: http://www3.who.int/icf/icftemplate.cfm (May 2, 2004).

This paper elaborates theoretical and methodological aspects of design processes in a disability context and aims to relate them to other sciences. It particularly emphasizes situated aspects of research: the need for being there, with the users in their daily lives, i.e. where the action is.

Research on different human aspects of functional limitations for the individual enhances the need to focus on functioning per se and design for functioning, be it learning and empowerment or well-being, recreation and pleasure or safety, freedom and flexibility.

Certec is a research and educational division in the Department of Design Sciences at Lund University.

The aim of our research and courses is to contribute to improved opportunities for people with disabilities by developing more usable technical devices, new design concepts, and new individual methods of learning and searching.

Certec employs about 25 people. Our annual budget is approximately 14 million Swedish kronor.

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SITUATED RESEARCH AND DESIGN FOR EVERYDAY LIFE