MSc Thesis in Interaction Design

Reflection through interaction

Raising energy awareness among young people with interaction design and speculative re-design of personal objects

Mattias Ludvigsson

Göteborg, Sweden 2005

Chalmers Department for Computer Science

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Abstract

This master thesis has been carried out within the framework of Interactive Institute's Static! project, which investigates interaction and product design as a way to increase energy awareness and stimulate changes in energy behaviour among the general public. The thesis narrows the scope by focusing on young people and the personal objects they use on a daily basis and investigates how interaction design can be used, in combination with conceptual design and a speculative approach, to change existing attitudes and behaviours regarding their energy use and consumption. The investigation was carried out in form of a design project, where the exercise in design methodology played an equal important role as the actual outcome from the design project. Many new and non-traditional design methods were used and explored in a both dynamic and reflective design process.

The design project resulted in three themes of conceptual design proposals, represented by sketches and mock-ups without technical functionality, which all exemplifies how existing personal objects can be re-designed in order to raise energy awareness among young people. The provocative behaviours inherited in the design proposals are all illustrative examples of how interaction design can be used to achieve reflection through interaction. The master thesis introduces speculative re-design and suggests that it can be used for giving provocative properties to re-interpretations of existing objects. Speculative re-design resides in the span between critical design and real-world products and its provocative and speculative nature suits well in order to achieve reflection through interaction, preferably over a longer period of time. Introducing speculative re-design as an approach to interaction design also suggests that it can be used even in a broader sense, applied in different contexts and situations in order to achieve actual changes of existing attitudes and behaviours.

Keywords: interaction design, reflection, energy awareness, personal objects, speculative re-design, conceptual design, provocative design, critical design, prototypes, design methodology.

Sammanfattning

Magisteruppsatsen har utförts inom ramen för Interactive Institute's Static!-projekt, som undersöker hur interaktionsdesign kan användas som ett medel för att öka energimedvetenheten hos allmänheten. Uppsatsen är begränsad i det avseendet att den fokuserar på ungdomar och de personliga objekt som de använder dagligen. I magisteruppsatsen undersöks hur interaktionsdesign kan användas för att, i kombination med konceptuell design och ett spekulativt angreppssätt, kunna förändra ungdomars existerande attityder och beteenden rörande användande och konsumtion av energi. Undersökningen har skett i form av ett designprojekt där praktiserandet av designmetodik spelat en lika viktig roll som det slutliga resultatet av designprojektet. Många nya och otraditionella designmetoder användes och undersöktes i en både dynamisk och ständigt reflekterande designprocess.

Designprojektet resulterade i ett antal konceptuella designförslag med tre olika teman, som presenteras i form av skisser och fysiska modeller utan teknisk funktionalitet. Dessa designförslag exemplifierar hur olika existerande personliga objekt kan ges delvis nya former i syfte att öka energimedvetenheten hos ungdomar. De i designförslagen inbyggda provokativa egenskaperna är alla illustrativa exempel på hur interaktionsdesign kan användas för att uppnå reflektion i själva interaktionen med objekten. Magisteruppsatsen introducerar även begreppet spekulativ re-design och föreslår att detta kan användas för att ge provokativa egenskaper till existerande objekt. Spekulativ re-design befinner sig i området mellan kritisk design och färdiga produkter och dess provokativa och spekulativa natur gör den lämplig för att uppnå reflektion genom interaktion, lämpligen över en längre tidsperiod. Genom att introducera spekulativ re-design som ett angreppssätt till interaktionsdesign föreslås samtidigt att det även kan användas för ett bredare syfte, till exempel applicerat i andra sammanhang med syfte att uppnå faktiska förändringar av existerande attityder och beteenden.

Magisteruppsatsen är skriven på engelska.

Nyckelord: interaktionsdesign, reflektion, spekulativ re-design, kritisk design, konceptuell design, provokativ design, prototyper, designmetodik, personliga objekt, energimedvetenhet.

Preface

This master thesis is the result from many weeks of hard work, lots of thinking and reflection, but also from many happy moments of insight and excitement. The journey within the domain of design and its multi-faceted disciplines has given me much inspiration. It has been very stimulating to learn more about these new areas that definitely have caught my interest during this master program. I have also achieved much knowledge and experience through the long discussions and hard work together with my fellow class mates, far beyond what is usually found in the literature or received on lectures.

I would like to thank my supervisors; Peter Ljungstrand at the Interaction Design group, Chalmers University of Technology, and Johan Redström at the RE:FORM studio, Interactive Institute, for all their help and constructive feedback during my work. Further I would like to thank Ramia Mazé, director of the RE:FORM studio, for her valuable input and encouragement. Thanks also to all members of Interactive Institute's Static! project, sponsored by Energimyndigheten (The Swedish Energy Agency), my opponent Tomas Andersson for his useful comments and Kristina Nyström at IT-University of Göteborg for her help with the giveaways.

I am grateful to the following students for all their time and help, from IT-University of Göteborg: Ina Maja Bengtsson, Emelie Dolfe, Jon Mårtensson, Anna Olvenmyr, Johanna Oxstrand, Hanna Stjernkvist, Sofia Torberntsson, Kalle Ulvstig, and from Polhemsgymnasiet in Göteborg: Linn Durhammar, Anna Kuliginova, Amanda LaMont, Lisa Nyman and Gabriel Triana.

This master thesis has required lots of time and effort so I would like to send a special thanks to my girlfriend Sara who has encouraged me during this time with valuable advices and practical help. I wouldn't be here without all of her support!

Mattias Ludvigsson
Göteborg, 2005-06-02

Table of contents

Introduction

This chapter introduces the background of the master thesis and describes the problem area. It also raises the research problem and defines the thesis scope. The chapter ends by outlining the thesis structure.

Introducing the thesis

This master thesis is carried out at the Master program in Human-Computer Interaction and Interaction Design[1] at the IT University of Göteborg[2], Sweden. The master program focuses on the interplay between people and products where information technology plays an important role as a design material. During the courses within the master program, I have found specific interest in three different areas. First, there is an interest in research approaches that uses interaction design as a means to provoke, speculate and raise questions about contemporary issues within the society. This area has been explored through in-depth studies of relevant literature, but also by writing a paper around this topic. Second, there is an interest in investigating how invisible and abstract things, e.g. sound and bragging, can be made tangible through the use of interaction design. Two longer projects focusing particularly on these issues have been carried out during the master program. Third, there is an interest in exploring both new and existing design methodologies in order to learn, practice and evaluate them as useful tools in the interaction design process. This has to a certain degree been explored in a number of projects over the last year, but there exist many interesting design methodologies and methods still undiscovered.

With an aim to use the knowledge gained from courses within the master program and to further deepen these areas of interest, it felt natural to search for a place where the master thesis could be carried out in collaboration with a partner having the same interests. This partner was found at the Interactive

[1] 2005-04-30 ::: www.ituniv.se/mdi/
[2] 2005-04-29 ::: www.ituniv.se

Institute[3], which is an experimental IT research institute consisting of multiple research studios spread throughout Sweden. The institute acts as a meeting place—an interdisciplinary arena joining art, science, industry and public life in research projects and strategic initiatives to promote innovation, creativity and sustainable growth. The thesis is carried out together with the Interactive Institute's RE:FORM studio[4] in Göteborg, which explores emerging roles of technological objects in everyday life through design research experiments and development of theoretical and practical common ground in the domain of interaction design.

Photo: www.tii.se/static/

Figure 1: The Power-Aware Cord is a power strip visualising the amount of electricity flowing through connected appliances. A design example developed in the Static! project illustrating the invisible nature of energy.

The master thesis resides within the framework of the Static! research project[5], which investigates interaction and product design as a means to increase our awareness of how we use energy in everyday life and how to stimulate changes in energy behaviour with an intention of empowering people in their use of products by increasing the visibility of choices available. The project is funded by the Swedish Energy Agency[6] and is carried out in collaboration between Interactive Institute's RE:FORM and POWER[7] studios. The aim of the Static! project is to raise a discourse beyond utility in order to raise public discussion, to inform energy research and product innovation processes. This framework constitutes the base for the research conducted within this thesis.

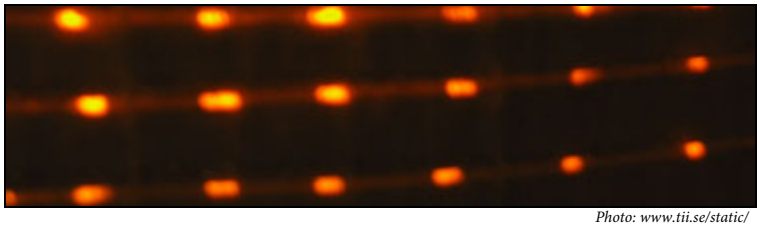

Photo: www.tii.se/static/

Figure 2: The Energy Curtain gives users a tangible choice to capture energy, converted from sunlight during the day, to be displayed in the evening as emitted light. A design example developed in the Static! project illustrating how power becomes integral to the function and the aesthetic expression of the artefact—thus energy is in focus as a design material.

[3] 2005-04-09 ::: www.tii.se
[4] 2005-04-09 ::: www.tii.se/reform/
[5] 2005-04-09 ::: www.tii.se/static/
[6] 2005-04-27 ::: www.stem.se
[7] 2005-04-09 ::: www.tii.se/power/

Describing the problem area

Our society has, according to the Swedish Energy Agency (2004), become increasingly dependent on electric energy since the electrification began in Sweden more than a century ago. The electricity use in Sweden has for example doubled between 1970 and 2002 (Energimyndigheten, 2005), often with contribution from the increasing number of electrically powered objects, appliances and gadgets that nowadays occupies our everyday lives (cf. Carlsson-Kanyama et al., 2003). Overall awareness about the effects of energy consumption and its connection to our behaviour is in general low among the public (ibid.) and is therefore often neglected or taken for granted. A more profound and prolonged awareness about our energy behaviour has to arise in order to achieve a more sustainable future where information campaigns, laws and regulations are traditional approaches to solve this kind of problem (cf. Energimyndigheten, 2005).

Figure 3: The use of electricity in Sweden has, according to the Swedish Energy Agency (2004), doubled between 1970 and 2002. This fact has made our society increasingly dependent on electric energy.

Young people, preferably 15-25 years old, are seen as specifically interesting since they in this age are about to create their own opinions and they are willing to explore and adapt new ideas, but also actively questioning the world as they see it today (Ungdomsstyrelsen, 2001, 2003). Carlsson-Kanyama et al. (2003) points out that people's use of energy to a large extent are influenced and dependent on energy behaviours learned and adopted while they are still young. Therefore it becomes important to make young people more aware of their energy use and energy behaviour, especially since approximately 60 percent of the population in the year 2030 are born in the eighties or later (ibid.). By giving young people healthy norms about energy consumption, energy use and methods for energy saving offers them a great possibility to affect their own future.

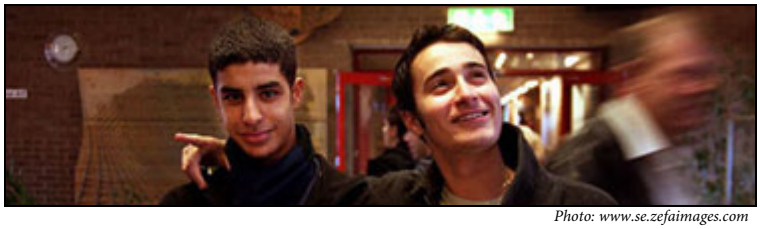

Photo: www.se.zefaimages.com

Figure 4: Young people are seen as specifically interesting since, for example, their energy behaviours are often learned and adopted while they are still young (Carlsson-Kanyama et al., 2003).

Raising the research problem

Since the research of the Static! project consider aspects of energy awareness among the general public within domestic and public spaces, this master thesis narrows the scope by focusing on young people and the personal objects that surrounds them in their personal spaces and which are used on a daily basis. The thesis will therefore investigate whether re-designed personal objects can reinforce young people's awareness about their energy use and consumption in order to stimulate a change of their energy behaviour in everyday life. The investigation is carried out in form of a design project, resulting in a number of conceptual design proposals that illustrates and exemplifies how such re-designed personal objects could be designed. The design project will try to answer the following research question:

> *Can re-designed personal objects reinforce young people's awareness about energy consumption and stimulate a change of their energy behaviour in everyday life?*

To have a profound and prolonged effect on young people's attitudes, my assumption is that these personal re-designed objects should be used on a daily basis in order to be truly effective. The impact of using such objects as mediators may therefore be useful when entering people's personal spaces. But in order to actually change the existing behaviours of young people, I suggest that the conceptual design proposals should be re-designed with a critical approach in mind. By making them provocative in their nature, it might be possible to evoke some kind of reflection through the use and interaction with the objects.

By embracing a critical approach makes it also possible to view the rather concrete research question from a more general perspective where interaction design and conceptual design are seen as adequate tools for making changes in existing behaviours. My hypothesis is that interaction with conceptual objects can make abstract issues tangible and act as an innovative and accessible way of generating both discussions and reflections. This general perspective raises questions on a more abstract level that are perhaps even more interesting than the specific research question. These questions will therefore also be discussed and investigated further in this master thesis where the design project can be seen as a practical example of exploration around this topic.

Defining the thesis scope

This master thesis targets towards practitioners, teachers, students and people with a common interest in design and interaction design in particular. Explicit knowledge of specific terminology related to the area should not be required for a general understanding, but could be useful in order to fully grasp all aspects of the thesis.

The thesis aims to investigate a perspective of interaction design where it is used as a means to start a reflection through interaction in order to change existing attitudes and behaviours. The investigation is carried out in form of a practical design case which will result in a collection of conceptual design proposals. These are illustrative examples of re-designed personal objects that

occupy points in the design space, not necessarily being the best devices to populate it, but which are sufficient enough to start a discussion. The thesis should rather be seen as experimental action research by project, where the exercise in design methodology plays an equal important role as the outcome from the design project. The limited time available for the thesis and its design project makes it impossible to dive deep into all relevant aspects or explore every interesting perspective related to the research question and the problem area. It has therefore been necessary to define some boundaries for the work to narrow the scope of the thesis.

For example, the research around interaction design as a means to change attitudes and behaviours using a provocative approach is a rather new area of interest and appropriate methodologies and examples are therefore limited. A focus for the thesis has therefore been to investigate the approach where the designer takes a subjective stance and uses conceptual, critical, provocative and speculative design as tools in the design process. It is likely that the results and conclusions would have been quite different if, for example, a more participatory approach had been used, e.g. *ethnography* (Hughes et al., 1994, 1995; Simonsen & Kensing, 1997), *participatory design* (Muller & Kuhn, 1993; Schuler & Namioka, 1993) or *contextual design* (Beyer & Holtzblatt, 1999).

Many related topics have only been investigated briefly because of the limited time available for the master thesis. One of these is Herbert Simon's (1969) idea of a science of artifacts, or artificial science, that emphasises the important role artifacts plays in shaping the modern world (Dahlbom, 2002). Artifacts are in this thesis only reflected upon as personal objects that, as often used in conceptual design, act as narratives or mediators in order to spark debate and as carriers of young people's attitudes and image. Another topic that is only briefly investigated is different scientific methods for influencing and changing attitudes and behaviours among people (Ajzen & Fishbein, 1980; Zimbardo & Ebbesen, 1969; Fogg, 1998, 2003). Behavioural changes are in this thesis rather seen as a possible outcome and are suggested to be evoked by the provocative nature inherited in the critical approach.

Illustration: www.nordex-online.com

Figure 5: A drawing describing the advanced technology behind a wind turbine, used for transforming sustainable wind power to electricity. These kinds of theoretical and practical aspects of both energy and technology are not covered at all in this thesis.

This thesis will not dive into any theoretical or practical aspects of energy and technology, or the closely-related topic of *sustainable design* (Papanek, 1985; Manzini, 1994). The developed design proposals focuses on the possible effects of using interaction design in combination with conceptual design rather than on technological feasibility, but properties of both energy and technology have been considered on a general level during the whole design

process. The developed design proposals do not necessarily, because of this decision, result in physical models or working prototypes, but should in a sufficient and clear way describe the intention behind the ideas of the examples.

Outlining the thesis

This *Introduction* chapter puts the master thesis in a context by introducing the background and describing the problem area. It then raises the research problem and defines the scope for the master thesis. The chapter ends by outlining the thesis. The *Background* chapter describes the design space in which the master thesis resides and introduces interaction design, the object as a narrative and different roles for conceptual design. The chapter continues with a description of critical and provocative approaches to design and ends by illustrating some examples of related work. The *Methodological framework* chapter investigates the methodological foundation for the master thesis and describes different views on the design process, the role of the designer and discusses different design methods. The chapter ends with a more in-depth discussion of some used design methods.

The design project chapter describes all activities performed in the design project, from idea generation to evaluation with potential users. It starts with a definition of the directions for the design project and describes the following gathering of inspiration and information, the creative expansion of mind and the grouping and characterising of all ideas. The chapter then describes the refining of the ideas into three different themes of conceptual design proposals and ends with user evaluation and building of mock-ups.

The *Discussion* chapter analyses the outcome from the design project with respect to both energy awareness and personal objects. It then continues with a discussion of how interaction design can be used as a tool to change attitudes and behaviours. It also discusses the role for conceptual design as provocative mediators and introduces speculative re-design. The chapter then discusses the notion of reflection through interaction and ends with some directions for future work. The *Conclusion* chapter summarises the master thesis and the *References* chapter lists references to all literature.

Background

This chapter describes the design space in which the master thesis resides. It introduces different views on interaction design and discusses alternative ways to use the object as a narrative. It continues by investigating different roles of conceptual design and examines critical and provocative design. The chapter ends with examples of related work relevant for the thesis.

Introducing interaction design

Interaction design has evolved over time and can nowadays be seen as one discipline among others within the larger domain of design. Löwgren and Stolterman (2004) suggests, in an attempt to define interaction design, that it is the process that, within certain constraints, creates, form and decides the structural, functional, ethical and esthetical properties of a digital artifact.

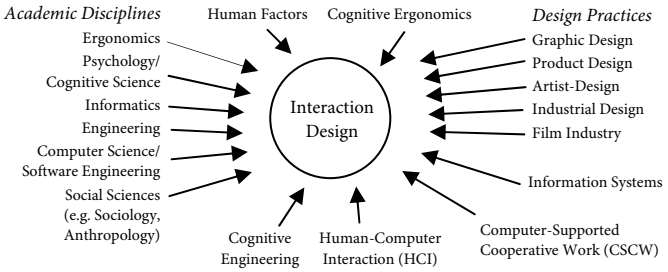

Figure 6: Relationships among contributing academic disciplines, design practices and interdisciplinary fields concerned with interaction design (Preece et al., 2002, p. 8).

Preece et al. prefer a much broader definition where interaction design is defined as »designing interactive products to support people in their everyday and working lives« (2002, p. 6). Interaction design has, according to them, close relationships to academic disciplines (e.g. informatics, computer science and psychology), design practices (e.g. graphical design, product design and

artist-design), as well as interdisciplinary fields (e.g. HCI[8], CSCW[9] and Information Systems), and is therefore fundamental to all areas concerned with researching and designing computer-based systems for people. One common property between these two definitions is the emphasis on putting user needs and involvement in the centre of the design process.

Dourish (2001) means that interaction design not only concerns aesthetics, he sees interaction design within a holistic and larger frame, often a cultural frame, and he means that an interactive artifact must be designed as a part of this larger system. He further means that interaction design recognises the ways in which design and design motifs express system of values—design communicates. So a key component of interaction design involves considering the message that the design should communicate and how this relates both to the task at hand and to the details of the design (ibid.).

The object as a narrative

Forty argue that a product arises in a social context rather than from decisions of designers and consequently is a reflection of society resulting in that »no design works unless it embodies ideas that are held in common by the people from whom the object is intended« (1986, p. 245). Changes in products can therefore also result in social consequences, since products are inescapable intertwined with society. This interesting relationship offer possibilities to see the object as a narrative in order to raise questions and spark debate about interesting and important topics within the society.

Fictional products and conceptual objects

Dunne (1999) suggests fictional products or conceptual objects as a means to develop forms of engagement and discussions through the imagined use and interaction with the designed object. He uses conceptual design to comment on the role of electronic objects in everyday life and introduces five designed objects that can be seen as material tales or a process of investigation. These are props rather than working prototypes, not intended for mass-production but for mass-consumption via publication and exhibition.

Illustration: Dunne and Raby, 2001

Figure 7: Sketches of eight accessories for lonely men. These accessories also exist as physical props in the short film Accessories for Lonely Men (in Dunne & Raby, 2001).

Noam Toran's short film *Accessories for Lonely Men* (in Dunne & Raby, 2001) uses objects as props in fictional histories where they all tell different stories. The eight designed accessories in his pseudo documentary act as substitutes or

[8] Human-Computer Interaction
[9] Computer Supported Cooperative Work

placebos for a relationship that is no longer. There is a breath device that softly exhales warm air on your neck at night, a device that smokes a cigarette with you after a session of solitary sexual activities and also a sheet stealer that reintroduces one of the less pleasant sides of living together.

Photo: www.netobjects.org.uk

Figure 8: The netGoal object alerts and playback goals scored by or against your team.

The exhibition of *netObjects*[10] consists of eight fictional stereotypes of media consumers that are fascinated, and even obsessed, with different types of content. The collection of re-appropriated objects is intended as real products of today, for everyday use by people who seldom get online through the computer screen. By materialising virtual information, they all propose an alternative way to enjoy online content at home. The objects were exhibited through eight interactive prototypes, eight photographs and a short video with testimonials of the eight characters of the story.

Personal objects for young people

Objects, and especially those intended for personal use, can reveal interesting stories about its user, e.g. about their identity, attitudes and status—in other words, the way they wish to be perceived by others (cf. Ungdomsstyrelsen, 2004). Clothes, headgears, eyewear, shoes and bags are all different examples of personal objects that have both attitude and image inherited in the design (cf. Ilstedt Hjelm, 2002) and they are frequently used among young people as a way to distinguish their identity.

Figure 9: Examples of personal clothing with attitude inherited: a hood jacket with manga print[11], a fancy handbag[12] and cool sneakers[13].

Mobile phones are another example of personal objects. It has almost gone 20 years since the first generation of mobile phones was introduced (Väänänen-Vaino-Mattila & Ruuska, 1999). Not until recently has the mobile phone become socially accepted and commonly used among the general public. The

[10] 2005-04-23 ::: www.netobjects.org.uk
[11] 2005-05-03 ::: www.alienbase.com
[12] 2005-05-03 ::: www.diesel.com
[13] 2005-05-03 ::: www.caliroots.se

mobile phone has transferred from being an ordinary communication tool to become a personal object that is used on a daily basis, playing an important role in people's lives (Hallnäs & Redström, 2002). By differentiating mobile phones in form of models, colours and additional accessories, they are now used to reflect the identity of its user, a popular feature among young people.

Figure 10: Examples of accessories that personalises mobile phones, e.g. Nokia's X-press on cover[14], mobile phone jewellery[15] and flashing stickers[16].

Sandelin and Torstensson (2003, p. 56) exemplifies that electronic objects can be considered personal if it is »owned and operated mainly by one person; or if it adjusts itself, or is adjusted, to fit the needs and behaviours of a specific individual; or if a person has developed a special relationship or an emotional attachment to it; or if it is small enough to be carried, worn or implanted and thus reside within the very personal physical space of the body. Another way to look at it is to think of personal technologies as electronic objects that help us articulate, to ourselves and others, who we are«.

Figure 11: Examples of wearable electronics: Moi[17] is a radiant light jewellery, Kio[18] is a fictive student with a device for handling both information and entertainment and New Nomads is Philip's exploration of wearable electronics, e.g. the In the Mix DJ outfit[19].

Communicating through the form

The design of an object can communicate function as well as more symbolic values through its form. Dourish means that »an artifact itself may be physical, but as it is incorporated into a practice, it takes on a symbolic value too. The artifact, and the actions that people might engage in with that artifact, have meaning, both for the people engaged in those actions and for members of the community of practice. Interaction with physical artifacts, as has been explored, often also implies a reaching through those artifacts to a symbolic realm beyond. /…/ It is a physical realization of a symbolic reality, and the

[14] 2005-04-29 ::: www.nokia.com
[15] 2005-04-29 ::: www.designtorget.se
[16] 2005-04-29 ::: www.flashstick.nl
[17] 2005-05-03 ::: www.moinewyork.com
[18] 2005-05-03 ::: www.ideo.com/MIT/
[19] 2005-05-03 ::: www.design.philips.com

symbolic reality is, often, the world being manipulated. /…/ The principal concern for design, then, is not how to map symbolic representations onto physical counterparts, but how the relationship between the two can be managed—how physical interaction models can "hold on" to the symbolic.« (2001, p. 207) An object's form can, whether it is physical or not, in this way embody and materialise representational features which often are interpreted by users with appreciation or disapproval (Vihma, 2003).

Monö (1997) argue that the physical form of an object can be augmented in order to steer and control the interaction with the object, but it also requires that the designer carefully consider the choice of both form and function with respect to common practice. He further argues that objects can be designed to inherit four different aspects of semiotic functions: descriptive functions that describe an object's purpose and mode of operation; expressive functions that describe characterising properties of an object; exhorting functions that allows an object to trigger some kind of reaction; and identifying functions that differentiates an object from other objects (ibid.).

The design of an object can therefore be regarded as a function, since the form also explains and guides the user how it can be used (Westerlund, 2002) and sends a message to the user what it is aimed for (Ilstedt Hjelm, 2002). The inherited affordance built into an object's form can, according to Vihma (2003), imply human actions that can be used to affect people's behaviours, if designed in appropriate ways. These aspects must all be considered carefully when working with design, and especially in conceptual design, since the representational form in this case is seen as the main bearer of an idea, often presented as an imaginative image of a suggested form or design. The most important thing, however, is that the representation of the concept is clearly communicated in order to provide a good understanding.

Different roles for conceptual design

Conceptual design, often represented with conceptual design prototypes, plays different roles depending on the purpose and context it is used for and in, but it can generally be seen as an important tool to communicate and visualise ideas and concepts to a broader audience. Traditionally, conceptual design is understood as an initial conceptual stage in product development, used before ideas are evaluated and filtered for practicality and utility in which hypotheses and ideas are explored (Lundequist, 1995; Dunne & Gaver, 1997). It often includes a description or a representation of the proposed solution, where user requirements and needs are transformed into a conceptual model or prototype that could be understandable by the users in the manner intended (Preece et al., 2002). Conceptual design is also used for commercial purposes, where conceptual design prototypes are often used to illustrate ideas that challenge people's imagination and preconceptions of the existing, especially useful to communicate and visualise concepts and visions of possible futures (Gabrielli & Zoels, 2003). The introduction of imaginable future products is therefore commonly used for marketing and branding purposes in order to be competitive and attractive to strengthen the image and brand of both products and companies.

Conceptual design is also commonly used within the context of design and art. Dunne and Gaver (1997) suggests, in contrast to the traditional view, another approach to conceptual design where it should rather be seen as an activity in itself exploring and raising challenging hypotheses and ideas for the public instead of aiming towards realisable and marketable products for the industry. Adapting this kind of experimental view of conceptual design allows designers to use conceptual design as a means to explore the medium and to extend it in matters of both progress and aesthetic novelty (Dunne & Raby, 2001). Such conceptual design proposals are for example also used for concretisation and exemplification within the context of design research.

Common characteristics of conceptual design are that it, regardless of context, often tries to raise critical, provocative or speculative ideas where the prototypes work with both interactive and reactive behaviours of things to question and raise such issues with their audience or users. Many conceptual design prototypes also use interaction design, imagined or in practice, as a means of enquiry into everyday life situations and evolving experiences.

Conceptual design in an art and design context

The imagined and challenging nature of conceptual design has been widely adopted within the art and design disciplines. Conceptual design prototypes, originating from a creative artistic process, can be seen as art objects or one-offs, since they all aim to make some sort of statement rather than being mass-produced. Therefore, this kind of conceptual design, exploring the boundaries of the discipline and the world between the real and the fictional, often resides outside the market place, e.g. in exhibitions and museums, or is manufactured only in a mere handful of examples.

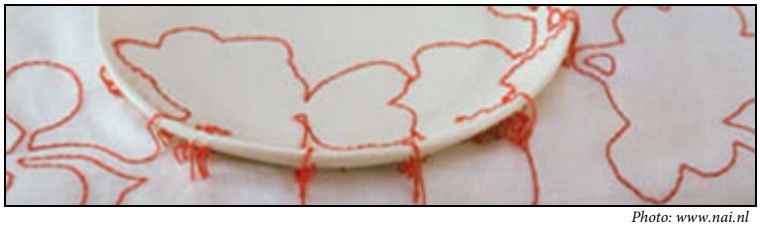

Photo: www.nai.nl

Figure 12: The embroidered porcelain tablecloth by Hella Jongerius is inspired from the techniques and materials of ceramics decoration and textile embroidery.

The provocative ideas behind these prototypes are used to speak to our imagination and are often communicated to a wider audience through media exposure with an aim to spark debate and a widespread discourse within the fields of design and art. This approach to conceptual design is for example represented by the Dutch Droog Design[20], which introduced the work of designers like Jurgen Bey[21], Richard Hutten[22], Hella Jongerius[23] and Marcel

[20] 2005-04-22 ::: www.droogdesign.nl
[21] 2005-04-22 ::: www.jurgenbey.nl
[22] 2005-04-22 ::: www.richardhutten.com
[23] 2005-04-22 ::: www.jongeriuslab.com

Wanders[24]. The work of these four well-known designers can also be seen as conceptual design balancing on the thin border between art and design.

The approach of using conceptual design for exemplifying design research was adapted by the British Royal College of Art[25], for example represented by the work of Anthony Dunne (1999; Dunne & Gaver, 1997) and William Gaver (Gaver & Martin, 2000; Gaver & Dunne, 1999; Gaver et al., 2003). By introducing speculative intentions and ambiguity more in design, they suggest provocative solutions in their conceptual design examples. In *Alternatives*, Gaver and Martin (2000) propose speculative design as a way to explore and shape new possibilities for everyday technologies and they also introduce a workbook with conceptual design proposals of information appliances that are »occupying points in the design space without necessarily being the best devices to populate it« (ibid., p. 216). All of these conceptual design proposals are purposefully made ambiguous where many details are left unresolved in order to open up conversations and obtain alternative perspectives of existing technology.

Photo: Gaver and Martin, 2000

Figure 13: Examples of the conceptual proposals suggested in the Alternatives workbook.

The objects produced in the experimental *Placebo Project* are, according to the creators Dunne and Raby (2001), examples of conceptual products rather than conceptual design, aiming to illustrate their theory of *design noir*; a genre that »focus on how the psychological dimensions of experiences offered through electronic products can be expanded« (ibid., p. 46). Dunne and Raby approach conceptual design from both an artistic and critical perspective where they suggest that conceptual products fuse complex narratives with everyday life. In contradiction to conceptual design, which they proclaim uses design proposals as a medium for exploring what these products might be like, they let users become protagonists and co-producers of a narrative experience rather than passive consumers of a product's meaning. »These objects are clearly not intended for production, but are designed to provide mental pleasure and stimulate reflection. They are products for the mind. Their generic form raises issues about the use of form in conceptual design. If they are too realistic—that is, if they look as if they really should be used—objects like these can quickly become ridiculous. Their abstract form signals that they are intended to be used in the imagination« (ibid., p. 64).

[24] 2005-04-20 ::: www.marcelwanders.com
[25] 2005-05-03 ::: www.rca.ac.uk

Conceptual design in a commercial context

In a commercial context, conceptual design is often used to communicate and visualise new ideas, concepts and products to a broader audience; sometimes in order to test new product ideas or to receive feedback about the direction of future products. Conceptual design can also be used to add value to business and supporting decisions concerning business direction or strengthen the marketing and branding of both products and companies, often with help and assistance from star designers. Two examples of such collaborations are a product-oriented branding project where IDEO, together with the artist and designer Crispin Jones, developed the *social mobiles*[26] and the *do create*[27] exhibition created by designers from Droog Design together with the Dutch publicity firm KesselsKramer.

Whirlpool Europe's *Project F* (Gabrielli & Zoels, 2003) uses a product development approach where design and foresight are combined in order to communicate and visualise an imaginable future for domestic appliances through highly realistic conceptual design models of vivid concepts. A number of innovative future design concepts were developed by multi-disciplinary teams with experts offering opinions which were aggregated to form a view of possible futures in order to inform and influence policy-makers, but also to challenging people's preconceptions and affect future social acceptance of solutions that may require a change of expectation or change of behaviour.

Photo: Gabrielli and Zoels, 2003

Figure 14: The BioLogic concept prototype is one of five examples in Whirlpool Europe's foresight of an imaginable future for domestic appliances.

The *Vision of the Future* project was initiated by Philips (1995) to explore what technology people would perceive as useful, desirable and beneficial in the future, and resulted in findings that aimed to influence their future business direction. They investigated latent needs and aspirations of people together with the qualities they would value in future products and services that could enhance and extend their experiences. The visionary concepts developed for both future products and services are communicated in the form of tangible models, simulations of interfaces and short films which provided brief glimpses of people's everyday lives where the proposed products or services were being used in realistic future scenarios.

[26] 2005-04-08 ::: www.ideo.com/case_studies/social_mobiles/index.html
[27] 2005-04-22 ::: www.droogdesign.nl

Photo: www.design.philips.com

Figure 15: Examples of conceptual prototypes from Philips Vision of the Future project that presents visionary concepts developed for future products and services.

Volvo Cars *concept cars*[28] are examples of when conceptual design is used for business direction, marketing and branding of a company and its products. These concept cars are all speculative prototypes of futuristic models that traditionally concerns aspects of visionary interior and exterior designs, but also offer explorations in new materials, innovative solutions for safety and environmental sustainability. The concept cars also challenge people's existing attitudes and behaviours of their cars to be perceived as a part of their personality rather than a medium for transportation.

Photo: www.conceptlabvolvo.com

Figure 16: The Volvo YCC (your concept car) is one example of how conceptual design is used for business direction, marketing and branding of a company and its products.

Critical and provocative design

Design in general terms has in a historical perspective played an important role as a powerful agent of change and acted as a medium for both social and economic criticism as well as political and ideological propaganda (cf. Sparke, 1987). The bearers of critical ideas were in the early twentieth century often disciplines like architecture and contemporary art. Design constellations like *Bauhaus*, *De Stijl* and the *Memphis Group*, have to a great extent contributed to debate and opinion through their expressions and critical view on existing design standards. By introducing, in their eyes, better form for products and architecture, design has in an efficient way been used as a means to imply changes. Influencing the public opinion had for example a major impact in the transformation between art movements like art nouveau, modernism, and post-modernism (cf. ibid.).

[28] 2005-04-22 ::: www.conceptlabvolvo.com

Photo: www.design-technology.org

Figure 17: The superlamp by the Memphis group is made of fibreglass with rubber tires.

Disciplines like art, architecture, furniture, graphic design and commercials have, rather than product and industrial design, kept the critical design alive since the middle of the twentieth century. One explanation could be, according to Dunne and Raby (2001, p. 59), that »to be considered successful in the marketplace, design has to sell in large numbers, therefore it has to be popular. Critical design can never be truly popular, and that is its fundamental problem. Objects that are critical of industry's agenda are unlikely to be funded by industry. As a result, they will tend to remain one-offs«.

Critical design can, in general terms, be seen as a way to provide critique of the prevailing situation through designs that asks carefully crafted questions and makes us think in order to stimulate discussion and debate with emphasis on challenging conventional values through the lived experience rather than on the medium itself. Gaver et al. proclaim that »instead of designing solutions for user needs /…/ we work to provide opportunities to discover new pleasures, new forms of sociability, and new cultural forms. We often act as provocateurs through our designs, trying to shift current perceptions of technology functionally, aesthetically, culturally, and even politically.« (1999, p. 25) Design examples, in form of conceptual design proposals and artificial products or prototypes with different or new ways of interaction, can be used in order to influence people's behaviour, attitudes, feelings and thoughts (cf. Fogg, 1998). According to Gaver and Martin (2000) can such concretisation of ideas be done in different forms, e.g. through narratives and descriptive images or physical artifacts, but the choice of medium should not be the most important issue. More important is that the medium that is selected can, in an appropriate and effective way, visualise the standpoint taken or be able to start a debate or discussion about the intentions behind the design example.

Photo: www.artistes-en-dialogue.org

Figure 18: Philippe Ramette's Praise of Laziness is an example of para-functional objects and features a huge helium-filled balloon harnessed to the head, presumably lightening the body weight and metaphorically relieving the thoughts but also limiting movement with its excessively large size, which would require slow and deliberate motion.

Dunne (1999) introduces two approaches to critical design: value fictions and para-functionality. In value fictions, plausible technologies are used in service

of unusual cultural values, in contrast to science fiction in which implausible technologies are invented to support recognisable cultural activities. Value fiction serves both to suggest new functions for technology and as a criticism of existing uses, culture and technology. Para-functionality is a form of design where function is used to encourage reflection on our relation to technology, or »how electronic products condition our behaviour« (ibid., p. 44). Using a para-functional object often creates a heightened sense of distance, mainly because its function is conceptually difficult to assimilate into our view of reality. To acknowledge its usability is hence also to discover new ways of seeing the world, or at least parts of it.

Figure 19: Another example of a para-functional object is an electric bath-duck, which creates a sense of distance since its function is conceptually difficult to assimilate.

Examples of related work

The following conceptual or critical examples all work with both interactive and reactive behaviours of things to question and raise such issues with their audience or users. They all use provocative interaction design as a means of enquiry into everyday life situations and evolving product experiences.

Provoking a change in behaviour

Anthony Dunne and Fiona Raby's *Placebo Project* (2001) involves a series of eight conceptual prototype objects, created to offer a sort of psychological comfort to the users, in order to explore their relationships to invisible electromagnetic fields. For instance, a *Compass Table* with 25 embedded magnetic compasses that twitch and spin when it is exposed to radiation from electronic products, or the *Nipple Chair*, with two nipples set on the back, which transform surrounding electromagnetic fields into vibrations. All objects are purposely diagrammatic and vaguely familiar in their design, but open-ended enough to prompt stories but not so open as to bewilder. The designers invited people to adopt the objects and documented the narratives that emerged over time as people lived with their objects.

Photo: www.dunneandraby.co.uk

Figure 20: The 25 compasses in the compass table twitch and spin when any electronic objects are nearby, reminding of that they actually extend beyond their visible limits.

Social Mobiles[29] were developed in collaboration between IDEO and Crispin Jones, as a provocative exploration of mobile phone behaviour and their social impact in everyday life. The provocative functionality of the five prototypes modifies, in different ways, their users' behaviour to make it less disruptive. The *SoMo1* mobile phone delivers a variable level of electric shock depending on how loudly the person on the other end is speaking. As a result the two parties are induced to speak more quietly in order not to disturb others with their intrusive conversations. The *SoMo5* mobile phone act as a catapult which can be used to launch sounds into other people's phone conversations. Firing the catapult transmits a sound into the offender's phone and provides in this way a direct, yet discreet, way of invading their personal space.

Photo: www.ideo.com

Figure 21: The SoMo1 mobile phone gives the user a electrical shock depending on how loud the person at the other end is talking.

Nowadays, physical presence no longer guarantees a person's availability and attentiveness since many mobile phone users often split their attention between people in the immediate surrounding and the remotely linked person. This often results in multitasking, which in practice degrades the quality of interaction. To stress this phenomenon, Agnelli Davide and Drori Tal (2004) introduce *Mass Distraction*[30], a series of three jackets intended to provoke thought and discussion about the idea of presence and mobile phone behaviour. Each jacket replaces a normal mobile phone in a prototypical situation of mobile communication, causing the user to answer an incoming call in peculiar ways. For instance, the *Game Jacket* is connected to a mobile phone and a videogame. In order to answer the phone, the user needs to hand over the game to a friend and the phone call will keep lasting as long as the friend keeps on playing. The mobile phone in the *Hood Jacket* is embedded in the hood and in order to answer, the user has to close the hood completely and the phone call continues, as long as the hood is closed.

Photo: www.mass-distraction.org

Figure 22: The hood jacket forces the user to close the hood in order to answer the call, resulting in an unsocial behaviour.

[29] 2005-04-08 ::: www.ideo.com/case_studies/social_mobiles/index.html
[30] 2005-04-09 ::: www.mass-distraction.org

The power of electricity

Power Pilgrims[31] is a performance project made by Erik Sandelin and Magnus Torstensson where the pilgrims wear robes made of several pieces of red fabric, held together by electro-magnets. The magnets are powered by an attached battery that is recharged from a wall socket via an ordinary power cord. Without power the electro-magnets cease to function and the robe fall to the ground in pieces, leaving the pilgrim in a very exposed situation. The concept is a powerful illustration of how the meltage of man and machine always implies surrendering some control to larger technical structures. Wearing the robe produces a strong feeling of dependency where the pilgrims have to be aware of the power outlet geography in the surroundings and to a large extent rely on the generosity of others to share their power outlets.

Photo: rd.labbs.net/pilgrims.htm

Figure 23: The power pilgrims wear robes held together by electro-magnets. Without power the electro-magnets cease to function and the robe fall to the ground in pieces.

Techno-Parasites[32] are introduced by Erik Hobijn and Andreas Broeckmann as conceptual sketches and descriptions of six parasitical machines, all attentive and adaptable to their host's structures. Their innovative struggle for survival causes different technical disruptions, for instance sucking other machines empty, disrupting their circuits or simply destroying them. Once constructed and liberated, they acts at whim and are out of human control as they feeds on vital and symbolically charged resources of modern infrastructure, e.g. light sources, electrical currents and communication lines. *EH00230030.201s* is a socket finder which, once it is plugged in, charges itself like a fat battery and subsequently discharges other connected objects in the electricity network. *EH00020006Lh* is a lantern parasite that climbs up any lantern post in a spiral movement with a light-driven motor. When it reaches the lamp it destroys the glass with a hammer, killing its own source of life, and falls to the ground.

Illustration: www.thing.de/parasites/

Figure 24: This techno-parasite climbs any lantern post with a light-driven motor, destroys the glass and kills its own source of life, and falls to the ground.

[31] 2004-11-09 ::: rd.labbs.net/pilgrims.htm
[32] 2005-04-08 ::: www.thing.de/parasites/

An invisible world of electromagnetic fields

In *Hertzian Tales*, Anthony Dunne (1999) presents five conceptual design proposals in form of post-optimal electric objects. These objects are all meant for investigations in order to ask questions and stimulate discussion rather than as finite things in themselves. The design proposals are not intended for mass-production or even prototyping, but for mass-consumption through publication and exhibition. For instance, *Thief of Affections* explores the notions of role models and psychosocial narratives in design, implying that the conceptual model of interaction through the object is more important than interaction with the object. The *Faraday Chair* proposes an imaginative electronic radiation-free space in form of a cage protecting the contained human body from surrounding electromagnetic pollution.

Photo: www.dunneandraby.co.uk

Figure 25: The faraday chair offers an imagined electronic radiation-free space.

Fashion Victims[33] is a project by Agnelli Davide, Buzzini Dario and Drori Tal where they propose a collection of three everyday garments as medium to criticise the increasing use of mobile communication and for making the invisible world of hertzian space more visible. The garments consist of a *shirt*, a *bag* and a *hat* which all react according to surrounding mobile phone calls by progressively and permanently stain them with red colour, representing blood.

Photo: www.fashionvictims.org

Figure 26: Fashion Victims consists of three garments which all reacts to radiation from mobile phones and stains the textiles of, in this example, a bag.

Interacting with objects in everyday life

The *do create*[34] collection, developed by Droog Design in collaboration with the advertising agency KesselsKramer, demands that users interact with rather open and generic objects as a way to customise and personalise them. The *do hit* chair is a cube made of thin steel where the user can, after laborious pounding, form a shape suitable for sitting on and the *do add* chair is build with one leg short, implying the user to fill the empty place with something in order to sit properly.

[33] 2005-04-09 ::: www.fashionvictims.org
[34] 2005-04-22 ::: www.droogdesign.nl

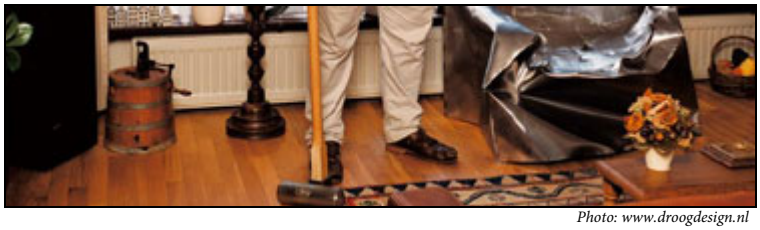

Photo: www.droogdesign.nl

Figure 27: The do hit chair allows the user to transform their chair into a wished form.

Inculpable Killing Machines[35], designed by Stuart Penny and Gianni Tozzi, are a set of electronic mousetraps, designed to help us clear our conscience. Seen as moral products they are an exploration of objects' effect on our sensibility and decision capabilities and plays with the awareness of our responsibility by pinpointing the consequences of our actions. All of the presented mousetraps suggest new attitudes towards phenomena that are so ubiquitous as to be overlooked, in this case the notions of cruelty to animals, and thus allow us to appreciate them anew.

Photo: www.interaction.rca.ac.uk/alumni/00-02/gianni/

Figure 28: An example of a pest control device in form of an electronic mouse trap with a head counter, designed to address the area of moral products.

With the collection of *Household objects in the act*[36], Aparna Rao modifies a number of ordinary everyday objects to explore various ways to illuminate unspoken interpersonal relations within her family. For example, the *22 Pop* is an enhanced traditional typewriter that helps her technology-averse mother to send e-mails. The *Uncle Phone* is a two meter long landline phone designed for her extravagant uncle that requires two people to use it, which highlights that he always asks somebody else to dial numbers for him. By altering the form, function or interaction of these household objects, Rao changes their meaning and how they were originally perceived.

Photo: people.interaction-ivrea.it/a.rao/

Figure 29: The 22 pop typewriter allows even non-technical people to send e-mails.

[35] 2005-04-08 ::: www.interaction.rca.ac.uk/alumni/00-02/gianni/
[36] 2005-04-09 ::: people.interaction-ivrea.it/a.rao/

Methodological framework

This chapter introduces the methodological framework for the master thesis and describes different views on the design process, the role of the designer and various aspects of usage and selection of design methods. The chapter ends with a description of some used design methods.

The design process

Löwgren and Stolterman (2004) mean that the design process is far to complex and varying to be comprehensive described in a general way, and according to Jones (1992) the structure and characteristics of the design process is not predetermined or ruled by any specific standards—it changes each time from project to project. Each new design process must therefore itself be designed to fit the specific design situation and all of its conditions (Löwgren & Stolterman, 2004). Despite this, it is assumed that the designer needs some sort of descriptions, models and theories that can be used in order to manage, organise, value and navigate through the design work, whether it is a well-structured design process or an experimental act of research through design.

A structured design process

As the constitution of a model describing the design process varies a bit between different disciplines within the design community, a few of them will be described here. Even though there is no unified and complete description, many designers share a common view that the design process includes three essential stages of *analysis*, *synthesis* and *evaluation*—or as Jones (1992, p. 63) put it; »breaking the problem into pieces, putting the pieces together in a new way and testing to discover the consequences of putting the new arrangement into practice«. This sequence of stages are often repeated many times during the design process, and becomes progressively less general and more detailed for every cycle (ibid.). Jones describes the design process from a system level perspective, but still in a general way, and he prefers to name the three stages as *divergence*, *transformation* and *convergence*. Divergence defines the initial

uncertain phase where the area of design must be expanded and explored, breaking prior conceptual constraints. The transformation stage describes the creative phase of pattern making where new various proposals of design can be formed from the scattered inspiration of the previous stage. Convergence defines the final phase where proposals are weighted against each other and evaluated to find the most fitting solution.

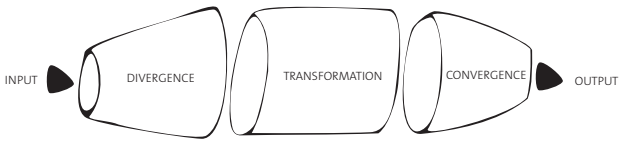

Figure 30: A schematic view of the three stages, i.e. divergence, transformation and convergence, of the design process according to Jones (1992).

Landqvist (1994) describes the design process from a product design view as a structured, and in many ways linear, process based on the fundamental parts of *needs*, *analysis*, *visualisation/form* and *result/product*. Specific needs or problems are identified in the initial phase, which is followed up in the next phase with an in-depth analysis of the defined problem area. The third phase intends to visualise and give form to the solution of the problem. A finished product is the outcome from the last phase, where the result is compared towards requirements set and defined in the two initial phases.

Preece et al. (2002) suggests a similar but iterative model originating from software development which describes basic activities of design as a lifecycle model in a four-stage process; *identifying needs and establishing requirements*, *developing alternative designs*, *building interactive versions of the designs*, and *evaluate designs*. The target user's needs are identified using traditional data gathering methods and transformed into requirements. Conceptual and physical designs are then developed, always considering alternative designs. The creation of a working interactive prototype is followed by an evaluation regarding usability and acceptability requirements with representations from the target users before the final is decided. Preece et al. further argue for using a user-centred approach and suggests three overall characteristics of the design process that are especially important to consider; *focus on users, specific usability and user experience goals*, and *iteration*.

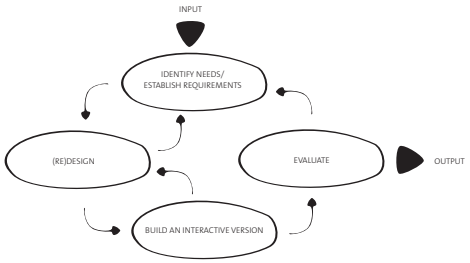

Figure 31: A schematic view of the four stages in the lifecycle model of the design process according to Preece et al. (2002).

A dynamic design process

In contradiction to more formal and structured views on the design process, Löwgren and Stolterman (2004) introduce a dynamic model that is applied to interaction design with a focus on the earlier phases in the design process. Instead of being linear or iterative, they assume that this model of the design process is totally dynamical and consist of three levels of abstraction; *vision*, *operative picture* and *specification*, with complex internal dependencies.

The vision is created in the designer's mind during the first confrontation with a design situation, and will be refined, changed, challenged, and possibly even discarded for other visions during the design process. It will be the foundation for the designer's decision making, guiding and influencing the daily work. The vision can also be seen as a good support for organising and continuously thinking of the design task and can represent thoughts about function, structure or technical aspects of the intended result. The operative picture, on the other hand, is a first attempt to make the vision more concrete, often through simple sketches and pictures.

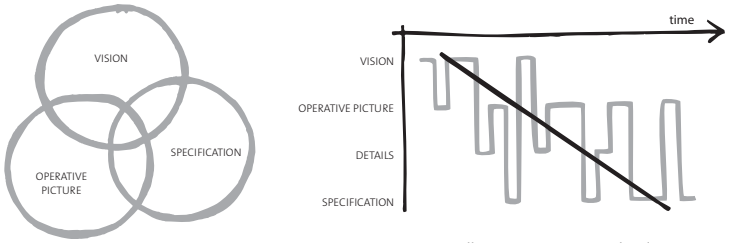

Illustration: Löwgren and Stolterman, 2004

Figure 32: Schematic views on the design process model consisting of vision, operative picture and specification (left) and their relationship over time (right) according to Löwgren and Stolterman (2004).

Development of the work in the design process is at all times dependent on the interplay between the operative picture, the design situation and the vision where the designer's view of the design situation is changing at the same time as the vision and operative picture develops. The operative picture is also developing, with help from structured and methodological ways of working, towards a more detailed and concrete representation where the result can be used as a tool for both internal and external communication. The operative picture will later on in the design process turn into a specification with descriptions of the coming creation. In this phase a new process, describing what is needed and what should be done for the construction, is initiated. New problems will arise during the construction and these will also be possible to view according to this three stage process.

This dynamic view on the design process has similarities with the ideas of Schön (1983), a well-known advocate of the practitioner's making, as opposed to describing practice as technologically rational. According to Schön does design and knowledge production take place in a reflective conversation with the materials of a design situation, where problem setting and problem solving is worked out simultaneously and not as the end of a logical chain of thought. Schön describe this as *reflection-in-action*, which typically takes place when a surprise, or something unexpected, appears in the process of accomplishing

the task. That surprise then causes the designer to question how and why it occurred. This process allows the designer to reshape the current work, while still working on it, and the on-going experimentation helps the designer to find a viable solution. *Reflection-on-action*, on the other hand, is not possible while acting; it needs distance, analogues and concepts that can be used on the practice. It can rather be seen as an evaluation of the designer's own process, implying that a designer needs to do something before it can be fully understandable. Schön says that »we reflect on action, thinking back on what we have done in order to discover how our knowing-in-action may have contributed to an unexpected outcome« (1983, p. 26). Another central idea of the design practice is, according to Schön, the need for a designer to temporarily frame a complex situation to see what happens, for example through the articulation of words, drawings, etc. Essential to the framing is that it is externalised and talks back to the designer (ibid.).

A research-oriented design process

The research area of design is a relatively new discipline with few established traditions, well-defined strategies or universally accepted approaches in the field (Gray & Malins, 1993; Laurel, 2003). Lack of appropriate methods has forced researchers to some degree inherent those which have been established in traditional scientific research (cf. Gray & Malins, 1993), such as the natural science, computer science and social sciences. The traditionally strict focus on reliability, validity, transparency and replicability within the scientific research often clash with the intentions of both designers and artists (Seago & Dunne, 1999), since most design problems that occur in real life are often wicked, that is, not simple and ordered as in most experimental situations (Ilstedt Hjelm 2004). They are therefore not likely to be repeatable and there is not one single answer to the problem.

Fällman (2003) makes the distinction between the terms design-oriented research, where research is the area and design the means, and research-oriented design, where design is the area and research the means. According to Fällman (2003, p. 231) is the contribution in design-oriented research »the [new] knowledge that comes from studying the designed artifact in use or from the process of bringing the product into being /…/ while the resulting artifact is considered more a means than an end.« In contrast, research-oriented design has the »problem solving within a given paradigm as its main component« and has the »production of new artifacts as its main motivation, not the production of new knowledge«. The latter approach has similarities to design practise which, according to Ilstedt Hjelm (2004), usually produce outcome which are context-specific, situated, subjective and often made particularly for one certain target group and task, rather than objective and generalised knowledge.

Alternative methodologies and approaches (Gaver & Dunne, 1999; Seago & Dunne, 1997) are suggested for the area of design research where perhaps more suitable and appropriate ways are proposed in order to better reflect the distinctive differences in the nature of design and the intentions of designers. Influences are often collected from related artistic disciplines like architecture,

art and industrial design. Seago and Dunne suggest that designers should go towards more fundamental philosophical issues and proposes action research by project, »where the end product is an artifact which, in effect, embodies the essential research« (1999, p. 14).

The designer

Design is, as in all other creating activities, very dependent on who is actually creating the artifact. The heaviest responsibility lies on the designer which should not be neglected since subjectivity plays an important role in design (Löwgren & Stolterman, 2004), with designers developing their own points of view in their work (Gaver & Dunne, 1997). Löwgren and Stolterman (1999, p. 14) also argue that »the result of any process will never be better than the people who participate in the process« and that »the skills and abilities of the designer determine the quality of the [artifact]«.

Designers as black boxes, glass boxes or self-organising systems

The designer can, according to Jones (1992), be symbolised in three different views, each bringing different aspects of designing in focus. These categories concern the amount of creativity, rationality and control that is put into the design process.

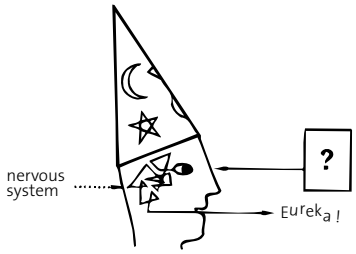

Illustration: Jones, 1992

Figure 33: A schematic view of the designer as a black box.

The *black box* view of a designer means, according to Jones (ibid.), that the most valuable part of the design process happens, often without conscious control, inside the head of the designer. The designer can therefore produce creative solutions but not be able to explain exactly how. An explanation to the fact that the human actions are not always conscious is that they instead are controlled by the nervous system. Jones concludes that the designer can be seen as a kind of magician with this viewpoint in mind. He also points out that it is not only the current situation but also experiences from the past that affect the designer's actions. With this statement Jones draws the conclusion that you need to have appropriate experience in order to be a good designer. Most design methods involve more rational thinking than thoughts based on the black box phenomenon.

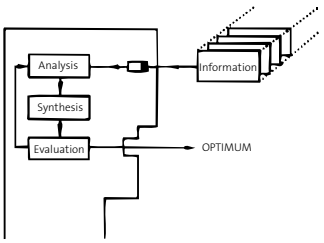

Illustration: Jones, 1992

Figure 34: A schematic view of the designer as a glass box.

A *glass box* designer can, according to Jones (ibid.), be seen as a human computer who operates in a planned way on the information fed to him. The information is processed in a systematic and rational procedure by going through different phases, such as analysis, synthesis and evaluation which can be repeated iteratively. Jones describes that such design process is expected to be under total control where designers can motivate all their decisions but the reality is more complex than that. Therefore, he means, is there in practice not possible to have complete insight during the whole design process.

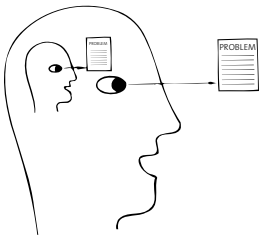

Illustration: Jones, 1992

Figure 35: A schematic view of the designer as a self-organising system.

The designer, seen as a *self-organising system*, has an ability to search for ideas and solutions and at the same time partly value his own process. This view of the designer makes him, according to Löwgren and Stolterman, capable to act as well as reflect upon his actions (2004) and that this kind of designer has both reflective as well as constructive skills (ibid., 1999). Jones (1992) considers that both views of the designer, as black boxes and glass boxes, have the effect of widening the area of search for solutions to a design problem. He argues that these designers create so many different alternatives for the solutions that it in the end becomes very hard to handle. To evaluate each alternative can therefore become a difficult task, but instead of just searching among the alternatives in blindness the self-organising system can, according to Jones, divide the design efforts into two parts. First, the designer can see which alternatives that support the search for an appropriate design. Second, the designer can look for the alternatives that help to control and evaluate the pattern of search. When this is done it becomes easier for the designer to perform an intelligent search to find short cuts across the unknown territory. This search for good alternatives for solutions is, according to Jones, based on both external criteria as well as the outcome from the partial search.

Designers as reflective practitioners

Similar to Jones (1992) view of the designer as an intelligent self-organising system, Schön (1993) argue that design work is pursued in dialectic between sketching, reflection and discussion. The process can be seen as a conversation between the situation and the designer, where the surrounding factors, the context and the user requirements are a part of the dialogue. This design process can be described, according to Schön, as *reflection-in-action*, whereby the designer works with a design model in dialogue with the context and the problem at hand. The solution usually appears in the process of arranging design elements in different patterns and structures where reflection and action are connected with the overall goal of developing a solution. Jones means that »the mind must be free to jump about in any sequence, at any time, from one aspect of the problem, or its solution, to another, as intuitively as possible. I also see that most of what is called *method*, and especially the collecting and sorting of information, is secondary to the free flow of mind« (1992, p. xxvi). By seeing design being characterised by a reflective process, Löwgren and Stolterman (2004) also states that the role of the designer then becomes important for the outcome.

The responsibility of the designer

Practitioners within the discipline of design, similar to artists and architects, continuously keep an internal discussion within the own professions whether work should arise from an ideological belief or commercial overtones. A few ideological manifests have come forward during the last century, for example *Design for Quality in Life* (cf. Sparke, 1987) and the *First Things First* manifests published 1964 and 2000 (cf. Meyer, 2003), where design practitioners are encouraged and engaged to take a larger social, cultural and environmental responsibility. Their knowledge and professional skills should, according to these manifests, be practiced in the services of the society rather than to promote consumption and market. There are not only groups of practitioners that critically see the designer as a part of shaping the world. A number of ideologists, among them Victor Papanek (1985), Ezio Manzini (1994) and Buckminster Fuller (cf. Sparke, 1987) have claimed and augmented that designers should take larger responsible for a sustainable development in their design of new products, whereas design perhaps cannot change the world, but is capable of giving form to a sustainable society.

Photo: www.arfarfarf.com

Figure 36: The geodesic dome is a lightweight, but extremely strong, shelter developed by Buckminster Fuller in order to address the post-war housing crisis.

Victor Papanek stressed already in the late 60's the responsibilities of the design discipline against society in ethical and social contexts. He proclaimed

that »the designer must be conscious of his social and moral responsibility. For design is the most powerful tool yet given man with which to shape his products, his environments, and, by extension, himself. The designer must analyse the past as well as the foreseeable future consequences of his acts« (Papanek, 1985, p. 102). The designer lives, according to Jones (1992), in a world where new needs rise and old needs slip away as a reaction to the changing patterns of facilities available. He draws the conclusion that designing should not be seen as a way of fulfilling existing needs, it is not to increase the stability of the man-made world that is the task for a designer. A designer's job, Jones means, is to change the things that establish the development of the man-made world where the designer has to give a substance to new ideas while simultaneously getting rid of physical and organisational ground of the old ideas.

Design methods

The academic study of modern design methods and methodology emerged during the 1960's and began with the large international *Conference on Design Methods* that was held in England (Gray & Malins, 1993; Bayazit, 2004; Ilstedt Hjelm, 2004; Lundequist, 1995). The emergence of the design methods movement came from an identified need to exercise more control over the process of designing, a direct response to the traditional and implicit process employed by designers as black boxes (Gray & Malins, 1993). The first generation of design methods were formulated and applied by scientists and designers. They were simplistic, systematic and rational, but still not mature enough to meet requirements of the existing complex, real world problems (Bayazit, 2004; Lundequist, 1995).

The second generation of design methods were a direct reaction to the first generation's view of the designer as an objective expert (Lundequist, 1995; Ilstedt Hjelm, 2004), where designers felt a need to compensate for the inadequacy that had been identified during this period (Bayazit, 2004). Characterising for the second generation of design methods was that the designer should work together with the users, acting as a coach that would help users develop their ideas (Lundequist, 1995). This lead to increased user involvement where both design decisions and identification of the user's objectives was put in focus (Bayazit, 2004). Another typical characteristic of the second generation was the development of empirical studies of concrete design projects, where designers realised that most of the systematic design methods proposed in the first generation did not apply to real cases (Ilstedt Hjelm, 2004). The view of design knowledge, as a kind of tacit knowledge that is implicit and contextualised, is the most characterising for the third generation of design methods (Lundequist, 1995). Designers started to apply philosophical dimensions towards the design process, where hypothesises and ideas were tested on the real world (Lundequist, 1995). The designer's thinking and competence was now put in focus and design was seen as a unique practice (Ilstedt Hjelm, 2004).

Design methods in the design process

Jones (1992) means that design methods often are used to externalise the design process, from the private thinking of the designer out to the public. He further says that »a major advantage of bringing design thinking into the open is that other people, such as users, can see what is going on and contribute to it information and insights that are outside the designer's knowledge and experience« (ibid., p. 45). The underlying aim is therefore to make designing more manageable, particularly at the systems level. Löwgren and Stolterman (1999) proclaim that design methods should be seen as tools for developing the designer's abilities and that the choice of methods should always be related to the situation at hand and the people involved. »It is the struggle with the complexity of design situations that the real value of a method can be reflected on. When this happens, your assumptions are challenged and have to be re-evaluated and re-formulated« (ibid., p. 19). They also argue that the use of design methods really contribute to the development of the designer's design ability and skills. Another reason for using design methods is that the methods can serve as a common ground for more successful communication between the stakeholders in a design process (ibid.), but they are also needed for the ability of being rational towards oneself as designer and the design team (Löwgren & Stolterman, 2004). They point out that if a designer is not able to explain his or her design no one will understand him or her. To describe one's design in a rational way requires the ability of communicate.

Choosing design methods

Jones (1992) argues that there are no general rules or principles for choosing and combining design methods. The choice of a method is therefore not possible to be generalised. He considers that the choice of methods is something that is for the designer or the design team to decide upon. When it is time to choose a method it becomes important to consider the actual conditions and circumstances, as well as the people involved, within the given situation and context. Jones (ibid.) further means that it is necessary for the designer to first understand the methods before he can be able to choose among them and say that one of them is more appropriate for the specific situation.

One way to select design methods is by categorising them according to the three common used activity stages available in the design process defined by Jones (1992); *divergence*, *transformation* and *convergence*. Methods in the start of design process aims to »expand the boundary of a design situation so as to have a large enough, and fruitful enough, search space in which to seek a solution« (ibid., p. 64). Examples of such methods are *literature studies* (ibid.) after already published information that can influence the output, *sketching* (ibid.; Schön, 1983; Preece et al., 2002) as a way to externalise the internal ideas of the designer, and *personas* (Grudin & Pruitt, 2002; Pruitt & Grudin, 2003) that helps designers to make their assumptions of the target users more explicit by generating fictive characters. When the territory of the problem is mapped, different methods for pattern-making, combining, simplifying, transforming, modifying and eliminating are needed, such as *affinity diagrams*

(Beyer & Holtzblatt, 1999; Doyle, 1999) that can be used to make a large number of various ideas easier to overview, *interaction matrix* (Jones, 1992) that permits a systematic search for connections between elements within a problem, and *removing mental blocks* (ibid.) to expand and find new directions of search. At this stage, when the problem is defined, variables identified and objectives agreed on, it becomes necessary to reduce remaining uncertainties until only one of many possible alternative designs remains. Useful methods for this are *checklists* (ibid.) that enables the designer to reuse relevant knowledge from previous similar situations and *ranking and weighting* (ibid.) in order to compare how an acceptable design is to be recognised.

Photo: Grudin and Pruitt, 2002

Figure 37: Personas are fictional characters, often illustrated with a picture, with certain characteristics that helps designers in making assumptions of the target users.

Another way of selecting design methods is that they should reflect the way that we see the designer (Jones, 1992). If the designer is seen as a *black box*, that produces creative solutions without knowing how it is done, methods that support this sort of creative processes are required. Examples of appropriate methods are *brainstorming* (ibid.; Landqvist, 1994) that stimulates a group of people to produce many ideas quickly, *synectics* (Jones, 1992) that uses analogies to re-pattern incompatibilities in internal structures, and *why-why-why* (Löwgren & Stolterman, 2004) where a chain of questions widening the understanding of problems through a backlog. On the other hand, if a designer is seen as a *glass box*, where every step in the design process is rational, descriptive and transferable, he needs methods that are systematic and easily breaks down a problem into sub problems. Examples of such methods are *boundary search* (Jones, 1992) in order to find limits within which acceptable solutions lie, *task analysis* (Preece et al., 2002) which systematically analyses existing situation, and *functional analysis* (Landqvist, 1994) that classify all functions in a systematic way. Last, if the designer is seen as a *self-organising system*, where the designer has the ability to search for ideas and solutions by his own and simultaneously value this process, methods needs to be on a meta-thinking level which supports the designer's reflections on the design process and his strategies. One method that can be used here is *reflection-in-action* (Schön, 1983), where the designer continuously have a dialogue with the context and the problem at hand.

The design process, from a design research perspective, may categorise design methods in another way where they are grouped in *user methods*, *design methods* and *usability testing methods*. User methods are used to identify possible or existing users, in order to find out objective facts about them (Preece et al., 2002). Examples of such methods, according to Preece et

al. (2002) and Löwgren (1993), are by watching and listening to users through *observations* and *interviews* or collecting demographic data and users' opinions through *questionnaires*. Design methods for the creative design work often uses a more subjective approach and addresses the process from idea generation to initial testing of generated ideas. Useful methods for idea generation are *interaction relabelling* (Djajadiningrat et al., 2000) where existing objects are used for describing the use of a non-existing object and *scenarios* (Preece et al., 2002) where an informal narrative description explores possible user experiences, needs, contexts or requirements. Initial testing of ideas and concepts can be done using methods like *prototyping* (Houde & Hill, 1997; Preece et al., 2002; Buchenau & Suri, 2000) where the prototypes can communicate and represent the ideas implying further discussions, and *workshops* (Jacobs & Mazé, 2004) where users can engage and experience in a test where the context is framed by the designers. Usability testing methods are used to evaluate design proposals against pre-defined requirements using, for example, formalised and strongly controlled *usability tests* (Preece et al., 2002) which measures users' performance on carefully prepared tasks, and expert evaluations like *heuristic evaluation* (ibid.) where experts reviews user interfaces guided by a set of usability principles, or *cognitive walkthrough* where experts simulates a user's problem-solving process in detail (ibid.).

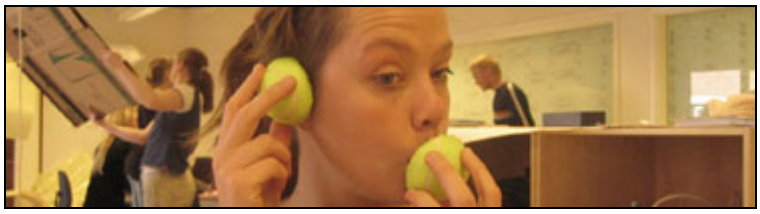

Figure 38: A prototype can have many different levels of abstraction, but can be useful in order to represent and communicate ideas. This picture is an example of a low-fidelity prototype, consisting of a divided tennis ball, which was used for initial testing of an idea about a new communication device.

Examples of used design methods

Design methods exist in a large number and are often seen as useful tools in any designer's toolbox. A large number of design methods have been used in the design project, see *The design project* chapter, but only a few of them, seen as specifically interesting for the outcome of the project, will be discussed more thoroughly.

Cultural probes

Gaver et al. (1999) describes *cultural probes* as a provocative collection of tasks designed to elicit inspirational responses from people about their individual lives. They provide an alternative to more traditional methods of user research from the social sciences, such as questionnaires, interviews or ethnographic studies. It is important to realise, argues Gaver et al. (2004, p. 53), that cultural probes values »uncertainty, play, exploration, and subjective interpretation« rather than scientific analyses of the material collected. A probe package may

consist of several objects, e.g. a disposable camera, post cards, maps or other material—all purposefully designed in an aesthetical and visual way. Gaver et al. (1999, p. 24) also stresses the different approach of their research, where they »concentrate on aesthetic control, the cultural implications of our designs, and ways to open new spaces for design« from the philosophical traditions of artists and designers rather than from more science- and engineering-based approaches.

Photo: www.interaction.rca.ac.uk/equator/

Figure 39: A cultural probe package containing a disposable camera, post cards, etc.

The cultural probes were initially deployed in the *Presence* research project (Gaver & Dunne, 1999), which was dedicated to exploring the design space for elderly in three European cities. It has since then been deployed in a number of design projects, e.g. *Equator* (Gaver et al., 1999), *interLiving* (Hutchinson et al., 2003) and *Digital Care* (Crabtree et al., 2003; Hemmings et al., 2002). Modified versions of the original cultural probes are used in the two latter projects where the aim is to gather information rather than act as sources of inspiration. This is an inevitable result in the process of extending the method, but Gaver et al. defines that if »probes are collections of materials posing tasks to which people respond over time, then *probology* is an approach that uses probes to encourage subjective engagement, empathetic interpretation, and a pervasive sense of uncertainty as positive values for design. We accept that Probes, the technique, may be appropriated for a variety of different ends. We hope, however, that other researchers and designers will embrace *probology* as well as probes in pursuing design for everyday pleasure.« (2004, p. 56)

Another example of using probes is suggested by Hutchinson et al. (2003) where they introduces *technology probes* as a way to investigate the usage of new technologies in real world settings. The probes can be seen as some sort of evaluation tools, since they are designed before they are handed out to users. They further suggest that technology probes can be used to inspire both users and designers to think of new technology and the ways it can support their needs and desires.

Personal inventory

The *Portable effects* research project at Interval Research Corporation (1998) was initiated by the architect and videographer Rachel Strickland and the educator Doreen Nelson. The exhibition resulted in an interactive computer-based installation at the San Francisco Exploratorium where the goal was to investigate the design motives that underlie people's daily transactions with ordinary objects (ibid.) and to »prompt visitors to reflect on the design decisions they make in choosing what to carry and how to carry it« (Back & Cohen, 1998, p. 239). Visitors were invited to share and describe the contents

of their personal physical containers, e.g. handbags, pockets, briefcases and backpacks, at interactive stations at the exhibition. The visitor's objects were sorted and labelled by the visitor and then digitally photographed and stored in a database for further processing and presentation. Visitors were also encouraged to reflect about the collection of things they were carrying and to ask themselves what these things were for.

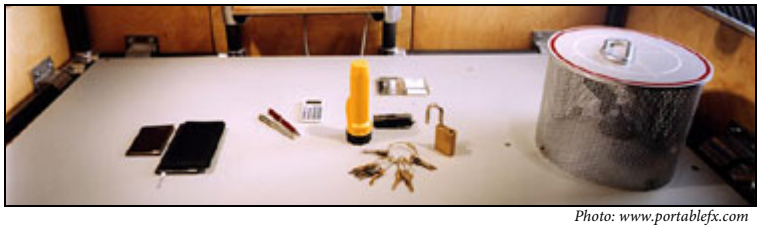

Photo: www.portablefx.com

Figure 40: The inspection station where visitors described the contents of their physical containers, e.g. handbags, pockets, briefcases and backpacks.

A similar method to inquire the personal space of people are *personal inventory* (IDEO, 2003) and *game 4: story of the object* (Mazé & Jacobs, 2003), which both documents the things people identify as being important and meaningful to them. By asking people to show and describe their personal objects makes it possible to catalogue evidence of their lifestyles, which can be useful for revealing people's activities, perceptions and values as well as patterns among them.

Brainstorming in slow motion

The initial exploration of *brainstorming in slow motion* was performed by Gaver and Dunne (1999), a method analogous to the traditional and more quantitative method of brainstorming where people generate as many ideas as possible, with none being criticised and all being documented (Jones, 1992; Landqvist, 1994). One difference between the two approaches is that ideas need to be generated in a limited period of time while using the traditional method. Gaver et al. mean that »in practice, learning from improbable ideas takes time, but traditional brainstorming sessions tend to be relatively brief« (1999, p. 603). Although ideas are not supposed to be evaluated during the brainstorm session, many of them often end up with being rejected if they seem too conservative or too frivolous. Given the possibility to explore ideas more deeply over time makes it possible to go beyond obvious or familiar possibilities (ibid.). This approach has many similarities to Schön's idea about *reflection-in-action* (Schön, 1983), where there is a constant dialog between the designer and the design material.

Sketching and drawing

Sketching and drawing is a traditional medium for creating accurate mental pictures of tentative designs (Jones, 1992). It is seen as a way of thinking for the designer (Schön, 1983) in order to form ideas and to communicate with both one self and others (Löwgren & Stolterman, 2004). It often becomes both important and necessary to externalise the design thinking during the

complex design process. By making external representations of the internal process inside the designer's mind, it becomes possible to have a conversation between the designer, material and the situation (Schön, 1983). This dialogue is extremely helpful during the work of making the abstract thinking more concrete. Externalising ideas gives, according to Löwgren and Stolterman (2004), the designer possibilities to see new openings and combinations, hard to figure without external representations. These can be helpful in order to structure the thinking, testing the logic in a proposal, remember restrictions, relationships and dependences, finding patterns and support the handling of many design alternatives (Löwgren & Stolterman, 2004; Jones, 1992).

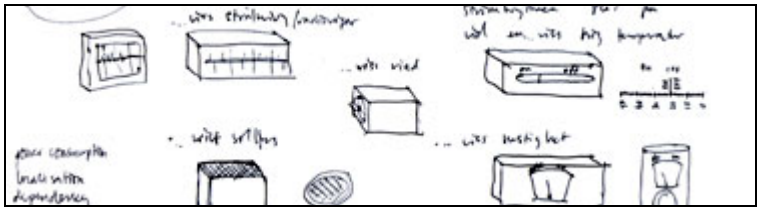

Figure 41: Sketches can visualise and concretise the internal thinking of the designer.

Externalising the own thoughts allows, according to Löwgren and Stolterman (2004), the designer to reflect on ideas in a different way. It makes it possible to react and acts as a discussion partner, offering some resistance, showing hidden properties, obstacles and openings. By externalising the ideas makes it also possible to formulate, communicate and present the thoughts, intentions and visions to others, giving them a chance to respond with feedback and suggestions (ibid.). On these occasions it is necessary to operate at the speed of thought upon a quickly responding medium that can represent the form of the problem (Jones, 1992).

Prototype model

Houde and Hill (1997) introduce a model that represents a three-dimensional space which corresponds to important aspects in the design of interactive artifacts. They define the dimensions of the model as *role*, *look and feel* and *implementation* where each dimension corresponds to a class of questions which are salient to the design of any interactive system. »*Role* refers to questions about the function that an artifact serves in a user's life—the way in which it is useful to them. *Look and feel* denotes questions about the concrete sensory experience of using an artifact—what the user looks at, feels and hears while using it. *Implementation* refers to questions about the techniques and components through which an artifact performs its function—the *nuts and bolts* of how it actually works« (ibid., p. 3). The triangle is drawn askew to emphasise that no dimension is inherently more important than any other.

The model can be an essential aid in the decision of what kind of prototype to build, since it separate design issues into three types of questions which frequently demand different approaches to prototyping. Implementation usually requires a working system to be built; look and feel requires the concrete user experience to be simulated or actually created; role requires the context of the artifact's use to be established. The model can be helpful in

visualising the focus of exploration since it is explicitly about what kind of design questions that has to be answered.

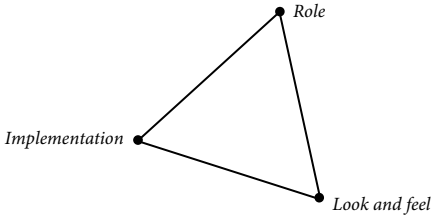

Figure 42: A schematic model of what prototypes prototype, represented by a three-dimensional space.

The design project

This chapter describes the process and outcomes from the design project that was carried out as a part of this master thesis. It starts with a definition of the directions for the design project and continues by describing the gathering of information and inspiration. It follows by an expansion of mind resulting in generation, grouping and refinement of ideas in three iterations. The chapter ends with a description of the resulting three themes of conceptual design proposals, the evaluation and the building of mock-ups.

Defining directions

The design project started with an introduction to the Static! project and its research theme. During this initial phase of the project, an extensive search for inspirational examples of related work was conducted by reading literature such as books, academic papers, articles and magazines. Inspiration was also gathered by searching and browsing the web where some of the findings from this research can be found in the *Background* chapter. Other findings that inspired the formulation of the design approach and statement of intent for the design project was found in the information gathered from studying results and ongoing work within the Static! project, e.g. through attending a two day long workshop, taking part of the existing project documentation and discussing with the project members.

Design approach

One of the intentions with the design project was to adapt a design approach that to a large extent was influenced by the work of Dunne and Raby in *Design Noir* (2001); Gaver and Martin in *Alternatives* (2000); Gaver and Dunne in *Projected Realities* (1999); and Dunne in *Hertzian Tales* (1999). Their work can be categorised as examples of critical, speculative and provocative design where the results, as well as the methodology, is characterised by designers formulating an idea or a statement which they implement and evaluate. Their ideas do not necessary have to be grounded in specific user needs, they rather originates from speculative questions or interesting phenomenon.

Another intention with the design project was to embrace the philosophy of *reflection-in-action* as an overall framework for the creative process, making it possible to work as a reflective designer in the spirit of Schön (1983). In order to do so, a reflective design process was needed to support this kind of philosophy. The planning of the design project was therefore influenced and inspired by the approach of action research by project (Seago & Dunne, 1997) and the view on the design processes described by both Jones (1992) and Löwgren and Stolterman (2004) in *The design project* chapter.

Statement of intent

With the design approach defined, a statement of intent was made in order to frame the master thesis design project:

- *Target young people*. The Static! project addresses the general public regardless of demographic aspects such as gender, age, geographical localisation, profession or education. The thesis design project should therefore, for two reasons, focus on a smaller target group; in this case young people in the age span between 15 and 25 years old. First, it would narrow the scope of the design project, necessary regarding the limited time available. Second, young people are seen as specifically interesting since they are about to create their own opinions, willing to explore and adapt new ideas but also actively questioning the world as they see it today. At this age, young people also have a lot of own experiences of both energy use and energy consumption.
- *Use personal objects as mediators*. Since the Static! project consider both domestic and public spaces, it would be interesting if the thesis design project specifically investigate the personal objects that young people uses on a daily basis and that surrounds them in their personal spaces. To have a profound effect on young people's attitudes, my belief is that the relationship to the objects in question must have some sort of personal connection in order to be truly effective. The impact of using personal objects as critical mediators may therefore be very useful when entering people's personal spaces.
- *Use interaction design to start a reflective process*. Another wish was to investigate interaction design as a means of increasing young people's awareness about energy and for stimulating changes in their energy behaviour. The thesis design project should therefore explore and study if interaction design could, with a particular focus on the daily interaction between young people and their personal objects, be used to start a process of reflection through interaction.
- *Use a critical, speculative and provocative design approach*. In order to achieve in-depth reflection through interaction, a decision was taken that the thesis design project should use a critical, speculative and provocative approach where the objective for the conceptual design proposals is to ask carefully crafted questions rather than being useful. The result of using such approach could imply young people to start a reflection process over their own energy use and consumption.
- *Design conceptual design proposals*. The outcome of the thesis design project should be conceptual design proposals that occupy points in

the design space as speculative and provocative examples of how personal objects can be designed in order to raise energy awareness among young people. The design proposals could result in anything from physical and working prototypes to sketches or scenarios, but should in a sufficient and clear way communicate the intentions behind the ideas.

Gathering inspiration and information

Three design methods, *cultural probes, personal inventory* and *secondary research*, were used to gather inspiration and information about young people and their everyday life, focusing on their interaction with energy and personal objects. Findings from these methods both inspired and informed the following generation of design proposals to a large extent.

Conducting cultural probes

The probes created for the design project were used to achieve a better understanding of young people's habits, thoughts and perceptions of energy in specific, but also to get a glimpse of their relationship to personal objects and the impact they might have in their mundane life. A probe package was carefully and purposefully crafted, consisting of a disposable camera, a pen, a set of dot stickers and a small booklet with instructions and a number of reflective questions.

Figure 43: The probe packages contained a disposable camera, a pen, a set of dot stickers and a small booklet with instructions and reflective questions.

All probes were given away in two rounds to in total nine students and collected after three to five days. The first round involved one male and four female upper secondary school students in industrial design whilst the second round consisted of one male and three female master students in interaction design. Students in the first round were between 15-20 years old and in the second round between 21-25 years old. Among the findings from the returns was the fact that many of the students perceived electromagnetic radiation from mobile phones as a dangerous form of energy, and that many of them had music players as their favourite personal object. Electricity and electronic appliances were often related to energy, but some students also associated energy with human power, sun, animals, heat and food.

Figure 44: Examples of returns from the probe packages, e.g. photographs and notes.

Considering cultural probes as a tool for inspiration, all probe returns were seen as successful resulting in many rich, interesting and inspiring findings. A similar method that could have been used is *self-observations* or *diaries* which suits well when it is difficult or even impossible to directly access a certain place, e.g. like in people's homes or when access is far too time consuming. Although this method involves the subjectivity of the participants in the data collected, it can be valuable to get a glimpse of life through the eyes of the people that are being studied (Design for Future Needs, 2003). If the aim is to collect information for a more qualitative analysis of young people's perception of energy and their usage of personal objects, it would have been necessary to follow up the probe returns with more in-depth *interviews* (Preece et al., 2002) afterwards. It might have been possible to find out more about the student's underlying motives and attitudes by asking them carefully crafted questions, for example about their attitudes towards energy use and consumption, or narratives of and feelings about their personal objects. Other methods for investigating existing behaviours are *observations* (ibid.) and *ethnography* (Hughes et al., 1995, 1997; Simonsen & Kensing, 1997), but a disadvantage of using these methods is that they require lots of time for collection of information and therefore easily gets expensive (ibid.).

Performing personal inventory

To find out a little bit more about the personal objects young people surround themselves with on a daily basis, a personal inventory was performed in order to document the things they identify as being important to them. Sixteen master students in interaction design were asked, without any prior notice, to empty their handbags and backpacks on a table where the content was documented with a digital camera. The students, consisting of both male and female students in various ages, grouped all their objects and bags without any explicit instructions, which in itself rendered some interesting insights of their personalities. Common objects among almost all of the students were mobile phones, pens, wallets, calendars, coins and keys. More rare things identified were a Leatherman tool, a key padlock, a pack of cards, a clarinet mouthpiece, a patent application, a ring, a pocket mirror and a marsh tree seed.

Figure 45: An example of a personal inventory with a student's backpack.

One benefit of performing a personal inventory is that it actually reveals all objects that young people carries around and uses on a daily basis. Another alternative method that could be appropriate for this purpose is *contextual inquiry* (Beyer & Holtzblatt, 1999; Preece et al., 2002), where the designer works as an apprentice to users, studying them in their natural environments. This method allows the designer to observe users and inquiring them during a contextual interview in order to achieve a better understanding of the user's actions. A useful complement to a personal inventory is *focus groups* (Preece et al., 2002) which could be carried out with a group of young people discussing about young people, in general terms, and their relations to personal objects.

Conducting secondary research

A secondary research (IDEO, 2003) was carried out in order to identify trends related to personal objects and energy technologies. This method is a useful way to make a broader inventory of available sources in published material where the findings can be used to ground further work upon. Browsing the web made it possible to develop an informed point of view on the state of the art regarding these issues.

Figure 46: Mobile electrical powered objects also imply new ways to charge them. The Voltaic backpack[37] (left) and the portable iPod charger[38] (middle) both uses solar cells to charge batteries or objects. The Battery first aid[39] (right) is a disposable battery that can keep, for example, the mobile phone alive for about 30 minutes.

Innovations for powering electrical objects were identified and many of them were sustainable alternatives (Jansen & Stevels, 1999) to traditional energy sources, e.g. batteries, which make them useful since they support mobility—important for young people of today. Other alternative ways to generate energy, for example through physical effort, seemed to be another trend and commonly used to secure important functions in case of emergency.

Figure 47: The flashlight[40] (left) gives five minutes of bright light after 30 seconds of shaking, the emergency wind-up dynamo radio (middle) uses a crank to generate power and the fruit clock[41] only uses the natural electrical potential of a fresh fruit or vegetables.

[37] 2005-04-29 ::: www.voltaicsystems.com
[38] 2005-04-29 ::: www.disruptivegroup.com/products/solio/
[39] 2005-04-29 ::: www.saftvet.com/se/
[40] 2005-04-29 ::: www.sportsimportsltd.com

Another trend that was identified was the increased interest in wearable music players, especially in form of MP3-players[42]. The recent development within micro-component technology has drastically reduced the size of such music players, allowing them be designed with a greater level of freedom. Design has therefore become an equal important and competitive factor as performance.

Figure 48: Design has become an important factor for MP3-players; Samsung's Yepp YP-W3[43] (left) looks like a pocket watch, the iPod[44] (middle) has the characteristic Apple design and the MPIO[45] (right) can be worn as a necklace.

A new trend among young people is the large range of popular accessories and jewellery for mobile phones. Both fun stuff and accessories with practical functions are today found among young people's personal objects, where many of them are used in order to distinguishing the owner from others.

Figure 49: Accessories in form of mobile bags[46] (left), small Japanese plant key chains[47] (middle) with living plants and key straps[48] (right) for both keys and mobile phones.

Expanding the mind

The generation of ideas around energy and personal objects started directly after the inspiration material was gathered. This was done by generating ideas over a longer period of time, allowing them to grow naturally. Many of the ideas were then visualised in form of sketches and drawings.

Brainstorming in slow motion

The method *brainstorming in slow motion* (Gaver & Dunne, 1999), with many similarities to Schön's idea about *reflection-in-action* (Schön, 1983), was used for the initial idea generation. An advantage with a constantly ongoing reflection is that it allows ideas to grow slowly or be discarded naturally, without any further need for explicit justification or criticism. Approximately

[41] 2005-04-29 ::: www.schylling.com
[42] 2005-04-29 ::: www.itresearch.se
[43] 2005-04-29 ::: www.samsung.com
[44] 2005-04-29 ::: www.apple.com
[45] 2005-04-29 ::: www.mpio.com
[46] 2005-04-29 ::: www.mobilsmycken.nu
[47] 2005-04-29 ::: www.plantkeychain.com
[48] 2005-04-29 ::: www.logoband.nu

45 ideas emerged over time using this method and they were written down on small post-it notes and put up on a wall. Many of the generated ideas were both abstract and vague, for example that it would cost the user something in order to change or use an object, that the user should be able to control or steel energy in some way, or that there could exist some sort of X-ray sight. Other ideas were more precise, for example a backpack that charge energy in relation to how much you walk, a mobile phone that parasite on other user's mobile phone radiation, a cap that makes it possible to collect energy from another car's exhaust pipe, or a music player that changes or modifies the music according to the overall usage of energy in the surroundings.

Figure 50: More than forty ideas were generated over time and written down on post-it notes that were put up on a wall.

Even though some of the ideas were quite indistinct and vague, this design method resulted in a manageable number of mostly qualitative ideas. Other ways to generate ideas are traditional *brainstorming* sessions (Jones, 1992; Landqvist, 1994), which are strictly restricted in time and procedure, or *interaction relabelling* and *extreme characters* (Djajadiningrat et al., 2000), which often concentrate and focus on a some specific issue. The results of using these alternative methods would perhaps render many ideas, since they are rather quantitative than qualitative, but they also need further processing afterwards for valuing and refining the large amount of generated ideas.

Sketching and drawing

Sketching and drawings were used to develop and visualise the initial ideas further. This way of making abstract ideas more concrete was necessary in order to support new openings and combinations (Löwgren & Stolterman, 2004) and to start the process of *reflection-in-action* (Schön, 1983). Schön sees sketching as a concretising method to find a solution for the various demands required of the final product and Fällman (2003, p. 230) claims that sketching is not »simply an externalisation of ideas already in the designer's mind, but on the contrary a way of shaping new ideas«. As soon as an idea were concretised in form of a sketch, new ideas often emerged quickly, resulting in a long chain-reaction ending with many alternative representations that all originated from the first idea. For example were a large number of possible implementations of how to visualise electromagnetic radiation generated from the idea of "dangerous" energy.

Figure 51: Sketches of different variations for medallions.

By reflecting on and evaluating ideas as soon as they became externalised made it also possible to quickly try different variations and solutions. This procedure of sketching can, according to Tjalve (1976), be performed in a structured and well-defined process where designers in a systematic way can investigate and explore several different variations of form for each idea. An alternative method for visualising the ideas is *low-fidelity prototyping* (Preece et al., 2002) where simple prototypes can be produced quickly of ordinary things like paper, cardboard or other available material. Problems with this sort of representations are the amount of time spent on both finding materials and to actually build the prototypes and the common lack of details.

Grouping and characterising the ideas

The fact that the amount of generated ideas quickly became hard to overview made it necessary to sort and group them in order to find duplicates or ideas that served to be divided in separate ideas or merged with similar ones. The sorted ideas were then placed in a matrix diagram for further categorisation and differentiation of the ideas regarding their concreteness.

Affinity diagram

One way to bring order in the chaos of post-it notes was to create an *affinity diagram* (Beyer & Holtzblatt, 1999; Doyle, 1999). A bottom-up approach was used, where ideas with similar characteristics were identified and grouped in common categories and then labelled with descriptive names. Examples of such categories were parasitical functions, wearable objects and visualisation. The grouping can also be done with a top-down approach, where categories are defined before the sorting and grouping takes place, instead of after. This variant was not applicable since there were no categories in the beginning; the categories were rather a result of conducting the method.

Figure 52: The many ideas generated were categorised in an affinity diagram in order to provide a better overview, separating the post-it notes with different colours and sizes.

The large amount of ideas generated made it difficult to overview them all when it was time for valuing and ranking. One of the biggest advantages of affinity diagrams is the visualisation, overview and possibilities to make fast

changes. This is possible since post-it notes are put up and organised on a wall, viewable and editable for all. These features are harder to achieve with alternative and more complex methods like *interaction matrix* and *interaction net*, both suggested by Jones (1992).

Matrix diagram

It soon became necessary to identify different stages of concreteness for all ideas, since it varied a lot during this phase. This was done by placing all of the ideas in a matrix diagram (cf. Westerlund, 2005) with two axes spanning from *conceptual* to *physical* and *abstract* to *concrete*. The ideas were then evaluated with respect to how they were best visualised and communicated (in form of a conceptual scenario or as a physical prototype) and their concreteness (well-defined or undefined ideas). For example, the idea of controlling energy was seen as abstract and it should probably need to be communicated through a scenario in opposite to the rather concrete idea of a ring that shrinks when it is exposed to hot water, which suits well to be visualised in form of a prototype.

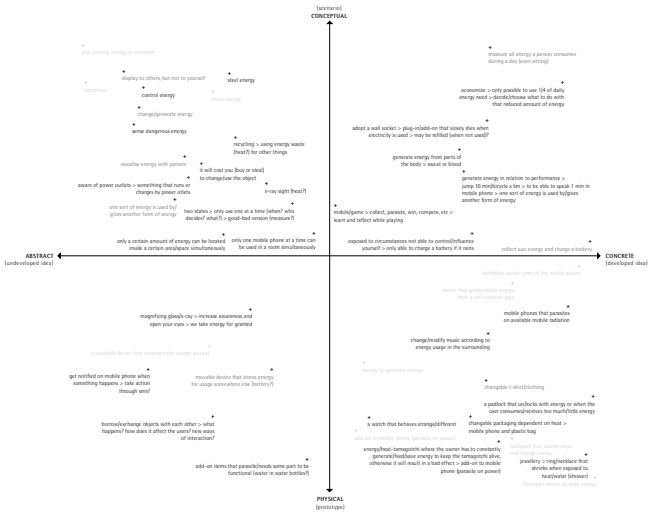

Figure 53: One of the matrix diagrams used to sort the ideas according to the two axes spanning from conceptual to physical and abstract to concrete.

By using the matrix diagram for further categorisation of the ideas made it also easier to both value their feasibility and to decide whether some of them should be rejected or developed further. Ideas that needed to be clarified in some ways were refined and then moved correspondingly within the matrix to reflect the changes. The matrix was therefore seen as an excellent tool in the creative design process. This could also have been done by using an *affinity diagram* (Beyer & Holtzblatt, 1999; Doyle, 1999), but the fact that many of the ideas existed in the span between two categories, rather than within distinct and pre-defined groupings, made affinity diagrams too imprecise. This span, provided by the matrix diagram, was therefore much more applicable for this purpose.

Refining ideas to concepts

A need to transform vague ideas into more well-defined concepts was raised after the initial creative phase, which resulted in a collection of more or less defined ideas. This process was carried out in three iterations, where ideas were further developed, refined and categorised into three different themes.

The first iteration

The continuing reflective process allowed the vague ideas to slowly evolve and mature where interesting properties and behaviours were re-grouped and re-labelled into many new combinations. Ideas for both entirely new objects and re-interpretations of existing objects were developed, sometimes ending in interaction situations that were very unlikely to happen, resulting in no or little reflection. These ideas were discarded in favour to ideas that seemed to have more potential in provoking users. The first iteration resulted in a large number of both more or less defined object categories and behaviours where the three most defined groups of ideas at this time are presented below.

Figure 54: Sketches of the padlock idea.

Padlock. One example of such object category could be a padlock, which could consist of a battery that keeps it locked as long as it has power. The user will in this case not know exactly when the battery goes empty and the following consequences, when the padlock is left unlocked, cannot be fully predicted. Alternative behaviours could result in a padlock that must be constantly fed with energy to be kept locked or a padlock that only can be locked and unlocked by using a large amount of energy or by parasiting on batteries belonging to other energy sources, e.g. mobile phones. The user will in this way get aware of how hard it is to constantly have energy available.

Figure 55: Sketches of the jewellery idea.

Jewellery. These examples investigate physical properties inherited in materials that are affected by properties of different kinds of energy, in this case heat in form of hot water. The idea was to visualise the usage of hot water by using jewellery, e.g. rings or bracelets, where their appearance would shrink when exposed to hot water during a hot shower or while doing the dishes. The ring or the necklace would after a while become very uncomfortable as the user

consumes more and more hot water, but the change would be temporary and in the end remind users about their consumption of hot water.

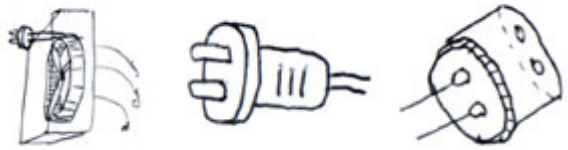

Figure 56: Sketches of the wall socket plug-in idea.

Wall socket plug-in. Another example is a plug-in that allows the user to adopt a specific wall or telephone socket and in this way making it personal. The plug-in could for example be used like a tamagotchi where the user cares about the plug-in, who slowly drains or dies when electricity is used from the socket, or a game where the user supervises and remotely control the wall socket by sending a SMS[49] to the plug-in to turn on or off the access to the electricity from it. This might encourage the user to investigate surrounding wall sockets to receive more information about their utilisation. It also gives the owner of the plug-in control over the access to the energy and all appliances that runs or charges using the specific wall socket, which could lead to both unexpected and interesting social effects.

The second iteration

Focus at the beginning of the first iteration was mainly on personal objects as such. It soon became obvious that the selection of objects were subordinate in favour to the effects of different interactions that could be achieved through the design of an object. This change of focus, from objects to interaction, was seen as an important factor in order to achieve a more profound reflection. Since most of the ideas mainly focused on pre-defined purposes, they became intentionally generalised and where the purposes intentionally were made vaguer in order to offer users possibilities for experiences, investigations and explorations rather than pre-defined answers. To be truly effective, the objects should rather be used on a daily basis, resulting in that a re-design of existing objects were suggested as the best solution. By purposely re-designing existing objects and making them more speculative, by adding unconventional and irrational behaviours or making them intentionally ambiguous, was considered as one way to open up a conversation with young people about different values that might characterise energy—values not always reflected in such existing objects. This speculative approach could be helpful in »transferring the responsibility from the designer to the users« (Jones, 1992, p. xxxvi) in order to move the designer away from making specifications of possible responses towards designing of both context and situations in which it becomes possible for users to determine the use of the objects for themselves.

Extracting the essence from the different ideas left, gave a list of five specific characteristics and some related questions that were considered as

[49] Acronym derived from Short Message Service

especially interesting to investigate further. Focus for the second iteration in the design process was to design examples that illustrate:

- *Our dependency on energy*. Findings from the inspirational research of young people's everyday life identified that they constantly used or were surrounded by energy in different forms. What would for example happen if this energy suddenly became unavailable or not affordable? What would happen if young people have to surrender some control to circumstances they are not able to affect themselves?
- *The localisation of energy*. Even though energy in different forms exists almost everywhere in our surrounding, and sometimes also for free, most people are not aware of it. The invisible nature of energy seemed therefore fascinating to explore more in detail, and many of the findings received from young people indicated that there exists a wide range of ideas of where to find energy.
- *That it costs to use energy*. It would be interesting to speculate what would happen if the cost of using energy would be rather significant, since most of the energy that is used by young people is taken for granted. Would this cost change young people's perception of the value in energy and as a consequence imply a change in their energy behaviour? Would they be interested to create energy for free if they at the same time have to destroy or leave something else, or vice versa?
- *Energy as a design material*. The inherent characteristics and qualities that usually are associated with energy could perhaps be used to add interesting properties, not always thought of, to interaction design. In what ways could these characteristics and qualities be used to enrich the interaction with personal objects?
- *The social and psychological consequences of our acting*. Every decision we take or anything we do will in the end result in different kinds of consequences, for us or for people in our surroundings. And people are often very sensitive to how the surroundings perceive them. How would our behaviours be affected if the consequences of our actions regarding energy use and consumption put us in awkward situations or faces us with uncomfortable decisions?

The third iteration

The process of reflection-in-action continued and was directed to find design solutions to the five resulting characteristics from the second iteration. As the design process evolved, ideas that seemed strongest and with best qualities were selected, combined and developed further into four more well-defined concepts. After developing a number of examples that could describe the concepts in a good way, they were illustrated with a small exploratory text and presented to supervisors, teachers and friends. The concepts were illustrated as sketches and a design decision were made to subordinate the form of the conceptual design proposals to give users little pre-definitions of the object and leave much for the imagination (cf. Dunne & Raby, 2001; Dunne, 1999).

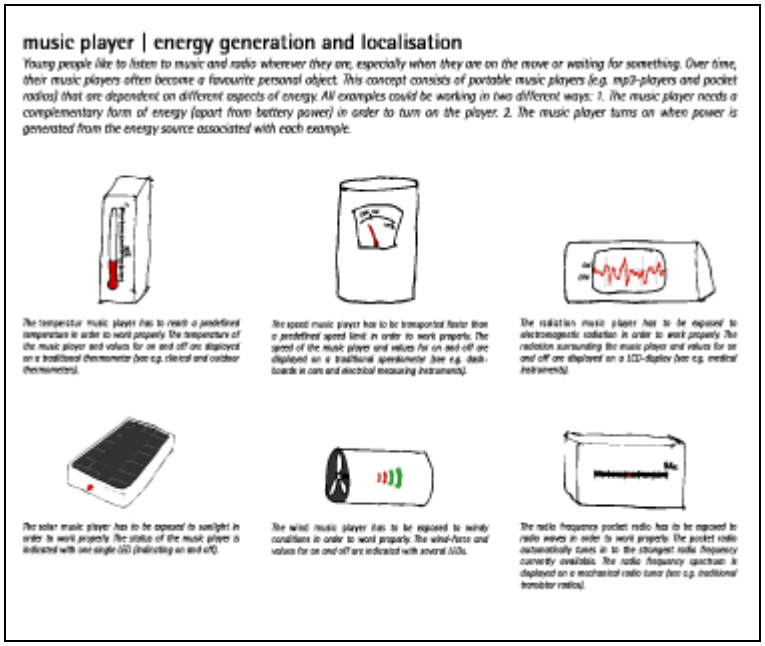

Figure 57: An example of the presentation of the concepts.

Music player | energy generation and localisation. This concept origin from the two ideas of making users more aware of different forms of energy existing in the surroundings and that energy should not be taken for granted. Music players, e.g. MP3-players or CD-players, were chosen to represent these ideas since they are often used by young people while they are waiting or during transportation from one point to another. The music players emphasises all five key characteristics mentioned above. Energy is seen as a design material since all music players needs a complementary form of energy, apart from batteries, to work properly. The search for alternative energy sources, which forces the user to use their fantasy, could result in unusual behaviour that may put the user in awkward situations with possible social and psychological consequences. This is the cost users have to pay for consuming energy. By surrendering some control for a while, these music players might also increase users' awareness of their dependency on energy.

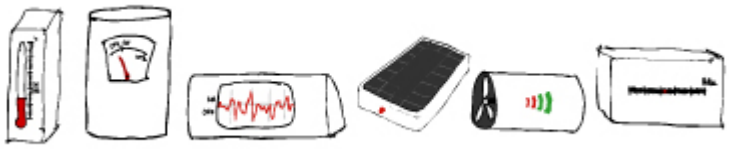

Figure 58: The six examples of the music player concept.

Jewellery | energy visualisation. This concept is a development of ideas that origin from visualisation of hot water usage and the speculation around physical properties inherited in materials that are affected by different kinds of energy. Hot water was in this concept replaced by electromagnetic radiation and visualised in form of medallions that changes their appearance when

exposed to such radiation. This concept emphasises two characteristics; the fear of the invisible and "dangerous" energy that is connected to mobile phone use and that it costs, in this case our own health, to use energy. The jewellery also highlights the social and psychological consequences of visualising the exposure of radiation as well as the localisation of such invisible radiation.

Figure 59: The first six examples of the jewellery concept.

The choice to use medallions were later on changed in favour to accessories, which represented, in a better way, the personal objects that young people actually uses today.

Figure 60: The final six examples of the jewellery concept.

Pocket mirror | energy visualisation. This concept origin from an idea of a magnifying glass that is equipped with X-ray functionality that enables the user to see inside and even through things. It was combined with the idea of exploring the invisible nature of energy that surrounds us in everyday life. Offering users possibilities to discover heat leakage in an amplified way could result in an increased awareness about, for example, the amount of energy waste daily present around us. A pocket mirror seemed to suit for this purpose, since it in normal cases displays the things we can see. The concept emphasises the localisation of energy and adds new functionality to the pocket mirror in form of a secretly implemented function that allows the user to see through the mirror and view the world behind, augmented with thermographic colouring and revealing the intensity of heat within a spectrum of colours enhancing an investigation of the surroundings.

Figure 61: The two examples of the pocket mirror concept.

Personal battery chargers | energy generation. This concept origin from an idea that it should, in some way, cost the user something in order to use or consume energy. Transforming physical effort into usable forms of energy, like for example electricity, seemed like a good solution for young people, especially since there is an obvious need for charging all of their electrically

powered objects, e.g. music players and mobile phones. The concept introduces ordinary objects that are used for ordinary tasks, re-designed as battery chargers that transform kinetic energy to electricity as they are used in everyday life situations. The battery chargers therefore highlight both our dependency on electrical energy and that it costs us something to use energy.

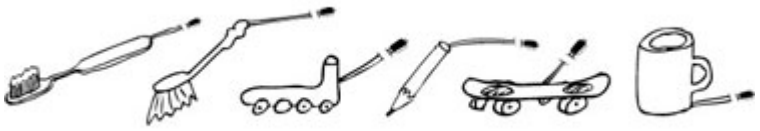

Figure 62: The six examples of the personal battery charger concept.

These four categories of concepts were still rather open and needed to be concretised further. By sketching different representations of concepts and imagined possible interactions with the proposals made it possible to reject some ideas and focus the development of others. The proposals were refined further according to useful suggestions and feedback that came back from showing the sketches to supervisors, classmates, students and personal friends. For example, the idea behind the pocket mirror was considered hard to understand and it was rejected as a design proposal. The ideas behind the jewellery were changed from being solely medallions to include all sorts of accessories, since suggested accessories better reflected the objects actually used by young people of today. Another refinement was that the music players were suggested to be self-sustaining, rather than powered by batteries.

Three themes of conceptual design proposals

The refinement of the ideas resulted in a small collection of conceptual design proposals where a number of ordinary and existing personal objects were given a speculative re-design, which all explore different aspects of energy. The collection is categorised in three themes, each of them exploring specific aspects of *visualisation*, *generation* and the *localisation* of energy. These aspects were selected in favour to others, e.g. measuring, storing and sharing energy, mostly because these aspects could be associated to findings in the inspirational material collected from young people, but they also addresses issues related to energy that concerns young people of today in their everyday life.

The three themes of conceptual design proposals are described below in order to provide concrete examples of how re-designed personal objects can appear as a means to stimulate reflection and raise energy awareness among young people. They are all visualised and communicated through sketches where the objects are purposely diagrammatic and vaguely familiar to focus the discussions on interaction rather than on form. As speculative design examples, these re-designed objects acts to stimulate reflection and reaction in their intended interaction where re-design is used as a method for rethinking basic notions of objects and use.

Energy visualisation

The probe returns showed that many of the students thought that mobile phones represented a "dangerous" form of energy. This was an interesting contradiction; especially since almost all students participating in the personal inventory carried a mobile phone in their bag and used it frequently on a daily basis. In order to evoke some reactions among young people, it became obvious that the invisible and intangible nature of electromagnetic radiation had to achieve some sort of physical representation. Without committing to whether mobile phone radiation is unhealthy and dangerous or not, these proposals all act as ambiguous displays visualising this kind of radiation.

Figure 63: Accessories that react to and visualises the amount of mobile phone radiation exposed to the users.

The *accessories* were inspired from dosimeters; badges indicating exposure of radioactive radiation. In similar ways, these accessories react to and visualises the amount of "dangerous" radiation from mobile phones that is exposed to its user. The *key strap* is sensitive to such radiation and reacts with an augmented effect by slowly dissolving the material, which in the end will make it non-functional. The fact that these straps are commonly used by young people to hold, not only important things like keys, but also their mobile phones, further emphasises the contradiction where increasing daily usage of mobile phones substantially decreases the important functionality of the key straps.

The *medallion* slowly releases small red drops in its glass container when exposed to mobile phone radiation, resulting in a visual effect similar to a lava lamp. Both the key strap and the medallion display accumulated, in an ambiguous way, values of electromagnetic radiation exposure. The red drops may be perceived as blood originating from the users body where the red colour indicates danger, but its aesthetical appearance and poetical nature leaves the interpretation open for speculation. The high visibility of the medallion, as for most jewellery, forces the wearer into a number of dilemmas; showing the medallion to others implies explicit knowledge about the owner's exposure to radiation, while hiding it away contradicts the very notion of jewellery—to be seen. Another dilemma occurs if the owner decides not to wear the medallion. Then its main purpose will fail, leaving the owner unaware of the possible risks during extensive mobile phone usage.

Unlike the above mentioned proposals, the *bracelet* instantly indicates the current amount of radiation exposure by printing a graph on a paper. This extensive amount of received information forces the wearer to continuously make decisions whether to give attention to or ignore the results being displayed. Individual interpretations of how to use the printouts are encouraged by not offering any fixed solutions. Instead, personal preferences

and interest in this kind of information will determine the usage. Some users may collect the printouts for further analysis, knowing important information could have been missed, while others may throw them away instantly without any further attention. The printouts may be given away as gifts or used as a tool during an exploration of the invisible electromagnetic radiation in the surrounding environment.

Energy generation

The personal inventory showed that many of the objects used by the students, e.g. mobile phones and music players, require electricity to work—an energy source not always available or affordable. A problem with electrically powered objects is that they quickly run out of power and therefore often needs to be recharged. Changing focus from consumption to generation could perhaps make young people more aware of the costs of producing energy, whether it is in a small or a large scale.

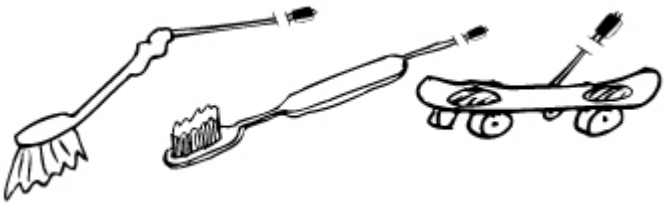

Figure 64: Battery chargers suggesting sustainable choices for generating energy with physical effort.

The *battery chargers* give young people a choice to generate energy by their own in a sustainable way, to be used instantly or perhaps saved for later use. Instead of plugging an ordinary battery charger into a wall socket, users can charge their mobile phones while brushing their teeth or powering other electrical gadgets by using a natural form of interaction with ordinary objects and tasks that is either fun or necessary, e.g. skateboarding or doing the dishes. This re-interpretation of ordinary and daily activities can act as an incitement to adopt a change in energy consumption among a group of people where energy is often taken for granted. In the end, this may generate some interesting interpretations of the battery chargers and it is possible that alternative energy behaviours will evolve over time. The physical effort resulting from ordinary activities can give young people a deeper awareness about energy and a hint of the relation between producing versus consuming. It may for example be sufficient to power music players while skating from school but a month of brushing to fully charge the electrical tooth brush.

Energy localisation

In the probe returns, some students associated energy with more natural and sustainable energy sources like wind-, wave- and solar power. Even though these forms of energy are constantly present and always surrounding us, we tend to not think of their presence. Another finding from the probes was that students mentioned music players as their favourite personal object. One reason for this appreciation was the company they brought during travelling

or waiting. It would be interesting to combine these two findings as a way to explore the localisation of energy.

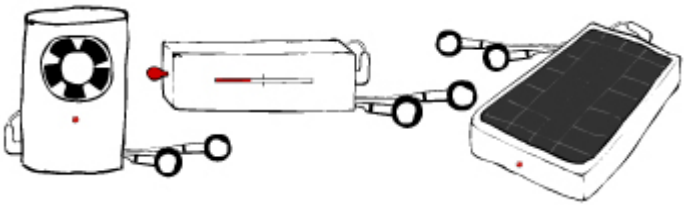

Figure 65: Music players powered with natural energy sources like wind, heat, and the sun.

All *music players* must be provided with energy from different sources to work properly, since they have no batteries of their own. In order to play music, young people are forced to continuously explore, localise and parasite on available energy sources in the surrounding environment. One of the music players is powered from wind that could be gained by running fast, holding the player in the hand; another of them requires a temperature difference and may parasite on the heat from an indoor radiator. Each music player is equipped with an ambiguous indicator, making it difficult to intuitively, without testing, knowing how much energy is actually needed.

When power gets short, the user has to continue the search for another energy source that could provide the player with new power, which could lead to new findings about undiscovered locations of hidden energy sources. This uncertainty about available power sources produces a strong feeling of dependency and the exploration can be seen as an intricate way to gain awareness about the energy geography in the surroundings. The players also illustrate that we sometimes have to surrender some control to larger structures outside our own control, e.g. the solar driven music player that stops working if it is cloudy.

Evaluating and building mock-ups

Sketches of the three themes of conceptual design proposals were evaluated in a workshop to receive feedback from young people. Three individual objects from the design proposals were then crafted as visual prototypes in form of mock-ups.

Feedback from young people

Initial feedback about the conceptual design proposals and the ideas behind them were received during a workshop involving one male and four female master students in interaction design. The students were in various ages and asked to evaluate the conceptual design proposals from a personal perspective as young people, rather than from a professional view as interaction designers. The sketches of the proposals were grouped in three themes as described above and introduced with a short background description. The proposals were, according to the students, seen as enough simple and clear to both illustrate and communicate the ideas behind them, but more descriptive information about their context were desirable in order to fully understand the concepts. Improved understanding of the interaction could possibly be

achieved if the proposals were represented with physical mock-ups or prototypes that users could actually feel, test, and use in some way. Physical representations could, on the other hand, also render some negative effects if discussions changed focus from reflections towards opinions about shape and form.

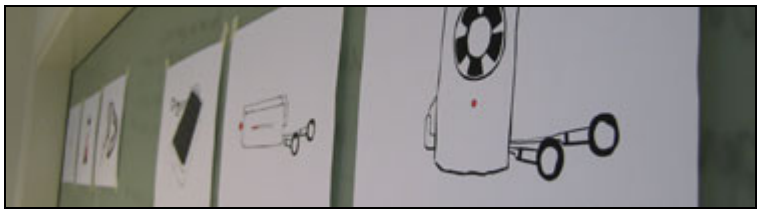

Figure 66: Sketches of all conceptual design proposals were in focus at the workshop.

The generation and localisation themes were in general considered easier to understand than the visualisation theme. Accessories in the latter theme were instead proposed to visualise the amount of energy generated by objects from the other two themes. Many students also feared that emphasising aspects of dangerous energy would support paranoia against mobile phone usage. In contradiction, one student saw the accessories as the only objects actually starting a process of reflection about energy.

Using personal objects for mediating the ideas were overall seen as positive. Most of the students said that the objects trigged some sort of reflection about energy, even though many of them had difficulties in articulating exactly what effect it would have in their everyday life. They also thought it was difficult to say in what context the conceptual design proposals should be used to gain most effect. Implementing them as working products, used on a daily basis in everyday life, was not seen as a real option, mostly because of frustration where these objects probably have to stand back for existing products. A better effect could possibly be achieved if the objects were subject for an exhibition, even though the long term impact on visitor's energy behaviour seemed hard to predict.

Building mock-ups

Three physical mock-ups were built in the last phase of the design project in order to better visualise and illustrate the conceptual design proposals. One object from each theme were selected and crafted in suitable materials.

Figure 67: The main parts of the wind music player consist of a small fan and a body of high-density foam.

The body of the wind music player was constructed from a piece of high-density foam and assembled with a small electric fan. A headphone contact

was mounted on the side of the body and a small red LED[50] on the front. The mock-up was then painted in black.

Figure 68: The blood medallion accessory consists of a small glass container filled with transparent oil and red coloured water.

The blood medallion accessory was created by filling a transparent glass container with transparent oil and a small amount of red coloured water. A piece of black rubber was used to create the top plug of the medallion where a thin fibre optic cable was used as a necklace.

Figure 69: The toothbrush battery charger consists of a cable connected to a toothbrush.

The toothbrush battery charger was constructed by connecting a cable, from an old mobile phone battery charger, to an ordinary toothbrush with glue. The toothbrush was then painted in black.

Final versions of the mock-ups

The final versions of the mock-ups visualises the conceptual design proposals in form of physical representations as well as illustrative images. The mock-ups are all prototypes without any technical functionality; instead they act as physical representations of the ideas behind the concepts. They are all given a generic form, not too realistic, but enough familiar to be easily recognised. Black was selected as a common identifier among the mock-ups.

[50] Acronym derived from Light-Emitting Diode

Figure 70: The final version of the wind music player mock-up.

Figure 71: The final version of the medallion accessory mock-up.

Figure 72: The final version of the toothbrush battery charger mock-up.

Discussion

This chapter analyses and discusses the outcome from the design project with respect to both energy awareness and personal objects. It then continues with a discussion of how interaction design can be used as a tool to change attitudes and behaviours. It follows by a discussion of the role for conceptual design as provocative mediators and introduces speculative re-design. The chapter then deals with the notion of reflection through interaction and ends by suggesting a number of different directions for future work.

Energy awareness and personal objects

The three themes of conceptual design proposals all explore one and each a specific issue of energy awareness—*visualisation*, *generation* and *localisation* of energy. But they also highlight and comment on more comprehensive and general aspects regarding young people's everyday relationship to energy that are not always explicit thought of and reflected upon. These are perhaps even more interesting as they focus on the consequences our energy usage has upon society and our everyday lives.

Highlighting different aspects of energy awareness

One aspect is the *dependency on energy* where the constant need for electricity makes us both dependent and vulnerable to circumstances we are not always able to influence ourselves. The music players and the battery chargers both act as reminders of that electrical energy cannot be taken for granted. As for the music players, users are totally exposed to environmental circumstances, and in order to use them it becomes necessary to constantly search and find alternative sources of energy. The battery chargers offer an always available alternative to generate energy instead of using ordinary wall sockets. Another interesting aspect is the *choices* young people have to make on an everyday basis regarding their own consumption of energy. The accessories force young people to actively decide to what degree they are willing to be exposed to "dangerous" energy connected to their usage of mobile phones. The battery

chargers suggests a sustainable choice for charging batteries that also demand physical effort in comparison to electricity—easily gained from any available wall socket, although more expensive.

Photo: www.punchstock.com

Figure 73: The increased number of mobile phones that are used today highlights the questionable side-effects resulting from extensive usage of them.

A third aspect is the *psychological and social consequences* resulting from the interaction with the objects. Wearing any of the accessories puts the wearer in a psychological uncomfortable situation monitoring the radiation exposure and in a social dilemma whether the accessories should be visible to others or not, knowing that jewellery are seen as personal expressions articulating, to themselves and to others, who they are and what they stand for. The intended usage of the music players and the battery chargers may result in a strange behaviour, not seen as socially acceptable or desirable among young people. The last aspect emphasise the fact that it *costs to use energy*. Whether they buy electricity or generate energy with physical effort, young people have to invest something in order to use energy. It can even be the health if exposed to large amounts of electromagnetic radiation from extensive mobile phone usage.

By explicitly highlighting and emphasising these comprehensive aspects regarding young people's everyday relationship to energy can, in combination with the more specific aspects of energy illustrated by the conceptual design proposals, be sufficient enough to at least evoke an initial awareness among young people about energy in general and their energy use and consumption in specific. The conceptual design proposals can be seen, despite their sort of imaginative character, as an alternative way to more traditional methods and makes the invisible nature of energy more tangible and in this way also more understandable.

Evaluating the re-designed personal objects

It is not yet possible to decide whether the re-designed personal objects can be perceived as successful tools in order to raise energy awareness among young people. The initial evaluation with students identified that many of them disliked the accessories, mostly because they feared a possible paranoia against mobile phone usage. This reaction is seen as positive since the provocative approach of the accessories aims to raise such uncomfortable questions about the perceived, but hidden, phenomenon of "dangerous" energy. The fictive nature of the battery chargers was considered to be an important factor enabling them to work in a speculative way. Many students directly imagined situations where such chargers could be used and started to calculate how much effort was needed in order to charge mobile phones and other electrical gadgets. The music players seemed to be, in opposite to the chargers, less

fictive and were also much more questioned regarding both technology and functionality. The speculative re-design representing them was perhaps too realistic to imply any deeper reflection about the topic of energy localisation, which could indicate that familiar and existing technology may be an obstacle for imagination.

Photo: international.husqvarna.com

Figure 74: The feasibility of the solar music player was seen as realistic, perhaps since it reminds of existing technical solutions, e.g. used for the Husqvarna's solar mower[51].

The design project started out by investigating personal objects that were used by young people on a daily basis. An idea that a personal connection to the objects in question should exist, in order to be truly effective and affective, was raised in the initial phase of the design project. The conceptual design proposals were consequently re-designed versions of existing objects identified among young people in the beginning of the design project. An interesting finding, seen in retrospective, is that actual interaction with the objects can make them even more personal since they reveal more of the user's personality over time. Take the accessories, for example, which all indicates and reflects the electromagnetic radiation exposed to the user and where the visualisation of this is individual and actually tells something about the user, identifying them as high- or low-risk users of mobile phones.

Even though no extensive user evaluation of the developed conceptual design proposals were carried out within the framework of this master thesis, they are all examples of how such objects could be designed in order to stimulate young people's energy awareness. Initial user feedback indicates that re-design of personal objects is considered as an interesting way to approach this problem area and that they have both relevance and significance to young people's everyday lives regarding their energy use and consumption.

Changing behaviours with interaction design

Introducing interaction design as a tool in order to change existing behaviours raises many challenges. Jones means that it becomes important to »identify the ease or difficulty with which a future population can be expected to break through the thresholds between the way things are now and each of several different ways in which things could be reorganised.« (1992, p. 33) People in general are, according to Norman (1998), not good at predicting the future, especially not when it concerns technology and its impact on our everyday life. He means that the designing of artifacts can have a strong effect on the way people look upon themselves, the society and the world. Inventions of today's everyday artifacts such as pencils, automobiles, telephones, televisions and

[51] 2005-05-10 ::: international.husqvarna.com

books have drastically influenced and changed the society, but also our own behaviours. These changes were impossible to predict and, for example, when the telephone was invented people criticised its existence. Today, however, it is an accepted part of the society and the effects new artifacts can have on people concludes that society and its people often transforms when new concepts are introduced to it.

Photo: www.se.zefaimages.com

Figure 75: The introduction of the telephone drastically changed how we communicate with each other over distance. The introduction of the mobile phone changed our view on availability and its hands-free earphone radically changed our behaviours. People could suddenly start to talk laud to themselves without any visible receiver.

Even though it was rather easy to determine the design of the personal objects it becomes almost impossible to determine their final use, which only can be predicted to some degree. In order to approach this dilemma, I decided that the resulting design proposals should intentionally be given a rather open and vague form with respect to their use, although suggesting initial ways to interact with the objects, allowing, or perhaps forcing, the users to experience and determine the use by themselves. One aim for introducing speculation into the design process was that »experience of *the new* can completely transform one's view of both the new thing, and of the old thing one was once adopted to« (Jones, 1992, p. xxxi).

Focusing on changing attitudes and behaviours

It is assumed that the provocative nature inherited in the personal objects should influence and possibly result in a change of attitudes and behaviours by encouraging young people to engage with the objects. This provocation can be seen as a form of persuasion where the users are either rewarded or punished, depending on personal preferences, by the effects caused by the interaction with the re-designed personal objects. If people's attitudes towards their own behaviours are perceived as good they have normally easier to continue with them and vice versa (Ajzen & Fishbein, 1980). This is also thought of as one of many important components in changing young people's energy behaviours, especially since for example environmental issues and possible negative effects caused by consumption are considered as important among young people (Ungdomsstyrelsen, 2004). The developed conceptual design proposals, e.g. music players and battery chargers, are all designed to reward users if they choose to use sustainable energy sources. By constantly being reminded of the amount of exposure from mobile phone radiation can also be seen as a persuasive argument to minimise the use of such devices.

Attitudes and behaviours of others also form people's own since we tend to compare ourselves to those who are similar in terms of age and other key

attributes (Fogg, 2003). This social pressure might therefore cause changes in behaviour if young people believe other's think they should or not perform a certain kind of behaviour (Ajzen & Fishbein, 1980). This kind of pressure from friends can be even stronger in matters of persuasive impact on young people and could therefore also result in changed attitudes and behaviours.

Technology as a tool for persuasion

Realised versions of the conceptual design proposals could in a broader sense also be defined as a persuasive computing technology since they are a form of »interactive computing systems designed to change people's attitudes and behaviours« (Fogg, 2003, p. 1) in a context where persuasion is defined as »an attempt to change attitudes of behaviours or both« (ibid., p. 15). Fogg argues that interactivity gives computing technology a strong advantage over other persuasive media where one advantage persuasive technology has over human persuaders is ubiquity, the ability to be embedded in everyday objects and environments where they can »intervene at precisely the right time and place, giving them greater persuasive power.« (ibid., p. 10)

Photo: www.realityworks.com

Figure 76: The Baby think it over program[52] uses dolls in order to educate young people about parenting responsibilities where participants are required to care for the dolls just as they would an actual baby, sometimes resulting in changed attitudes towards babies.

The term *Captology*[53], introduced by Fogg (1999), focuses on built-in intent, i.e. the persuasive intent that is designed into a computing product. »Social comparison theory holds that people seek to know the attitudes and behaviours of others in forming their own attitudes and behaviours /…/ the social comparison effect is strengthened when it allows people to compare themselves with *similar* others. In other words, the motivation people feel from social comparison is stronger when they can compare themselves to those who are similar to themselves in terms of age, ability, ethnicity, or another key attribute.« (ibid., 2003, pp. 98-99)

A number of circumstances seem to influence the possible impact objects can have on people in order to raise a more profound reflection through the interaction with them. The relation to the objects in question does often have to unfold over time to get necessary acceptance from its users. The context in which the objects are used is also a matter of importance since incitements and encouragement to change attitudes and behaviour is closely related to how important the subject of interaction is as well as the perceived rewards for doing something correctly. Nor should the impact from other people in the

[52] 2005-05-10 ::: www.realityworks.com
[53] Acronym derived from Computers As Persuasive TechnOLOGY

surroundings be ignored, where social pressure can be a very strong argument for persuasion. Likewise is emerging technologies that use computational power to augment the persuasion during interaction with both products and systems. E-commerce sites such as Amazon.com[54] make extensive use of language to convey social presence and persuade users to buy more products. When logged in, the site welcomes users by name, offers recommendations and lists a host of separate stores tailored to the user's preferences previously tracked in order to persuade users to maximize their online purchases.

Conceptual design as provocative mediators

I thought already in the beginning of the design project that it would be interesting if the resulting conceptual design proposals could communicate the ideas behind through simple pictures (cf. Dunne, 1999; Dunne & Raby, 2001; Dunne & Gaver, 1997). An example of this is *The Phone you can't pick up* by Sarah Pennington (2002), where a single picture is able to communicate the idea and at the same time trigger a series of deeper thoughts about the subject as well as the object itself. This phone also questions, implicitly, the choice of the medium in a critical design project; does the choice of this picture (where you can't tell if the object actually exists or is the result of a visual manipulation) reinforce the concept?

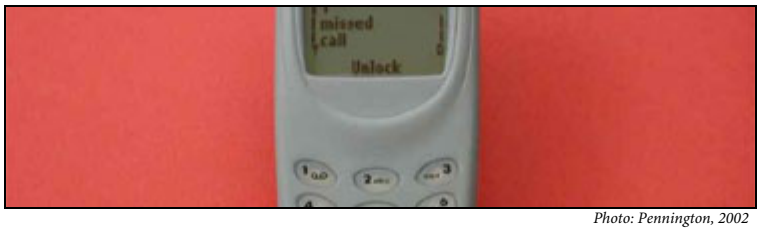

Photo: Pennington, 2002

Figure 77: The Phone you can't pick up is a mobile phone deprived of the answer and close buttons, exploring »telecommunication darkness. Eventually the ringing becomes more about musical tones and less about communication…« (Pennington, 2002, p. 10).

The final ideas were also in the end mainly represented with sketches and pictures of the mock-ups. Seen in retrospective, it can be discussed, even though many of the speculative ideas behind the conceptual design proposals seemed to work as intended, whether this format of presentation was appropriate for all of them. Initial feedback from students indicates that the way concepts are presented and communicated to its audience becomes crucial in order to achieve a wished result (cf. Dunne, 1999; Houde & Hill, 1997). It is possible that other kinds of representations could render some other results and findings.

Conceptual prototypes as mediators

Physical models and working prototypes are common ways to present ideas, but not the only options for embodying ideas. Visualisation methods ranging from sketches, drawings and renderings to computer modelling can also help

[54] 2005-05-26 ::: www.amazon.com

to make ideas seem real in earlier stages of planning. Convincing physical prototypes are also often used to embody ideas for both projects and systems, but also for environments. Scenarios of use, e.g. storyboards, demonstrations or videos, can for example model ideas into seemingly real situations so that audiences have much more to respond to, »prodding them into a fuller reaction: one that draws more information from them than they would be inclined to give without the provocation« (Design for future needs, 2003, p. 15). These types of conceptual prototypes are often represented in art, to visualise future concepts and visions but also when other types of prototypes are far too expensive to create or takes too long time to build. These kinds of representations are often good enough to communicate and express the ideas behind a concept, but users are often exposed to the prototypes during a short period of time and seldom in a natural environment or context. It therefore becomes crucial that the prototypes are expressive in their form.

Buchenau and Suri introduce the term experience prototyping which aims to »emphasize the experimental aspect of whatever representations are needed to successfully (re)live or convey an experience with a product, space or system« (2000, p. 424). The prototype is in this context seen as »any kind of representation, in any medium, that is designed to understand, explore or communicate what it might be like to engage with the product, space or system« (ibid., p. 425) that is designed. The actual interactive user experience is in this case equal, if not more, important than the selected medium for representation (Martin & Gaver, 2000; Buchenau & Suri, 2000). Time becomes central in this type of interaction where the actual usage of the prototypes, often during a longer period of time, render the experiences.

The resulting conceptual design proposals from the design project were represented, communicated and expressed through sketches, pictures and three physical mock-ups without any technical functionality. These different forms of prototypes can be identified within the prototype model (Houde & Hill, 1997) that is described in the *Methodological framework* chapter. Seen as examples of role models, the sketches aim is primarily to investigate questions of what these objects could do for users in real life. Although the conceptual design proposals are given a generic form, they describe in a sufficient way »the functionality that a user might benefit from, with little attention to how the artifact would look and feel, or how it could be made to actually work« (ibid., p. 6).

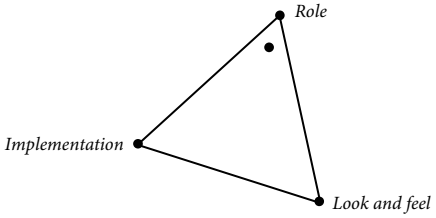

Figure 78: The sketches of the conceptual design proposals are seen as role models, where they aim to investigate questions about what the object could do for the user.

All of the mock-ups that were created in the end of the design project are technically non-working prototypes. They are on the other hand much more

concrete than the sketches, since they have an appearance and form that users actually can interact physically with. This allows users to comment both on the look and feel of the prototypes and an imagined interaction with the objects, which can end in suggestions for improvements of both form and actual situations where the re-designed personal objects could be used in. Since the focus is rather strong on the appearance for look and feel prototypes it can result in implications where underlying ideas to some degree might be overlooked in favour to the discussions about form.

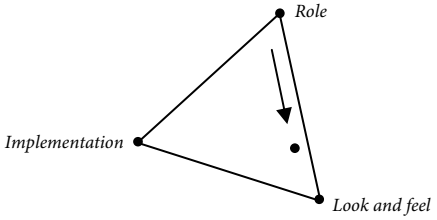

Figure 79: The mock-ups of the conceptual design proposals are seen as prototypes that allows user to comment on the look and feel, even though they do not have any technical functionality.

A natural future step would therefore be to build prototypes of the conceptual design proposals that all have technology that actually works. The prototypes do not necessarily need to have a final look and feel, but they should be constructed in a way that allows users to test the intended functionality and in some ways also experience the consequences of the provocative nature that is inherited in the design proposals. Creating implementation prototypes makes it possible to evaluate the effects of using the conceptual design proposals over a longer period of time. It should be noted that the form these prototypes are given can have some relevance in an evaluation, even though the focus is put on the functionality, since the form in this particular case plays an important role in how the ideas behind the concepts are communicated and perceived.

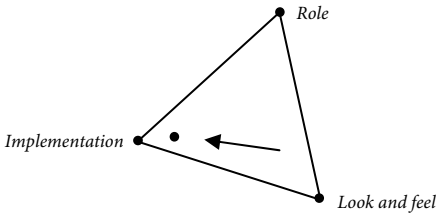

Figure 80: Prototypes of the conceptual design proposals with technical functionality are seen as prototypes that actually respond and react when users interact with them.

Prototypes that integrate all three of these aspects have to be developed to achieve a complete user experience. The overall goal for future work should therefore be to direct towards the centre of the three-dimensional prototype model, resulting in a prototype close to a final product, where look and feel, role and functionality are all represented. This can give users a possibility to experience the conceptual design proposals over time in their use of the prototypes where aspects of both time and form are equally emphasised.

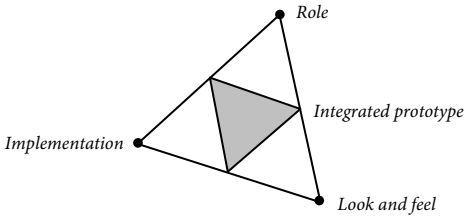

Figure 81: An integrated prototype resides in the middle of the model, where all three aspects are inherited in the prototype.

Provocative conceptual prototypes

The purpose with a prototype must be clear (Houde & Hill, 1997) in order to successfully select the most appropriate implementation. For the conceptual design proposals, the major aim for the prototypes representing them was to communicate the speculative and provocative nature inherited in the re-designed objects in order to achieve a reflection through the interaction with the objects. Prototypes that worked on a technical level were thought of in the initial phase of the design project, but were abandoned considering available time and existing resources. Sketches and mock-ups without any technical functionality were instead suggested to be sufficient enough to illustrate the ideas.

Seen in retrospective it is possible that the inherited provocative nature of the interaction with the conceptual design proposals is better communicated with physical interaction rather than as an imagined. The impact of imagining the consequences of an interaction with the objects through sketches, pictures and scenarios might be less strong than actually using a technically working prototype, which on the other hand, and in this particular case, could have been difficult to implement on a satisfactory level. Since the design project did not result in technically working prototypes, it would have been interesting to compare the developed mock-ups towards versions that actually have such functionality implemented to discover eventually differences regarding their impact as provocative mediators. It is likely that the use and interaction with physical objects could be more appropriate and result in a more in-depth reflection regarding the provocative nature of these objects than, for example, an imagined interaction via sketches or scenarios.

A prolonged period of use can give a more deep level of affection towards the objects and in the end resulting in a better understanding of its underlying ideas. The long lasting effects from using and interacting with such prototypes on a daily basis are probably in a direct relation to the level of technical sophistication built into the prototype. A user would also probably use the objects more often if they were perceived as useful or entertaining in some way. Sketches, pictures and scenarios are perhaps thoughtful and might start some instantaneous reflection, but they would probably not occupy user's mind long after the exposure. It therefore becomes crucial how much time a user spends on the re-designed object and the frequency they are exposed to them. The user's role towards the conceptual prototypes can also affect the impact they might have in the end. There is perhaps a stronger incitement to

start reflection if a user takes an active role in the relationship towards the objects by using and interacting with them rather than a more passive role simply observing the conceptual prototypes.

Introducing speculative re-design

The developed conceptual design proposals are all different re-interpretations of existing objects, familiar to its user, but re-designed in a speculative and provocative way. The choice to use existing personal objects as a starting point, and not introducing completely new artifacts or objects as often common in design practice, was the belief that a familiar feeling could be an incitement that makes it easier for young people to accept them quicker and thereby also use them in everyday life. Although having a familiar form, these objects should be re-designed with ambiguity and speculation in mind to trigger reflection in the daily interaction with them.

Ambiguity in interactive design

Gaver et al. (2003, p. 240) suggests that ambiguity could be used as a valuable resource for design, allowing designers to »suggest issues and perspectives for consideration without imposing solutions«. It may for example be possible for users to establish a deeper and more personal relation with the meanings offered by objects by encouraging them to individual interpretations. The ambiguous nature of the conceptual design proposals can therefore be seen as »an important factor in crafting interactive designs that are engaging and thought-provoking« (ibid., p. 240).

These interesting properties of ambiguity were considered as an important ingredient in the development of the conceptual design proposals and were applied in many different ways. Ambiguity of information was, for example, used for the accessories and implemented as imprecise representations of electromagnetic radiation to emphasise uncertainty and to force people to question for themselves the truth of the situation. The accessories require users to fill in the gaps of information that is purposefully imprecise and this could also lead to some over-interpretation of available data that encourage speculation, e.g. the levels of radiation and the impact of exposure to such radiation.

Implicating incompatible contexts makes it also possible to disrupt existing preconceptions by bringing together disparate contexts. The battery chargers, for example, offer users new possibilities and functionalities to charge their electric devices by simply performing ordinary daily tasks. Gaver et al. mean that to actually »engage with the design, participants must rethink their basic assumptions about given genres, and either privilege one discourse to the others or expand their understandings of the discourses to build bridges among them« (2003, p. 238). The music players are examples of familiar products where, in the opposite, expected functionality is blocked and limitations of the technology are built into the user experience to open a space of possibilities where users must navigate and explore surroundings after undiscovered sources of energy.

Ambiguity in the relationships to objects can, according to Gaver et al. (ibid.), reinforce people to consider new beliefs and values, and ultimately in the end their own attitudes. Unaccustomed roles can encourage user's imagination in considering the personal significance of things, behaviours or events in their environment. The design of the accessories, for example, can draw attention to overlooked aspects of electromagnetic radiation in the environment and encourage reflection on its significance in the user's life. By introducing disturbing side effects to the music players forces the user to question its environmental responsibility where a reflection about the balance of desire and ethics can be provoked by the design, that seem immediately appealing but which certainly have some disquieting implications.

Speculative re-design versus critical design

The fact that all of the design proposals were modifications of already existing objects made it difficult for some students to engage with the new re-design and to critically rethink basic assumptions about their existing functionality. This ambiguity inherent in the objects, where they fulfil a purpose besides its original function, is a common characterisation for both critical design and speculative design (cf. Dunne & Raby, 2001; Gaver & Martin, 2000). Likewise is the view on design as a tool for provoking and challenging people's pre-conceptions about relevant issues and for raising important questions, rather than giving answers.

One thing that actually differentiates speculative re-design from critical design is the intended context of use. Dunne and Raby proclaim that »critical design can never be truly popular, and that is its fundamental problem. Objects that are critical of industry's agenda are unlikely to be funded by industry. As a result, they will tend to remain one-offs.« (2001, p. 59) While critical design often resides outside the market place, e.g. in exhibitions and museums, speculative re-design are more likely to be found in the creation of imaginable future prototypes (cf. Gabrielli & Zoels, 2003) that are, despite its provocative and speculative nature, both feasible and possible to mass-produce with an aim to be used in everyday life. This differential characteristic of speculative re-design can be of decisive importance to achieve greatest possible impact with regards to long term changes of behaviours. Introducing feasible re-interpretations of existing and familiar personal objects, instead of designing totally new objects, could perhaps make it easier to both recognise and reflect upon the existing relation towards these well known objects and imagine the intended interaction with the conceptual design proposals. This finding, that there is a very thin border between speculative re-design and critical design, has slowly emerged during the design process and in the end resulting in a choice to adopt a speculative approach in favour to a critical, despite the initial thoughts of using the latter.

The comparison between critical design and speculative re-design points out some difficulties by using the former approach as a tool for long term changes of existing behaviours among a general public. The distance between the critical objects and people's ordinary lives may be too distant, resulting in a less efficient impact. As critical design often is presented as art objects or

installations, they must affect the user directly, often during a short period of time which often forces them to offer some sort of surprising effect or a very provoking content. Ideas that are strong enough to be reflected upon even after a longer period of time are rare, leaving most of the critical design as happenings rather than tools for long term changes. In contrast to the hypothetical proposals suggested by critical design, which is often perceived as close to art, can real-world products be far to comfortable to by any means starting a reflection through the daily interaction with such ordinary and familiar products. The usability aspects inherited in these products, perhaps one of the most important factors for a product residing at the marketplace, makes them less interesting to be used as bearers of changes.

This leaves speculative re-design in between critical design and real-world products, combining the provocative approach used in critical design with the familiarity of existing objects.

Reflection through interaction

As a complement to traditional approaches which also aims to raise energy awareness among the general public, e.g. information campaigns, laws and regulations, these suggested conceptual design proposals are meant to act as provocateurs in order to stimulate reflection. Their fictiveness provoked some initial thoughts among students, but some of them seemed to have difficulties imagine possible effects from a daily interaction by just looking at sketches. In order to reach a more profound awareness and a long term change of their energy behaviour, young people probably need to live with the objects on a daily basis where they interact and reflect about the provocative effects inherited in the objects over a longer period of time. These design proposals would, if implemented as personal props in everyday life, perhaps render some sort of psychological and social discomfort during interaction that implies modifications in the way young people live with these objects—in the end affecting their energy behaviour. Introducing energy as a basic design material gives the objects both new interactive and provocative properties, important in order to receive reactions and achieve a reflection through interaction.

This master thesis suggests the object as a subject for enquiry that could lead to increased awareness about energy and in the end resulting in a change of behaviour. Mazé and Redström (2004) mean that when we introduce a new object to people, it becomes important to consider that the understanding of the object is something that unfolds over time. The object will therefore need some time to present itself and people will need to start use it in order to find out what it is. Hypothetical products, that embody complex values, can for example be used as an innovative and accessible way of engaging young people in discussions about objects that makes abstract issues tangible and their role and impact within a context of everyday material culture. Their conceptual nature might imply a longer period of time for acceptance, than for example more usual and straightforward products, before users are ready to fully engage with the new objects.

Reflection through interaction can in this context be achieved first after a user actually use and physically interact with an object over a longer period of time where a provocative behaviour is inherent in the design. This master thesis has argued for and proposes a speculative approach, in combination with a re-design of existing objects, as a way to provoke users and thereby start a reflection through interaction. Introducing ambiguity and speculation in the behaviours of the re-designed objects can result in effects where unexpected consequences imply modifications in user's attitudes and existing behaviours.

Future work

The work presented in this master thesis should be seen as a starting point for further investigation and research within this interesting area. The presented re-designed objects were intended to be used by young people on a daily basis in order to be truly effective and affective. The conceptual design proposals should be seen as potential products rather than as critical imaginable one-offs, where further development should begin with refined representations of the design proposals, e.g. technically working prototypes. These should be used for in-depth user studies where young people use the re-designed objects over a longer period of time so that the effects of interacting with them over time on a daily basis could be both identified and analysed with respect to possible attitude and behavioural changes. If the conceptual design proposals were developed all the way to products, they would probably suit best to be distributed through the traditional product market-system, perhaps resulting in a widespread usage that directly affects young people's energy behaviour, or through research-context tests, where the results and examples indirectly could be used to spark social debates and trigger personal reflections that in the end could raise the energy awareness among young people.

There are also other, perhaps more general, directions that are interested to investigate further in order to explore the problem area and expand the design space. One direction could be to expand the test population to include all people regardless of demographic aspects such as gender, age, geographical localisation, profession and education. Another direction could for example be to generalise the concept of reflection through interaction, in combination with speculative re-design, and use it for raising awareness towards other topics. A third direction could be to focus on the objects, not necessarily personal, and investigate more deeply how these affect people in everyday life. Finally, there would be interesting to test, evaluate and compare the impact of using alternative forms of conceptual design prototypes, e.g. sketches and pictures towards prototypes with and without technical functionality, and to identify how they differentiate in order to effect and affect users.

Conclusion

This master thesis has been carried out within the framework of Interactive Institute's Static! project, which investigates interaction design as a means to increase energy awareness among the general public. The thesis has narrowed the scope even more by focusing on young people and personal objects. Three themes of conceptual design proposals were developed in a design project as a design case of how personal objects can be speculative re-designed in order to raise energy awareness among young people by reflection through interaction. Results from initial user feedback also indicates that the speculative and provocative ideas behind the collection of conceptual design objects do have some influence on young people's energy awareness, even though physical representations of the concept and more time for individual interpretation perhaps could give an even more profound and prolonged reflection through interaction. The design proposals are illustrative examples of how interaction design can be used as a means to change existing behaviours in combination with a speculative approach and conceptual design as a mediator.

The master thesis introduces speculative re-design and suggests that it can be used when giving form to re-interpretations of existing objects. Speculative re-design resides in the span between critical designed objects and real-world products and its provocative and speculative nature suits well in order to actually achieve reflection through interaction over a longer period of time. Introducing speculative re-design as an approach to interaction design also suggests that it can be used in a broader sense, applied in different contexts and situations in order to achieve changes of existing attitudes and behaviours.

The work with this master thesis has introduced me to many interesting aspects of interaction design. Perhaps the most interesting findings is the fact that interaction design do play a very important role in shaping the society, whether it is in form of making products useful or as critical, provocative and speculative enquires of everyday life situations.

References

Agnelli, D., & Drori, T. (2004). *Pronto? Where Are You?* Master Thesis. Ivrea: Interaction Design Institute Ivrea. Thesis available at: http://people.interaction-ivrea.it/d.agnelli/thesis/

Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting social behaviour*. Englewood Cliffs, N.J.: Prentice-Hall, cop.

Back, M., & Cohen, J. (1998). The sound of your stuff: designing a complex auditory display for an interactive museum exhibit. In *Conference on Human Factors in Computing Systems, CHI 98 conference summary on Human factors in computing systems*, pp. 239-240, Los Angeles, California, USA, ACM Press.

Bayazit, N. (2004). Investigating Design: A Review of Forty Years of Design Research. In *Design Issues*, Vol. 20, No. 1, pp. 16-29. Cambridge: MIT Press.

Beyer, H., & Holtzblatt, K. (1999). Contextual Design. In *Interactions*, Vol. 6, Issue 1, January February 1999, pp. 32-42, ACM Press.

Buchenau, M., & Suri, J. (2000). Experience Prototyping. In *Proceedings of the conference on Designing interactive systems: processes, practices, methods, and techniques*, pp. 424-433, New York City, New York, USA, ACM Press.

Carlsson-Kanyama, A., Lindén, A-L., & Eriksson, B. (2003). *Hushållskunder på energimarknaden. Beteenden och värderingar*. Report 181, Stockholm: FMS/FOI.

Crabtree, A., Hemmings, T., Rodden, T., Cheverst, K., Clarke, K., Dewsbury, G., Hughes, J., & Rouncefield, M. (2003). Designing with Care: Adapting cultural probes to inform design in sensitive settings. In *Proceedings of OzCHI 2003, New Directions in Interaction: Information environments, Media & Technology*, pp. 4-13, University of Queensland, Brisbane, Australia.

Dahlbom, B. (2002). The Idea of an Artificial Science. In Dahlbom, B., Beckman, S., & Nilsson, G.B., *Artifacts and Artificial Science*, pp. 9-42, Stockholm: Almquist & Wiksell.

Design for Future Needs. (2003). *Design for Future Needs*. Report available at: http://www.dffn.org

Djajadiningrat, J.P., Gaver, W., & Fres, J.W. (2000). Interaction relabelling and extreme characters: methods for exploring aesthetic interactions. In *Proceedings of the conference on Designing interactive systems: processes, practices, methods, and techniques*, pp. 66-71, New York City, New York, USA, ACM Press.

Dourish, P. (2001). *Where the Action Is*. Cambridge: MIT Press.

Doyle, M.J. (1999). Creative approaches to organizing information. In *Proceedings of Professional Communication Conference: Communication Jazz: Improvising the New International Communication Culture*, pp. 93-99, IEEE International.

Dunne, A. (1999). *Hertzian Tales: Electronic products, aesthetic experience and critical design*. London: RCA CRD Research publications.

Dunne, A., & Gaver, W.W. (1997). The Pillow: Artist-Designers in the Digital Age. In *Proceedings of the conference on Human factors in computing systems*, Atlanta, Georgia, USA, ACM Press.

Dunne, A., & Raby, F. (2001). *Design Noir: The Secret Life of Electronic Objects*. Basel: August/Birkhäuser.

Energimyndigheten/Swedish Energy Agency. (2004). *The Energy Market 2004*. ID-No: ET29:2004. Report available at: http://www.stem.se

Energimyndigheten/Swedish Energy Agency. (2005). *Energy in Sweden 2004*. ID-No: ET19:2004. Report available at: http://www.stem.se

Fogg, B.J. (1998). Persuasive Computers: Perspectives and Research Directions. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pp. 225-232, ACM Press.

Fogg, B.J. (2003). *Persuasive Technology: Using Computers to Change What We Think and Do*. San Francisco: Morgan Kaufmann Publishers.

Forty, A. (1986). *Objects of desire, design and society 1750-1980*. London: Thames & Hudson.

Fällman, D. (2003). Design-oriented human-computer interaction. In *Proceedings of the conference on Human factors in computing systems*, April 2003, pp. 5-10, Ft. Lauderdale, Florida, USA, ACM Press.

Gabrielli, S., & Zoels, J-C. (2003). Creating imaginable futures: using human-centered design strategies as a foresight tool. In *Proceedings of the 2003 conference on Designing for user experiences*, pp. 1-14, San Francisco, California, USA, ACM Press.

Gaver, W., Beaver, J., & Benford, S. (2003). Ambiguity as a resource for design. Conference on Human Factors in Computing Systems. In *Proceedings of the conference on Human factors in computing systems*, pp. 233-240, Ft. Lauderdale, Florida, USA, ACM Press.

Gaver, W.W., Boucher, A., Pennington, S., & Walker, B. (2004). Cultural probes and the value of uncertainty. In *Interactions*, Vol. 11, Issue 5, September October 2004, pp. 53-56, ACM Press.

Gaver, W., & Dunne, A. (1999). Projected Realities; Conceptual Design for Cultural Effect. In *Proceedings of the SIGCHI conference on Human factors in computing systems: the CHI is the limit*, pp. 600-607, Pittsburgh, Pennsylvania, USA, ACM Press.

Gaver, W.W., Dunne, A., & Pacenti, E. (1999). Design: Cultural Probes. In *Interactions,* Vol. 6, Issue 1, January February 1999, pp. 21-29, ACM Press.

Gaver, B., & Martin, H. (2000). Alternatives; Exploring Information Appliances through Conceptual Design Proposals. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pp. 209-216, The Hague, The Netherlands, ACM Press.

Gray, C., & Malins, J. (1993). Research Procedures / Methodology for Artists & Designers. In *Principles and Definitions*, Winchester College of Art on behalf of the European Postgraduate Art and Design Group. ISBN: 0 9515904 3 X. Available at: http://www.visualizingresearch.info/

Grudin, J., & Pruitt, J. (2002). Personas, Participatory Design and Product Development: An Infrastructure for Engagement. In *Proceedings of Participatory Design Conference 2002,* pp. 144-161, Palo Alto, USA.

Hallnäs, L., & Redström, J. (2002). From Use to Presence; On the Expressions and Aesthetics of Everyday Computational Things. In *Transactions on Computer-Human Interaction (ToCHI)*, Vol. 9, Number. 2, June 2002, pp. 106-124, ACM Press.

Hemmings, T., Clarke, K., Crabtree, A., Rodden, T. and Rouncefield, M. (2002). Probing the probes. In *The 7th Biennial Participatory Design Conference*, pp. 42-50, Malmö, Sweden.

Houde, S., & Hill, C. (1997). What do prototypes prototype? In *Handbook of Human-Computer Interaction*, 2nd edition, Helander M., Landauer T., & Prabhu P. (eds.). Amsterdam: Elsevier Science B. V.

Hughes, J., King, V., Rodden, T., & Andersen, H. (1995). The Role of Ethnography in Interactive Systems Design. In *Interactions*, Vol. 2, Issue 2, April 1995, pp. 56-65, ACM Press.

Hughes, J., King, V., Rodden, T., & Andersen, H. (1994). Moving Out from the Control Room: Ethnography in Systems Design. In *Proceedings of the Conference on Computer Supported Cooperative Work*, pp. 429-439, New York, NY, USA, Association for Computing Machinery.

Hutchinson, H., Mackay, W., Westerlund, B., Bederson, B., Druin, A., Plaisant, C., Beaudouin-Lafon, M., Conversy, S., Evans, H., Hansen, H., Roussel, N., Eiderback, B., Lindquist, S., & Sundblad, Y. (2003). Technology Probes: Inspiring Design for and with Families. In *Proceedings of the conference on Human factors in computing systems*, pp. 17-24, Ft. Lauderdale, Florida, USA, ACM Press.

IDEO. (2003). *IDEO Method Cards*. ISBN 0-9544132-1-0

Ilstedt Hjelm, S. (2002). *Semiotics in product design*. Stockholm: Kungliga Tekniska Högskolan/CID, Centre for User Oriented IT Design. Report available at: http://cid.nada.kth.se/publikationer/

Ilstedt Hjelm, S. (2004). *Making Sense – design for wellbeing*. Doctoral dissertation. Stockholm: Kungliga Tekniska Högskolan. Dissertation available at: http://cid.nada.kth.se/pdf/MakingSense.pdf

Interval Research Corporation. (1998). *Portable Effects: A survey of nomadic design practice*. Technical Report #TR1998-003. Report available at: http://www.portablefx.com

Jacobs, M., & Mazé, R. (2004). Design-by-Doing: Workshops for Designing Interaction. In *Proceedings of the Participatory Design Conference (PDC)*. Toronto, Canada.

Jansen, A.J., & Stevels, A.L.N. (1999). Human power, a sustainable option for electronics. In *Proceedings of the 1999 IEEE International Symposium on Electronics and the Environment*, pp. 215-218, IEEE, Boston, USA.

Jones, J.C. (1992). *Design Methods.* 2nd edition. New York: John Wiley & Sons.

Landqvist, J. (1994). *Vilda idéer och djuplodande analys: Om designmetodikens grunder*. Lund: Carlssons bokförlag.

Laurel, B. (ed.) (2003). *Design Research: methods and perspectives*. Cambridge, Massachusetts: MIT Press.

Lundequist, J. (1995). *Design och produktutveckling Metoder och begrepp*. Lund: Studentlitteratur.

Löwgren, J. (1993). *Human-computer interaction*. Lund: Studentlitteratur.

Löwgren, J., & Stolterman, E. (1999). Design Methodology and Design Practice. In *Interactions*, Vol. 6, Issue 1, January February 1999, pp. 13-20, ACM Press.

Löwgren, J., & Stolterman, E. (2004). *Design av informationsteknik: materialet utan egenskaper.* 2nd edition. Lund: Studentlitteratur.

Manzini, E. (1994). Design, environment and social quality. In *Design Renaissance: selected papers from the International Design Congress*, Myerson, J. (ed.). Glasgow: Open Eye.

Martin, H., & Gaver, B. (2000). Beyond the Snapshot: From Speculation to Prototypes in Audiophotography. In *Proceedings of the conference on Designing interactive systems: processes, practices, methods, and techniques*, pp. 55-65, New York City, New York, USA, ACM Press.

Mazé, R., & Jacobs, M. (2003). Underdogs and Superheroes: Designing for New Players in Public Space. In *Proceedings of User Aspects of ICTs conference (CAST)*, University of Art and Design, Finland.

Mazé, R., & Redström, J. (2004). Form and the Computational Object. In *Proceedings of Computers in Art and Design Education*, Copenhagen Business School, Denmark and Malmö University, Sweden.

Meyer, R. (2003). Systems, Sustainability and Design. In *Proceedings of 6th Asian Design Conference*, Tsukuba-shi, Ibaraki, Japan.

Monö, R. (1997). *Design for Product Understanding*. Stockholm: Liber AB.

Muller, M.J., & Kuhn, S. (1993). *Participatory Design*. In *Communications of the ACM*, Vol. 36, Issue 6, June 1993, pp. 24-28, ACM Press.

Norman, D.A. (1988). *The Psychology of Everyday Things*. New York: Basic Books.

Papanek, V. (1985). *Design for the Real World: Human Ecology and Social Change.* 2nd edition. London: Thames and Hudson.

Pennington, S. (2002). *Media layer and information thresholds*. In Annual Equator Conference, 2002. Report available at: http://www.interaction.rca.ac.uk/equator/papers.html

Philips. (1995). *Vision of the Future*. Publisher: V&K.

Preece, J., Rogers, Y., & Sharp, H. (2002). *Interaction Design. Beyond Human-Computer Interaction*. New York: John Wiley & Sons.

Pruitt, J., & Grudin, J. (2003). Personas: practice and theory. In *Proceedings of the 2003 conference on Designing for user experiences*, pp.1-15, San Francisco, California, USA, ACM Press.

Sandelin, J., & Torstensson, M. (2003). *Digital Peacock Tails, Designing Post-Optimal Electronic Attire*. Master thesis. Ivrea: Interaction Design Institute of Ivrea/Malmö: Malmö University. Thesis available at: http://dpt.unsworn.org

Schuler, D., & Namioka, A. (eds.) (1993). *Participatory Design: Principles and Practices*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Schön, D.A. (1983). *The Reflective Practitioner*. Aldershot: Arena, Ashgate Publishing Limited.

Seago, A., & Dunne, A. (1999). New Methodologies in Art and Design Research: The Object as Discourse. In *Design Issues*, Vol. 15, Number 2, Summer 1999, pp. 11-18, MIT Press.

Simon, H.A. (1969). *The Sciences of the Artificial*. Cambridge, MA: MIT Press.

Simonsen, J., & Kensing, F. (1997). Make Room for Ethnography in Design! In *Journal of Computer Documentation*, Vol. 22, Number 1, February 1998, pp. 20-30, ACM Press.

Sparke, P. (1987). *Design in Context*. Quarto Publishing plc, London.

Tjalve, E. (1976). *Systematisk udformning af industriprodukter*, Akademisk Forlag.

Ungdomsstyrelsen. (2001). *Bara vara*. Stockholm: Ungdomsstyrelsen. Report available at: http://www.ungdomsstyrelsen.se

Ungdomsstyrelsen. (2003). *De kallar oss unga: Ungdomsstyrelsens Attityd- och värderingsstudie 2003*. Stockholm: Ungdomsstyrelsen. Report available at: http://www.ungdomsstyrelsen.se

Ungdomsstyrelsen. (2004). *Ung 2004*. Stockholm: Ungdomsstyrelsen. Report available at: http://www.ungdomsstyrelsen.se

Vihma, S. (2003) On actual semantic and aesthetic interaction with design objects. In *Proceedings of 5th European Academy of Design Conference: Techne Design*, pp.1-7, University of Barcelona, Barcelona, Spain.

Väänänen-Vaino-Mattila, K., & Ruuska, S. (1999). Designing Mobile Phones and communicators for consumer needs at Nokia. In *Interactions*, Vol. 6, Issue 5, September October 1999, pp. 23-26, ACM Press.

Westerlund, B. (2002). Form is Function. In *Proceedings of the conference on Designing interactive systems: processes, practices, methods, and techniques*, pp. 117-124, London, England, ACM Press.

Westerlund, B. (2005). Design space conceptual tool: grasping the design process. In *Proceedings of 'In the Making' the First Nordic Conference on Design Research*, Copenhagen, Denmark.

Zimbardo, P.G., & Ebbesen, E.B. (1969). *Influencing attitudes and changing behavior: a basic introduction to relevant methodology, theory, and applications*. Reading, Massachusetts: Addison-Wesley.