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INTERACTION DESIGN

FOUNDATIONS, EXPERIMENTS

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PREFACE

This book collects experiments and discussions pursued over a period of some 6 years. It is not an overview of, or introduction to, interaction design in a more general sense. It is a discussion about the foundations of interaction design both as academic subject and as design practice. Our concern has been to present one – *our* - view, and to do so as consistent and uncompromising as we could.

There are several reasons for this approach. Besides obvious reasons such as the already growing range of introductory textbooks, there is one that we consider slightly more pressing: As a 'new' area like interaction design comes around, pieces and building blocks are brought in from various other areas as to provide a foundation for further work. Over time, however, it becomes increasingly clear that all these pieces do not fit together and that new pieces are needed to complete the puzzle. Now, if our ambition is to present and discuss the field in rather broad terms, these difficulties will typically be hidden as we both try to span a rather large set of ideas, methods and concepts, but also because we, consciously or unconsciously, try to arrive at a coherent view as to make the case for our new 'field'. Therefore, another strategy is needed if we want to discuss the foundational issues of interaction design; a strategy where gaps and conflicts between ideas and approaches are not hidden, but confronted.

We have not tried to collect a comprehensive bibliography on interaction design as an area of academic research. We have only listed the direct references that we actually have used as material or that have been a direct source of inspiration. There are of course lots and lots of other books, papers and projects we could have included, but there is always a certain extent of selections and ignorance you have to live with.

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Lars Hallnäs and Johan Redström
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FOUNDATIONS

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INTERACTION DESIGN

Interaction design is design,
but of what? It is a shift of focus
from what a thing does as we use it
to what we do in the acts that define
use, and from the visual presentation
of spatial form to the act presentation
of temporal behaviour.

1.1
A SHIFT OF FOCUS

There are several somewhat different definitions of "interaction design" in the literature. Some focus on the design of products that in a certain sense are "interactive":

> By interaction design we mean designing interactive products to support people in their everyday and working lives. In particular, it is about creating user experiences that enhance and extend the way people work, communicate and interact. *(Preece et. Al. 2002, p. 6)*

A related definition is given by ACM's Special Interest Group on Computer-Human Interaction (SIGCHI) – in this case, however, describing the area of 'human-computer interaction':

> Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them. *(Hewett et. Al. 1992)*

Other definitions focus on the design of "interaction" with computer-based systems:

> Human-computer interaction is by necessity a field with interdisciplinary concerns, since its essence is interaction that includes people and machines, virtual worlds and computer networks, and a diverse array of objects and behaviors. In the midst of this interdisciplinary collision, we can see the beginnings of a new profession, which might be called 'interaction design.' While drawing from many of the older disciplines, it has a distinct set of concerns and methods. It draws on elements of graphic design, information design, and concepts of human-computer interaction as a basis for designing interaction with (and habitation within) computer-based systems. Although computers are at the center of interaction design, it is not a subfield of computer science. *(Winograd 1997)*

Still other descriptions focus on the experience of using computers, as in this one by Thackara:

> Interaction design determines the value of a communication service to its users, and the quality of experience they have when using it. … Compared to physical products, communication services are experiences, not things. Interaction design deals with immaterial processes, and with services that adapt to an individual's needs and preferences. This is a completely new kind of design. *(Thackara 2001)*

Yet another notion of interaction design is presented by Löwgren and Stolterman. Their approach centres on the notion of use-oriented qualities of digital artefacts:

> Interaction design refers to the process that is arranged within existing resource constraints to create, shape, and

> decide all use-oriented qualities (structural, functional, ethical, and aesthetic) of a digital artifact for one or many clients. *(Löwgren and Stolterman 2004, p. 5)*

> One of the most challenging aspects is that interaction design is concerned with digital artifacts. The technology constituting our design material is changing so rapidly that there never seems to be time for reflection or for a more thoughtful approach. *(Löwgren and Stolterman 2004, p. 2f)*

Interaction design is design, but of what? Design of computer based products and systems with focus on use…

The computer was once upon a time a huge complex thing hidden away in special rooms handled by computer operators engaged in some sort of interactive computing. With "interactive computing" in that case we mean real time control of the computer. That is computing as communication with computer computing *(cf. Suchman 1987)*. Interaction design then refers to the design of this communication process in some way. What is of interest here is of course both the process, the acting, as such and the interface we communicate through. Designing the "interaction" here includes designing the interface and interaction devices as well as explicit methods of handling them.

Coming from a mainly military background, computers have evolved via office work towards the everyday and so has the notion of its use. Given this history, it is not surprising that aspects such as error-tolerance, efficiency, effectiveness, etc., typically form the baseline against which performance is related – the focus has been, and often still is, on the performance of the coupled man-machine system. As an illustration, consider the following from Norman's The Design of Everyday Things:

> Good design exploits constraints so that the user feels as if there is only one possible thing to do – the right thing, of course. The designer has to understand and exploit natural constraints of all kinds. Errors are an unavoidable part of everyday life. Proper design can help decrease the incidence and severity of errors… Such design exploits the power of constraints and makes use of forcing functions and visible outcomes of actions. We do not have to experience confusion or suffer from undiscovered errors. Proper design can make a difference in our quality of life.
> *(Norman 1990, p. 216)*

Although this perspective is now perhaps typical to human-computer interaction, it is also to be found in the early days of industrial design. As we look at the development of industrial and product design, we see that these ideas seem to have a history also before the computer came about – but the relation between man and machine plays a certain role also here:

> Economy of living must first be economy of labour. Every door-handle must require a minimum of energy to operate it. The traditional style of living is an exhausted machine which enslaves the woman to the house. ... Today the woman is the victim of a false style of living. It is obvious that a complete change is urgently required. New objects (the car, aeroplane, telephone) are designed above all for ease of use and maximum efficiency. Today they perform their function well. Other objects in use for centuries (the house, table, chair) were once good, but now no longer fully do their job.
> *(Fleischmann 1924, p. 302)*

The shift away from the things themselves to the acts that define them in use is perhaps something made more evident with recent developments of design, such as interaction design, but it was initiated long before computers and communication systems came about. Even the notion of 'form follows function' could be seen as pointing in this direction. Maybe it was because of the introduction of industrial production and the changes of the relation between maker and what is made that it implied, or maybe it was because of a more ambitious social agenda for design, or indeed something else, but somehow the wider context of products in use became the subject of much Modernist design thinking. Consider, for instance, the design program proclaimed by Gropius and the Bauhaus:

> The Bauhaus wants to serve in the development of present-day housing, from the simplest household appliances to the finished dwelling. In the conviction that household appliances and furnishings must be rationally related to each other, the Bauhaus is seeking — by systematic practical and theoretical research in the formal, technical and economic fields — to derive the design of an object from its natural functions and relationship. *(Gropius 1926, p. 95)*

Ideas such as the ones proposed by Gropius suggest a wider concern for what design is about, e.g., that it is not only about the shape of a cup or a bowl, but also about the rational construction of the modern household as such. Further, it introduces the idea that a basis for design decisions can be found through systematic research also in areas such as technology, economy and so on. Or in other words, this invites analytic empirical areas of research into the more constructive design process as to help lay the foundation for a rational design practice through the accumulation of knowledge about use and user requirements. As such, its legacy is far more extensive than the notion of 'modernist' or 'functionalist' design might suggest. This perspective is still clearly visible in, for instance, Preece's et. Al. picture of interaction design:

> A key question for interaction design is: how do you optimize the user's interactions with a system, environment or product, so that they match the user's activities that are being supported and extended? One could use intuition and hope for the best. Alternatively, one can be more principled in deciding which choices to make by basing them on an understanding of the users. … In particular, it focuses on how to identify users' needs, and from this understanding, move to designing usable, useful, and enjoyable systems. *(Preece et. Al. 2002, p. 5)*.

Thus it seems that the present concern for the usability of technical systems does not only come from the realm of computers, but also from the beginnings of industrial design at a time when mechanised production changed the way things were made. Perhaps this has something to do with the way the general understanding of technology seems to build on an instrumental perspective and that thinking about its design in terms of functions seems like a 'natural' perspective *(cf. Kroes 2001* on technical artefacts and *Verbeek and Kockelkoren 1998* on 'functionalist' design*)*. Although machines and technology have become increasingly important in design in general, 'functionalist' design has been replaced and re-discovered several times in the discourse since then. In the design of computational things, however, we are perhaps just approaching the first in a series of such movements..

Whatever will be the case, it is clear that the foundations for interaction design, especially with respect to its focus on the use of objects, and the role of the user, has a more general history than references to HCI might suggest. With respect to this background, it can be seen as being one in a series of steps away from the 'object' in design discourse *(cf. Thackara 1988)*, and as such it is not necessarily bound to the development of the computer. As areas such as biotechnology begin to present new materials to be used in design, it might even be that computational technology is but the first in a series of new materials that will be important to interaction design. That said, and for the time being, we will argue that computational technology does play a central role in interaction design.

Information technology is now a part of our daily life. It is there around us all the time and everywhere; in our cars, in our homes, in the street, in the watch, in the toys, in the phone, in the musical instruments etc. As technology matures we become more and more concerned about meaningful design, which refers not only to usability in the sense of cognitive ergonomics, but also to aesthetical issues.

As the computer itself disappears into the background, computational technology reappears as a new expressive design material. Communication with the complex machine is now in many daily situations nothing more that ordinary use of various things. We build things with a new material; we build computational things. Designing "communication" with computing machinery is now simply design

- with focus on use,
- where computational technology is a basic design material.

So one central leitmotif here is that interaction design introduces a shift of focus from the things themselves to the acts that define them in use. This raises questions about what it is we design in the interaction design process. What does it mean to shift focus from the things themselves to the acts that define them in use?

The shift of focus that interaction design introduces can be characterised in terms of a specific interpretation of the concepts of functionality and appearance. It is a shift

- from what a thing does as we use it to what we do in the acts that define use,
- from the visual presentation of spatial form to the act presentation of temporal behaviour.

The designed 'thing' is material we use to build the acts that define its use or an instrument we use to perform these acts; interaction design covers those issues in the design process that centres on acts defining intended use. To focus on use means that we view the products and systems through the central acts that defines them in use – or at to be more precise the acts that defines intended use.

Interaction design is design of the acts that define intended use of things.

"Intended use" does not refer to function in a more general sense, i.e. what a given thing does as we use it; a corkscrew opening a bottle of wine for example. It is about acts that define use of this particular corkscrew, i.e. it refers to a particular act interpretation of a given thing as a cork screw.

What does it mean to design these defining acts? The concrete acts themselves appear through actual use and it also quite possible that actual use do not correspond to intended use. Interaction design does no mean staging actual use – which would be unreasonable in many ways.

What we design is the conceptual context, which gives an act interpretation of intended use of a given thing. The design will then manifest itself in instruction manuals, training courses etc., but also in an inherent logic of intended use that perhaps more slowly will influence actual use. This design is then in a strong sense a basic foundation for the design of the given product or system as a thing to use. So interaction design is in this sense an essential component of the overall design process that leads from initial ideas to a finished product ready for manufacturing and use. This also means that it is somewhat meaningless to view interaction design in isolation from product- or system design; it is not only that 'use' always means use of something, but also that a designed thing or system is a central component of the acts that define intended use. The design of things, systems and the design of acts defining use connect in intricate circular patterns of dependencies.

Components of interaction design comes under many names and in many different forms; ergonomic design, cognitive design, usability, human factors engineering, human computer interaction etc.

Interaction design with respect to computer based products and systems lead naturally to the second main leitmotif, namely the view that computational technology is a design material among others. A material we use to build the acts that define use, a material that through its expressiveness builds the expressions of these acts.

Interaction design is product- and systems design where computational technology is a basic design material.

What is typical for these things is simply that their behaviour in use depends on the executions of given programs. This material is just

like the material of music a time-material and it shows itself only when we use the things.

What basically characterizes interaction design, both as academic subject and as design practice, is this combination of act design with a view of computational technology as a new expressive design material. Interaction design is not a subfield of computer science, but it is a link between basic research in computer science and product applications.

The designer delivers specifications that define functionality- and usability issues, but must at the same time understand basic properties of the computational material.

Those who work with the technical development and implementation of hardware and software must on the other hand understand that computers and programs in use are not neutral technical solutions, but rather expressive things that depend on a collection of – conscious or unconscious – basic design choices, aesthetical in nature.

We usually associate interaction design with use- and user oriented design of computer based products and systems. But designing the 'interaction' with products and systems is, of course, also of more general interest in industrial design as a whole.

> There is a common misunderstanding that interaction design is concerned fundamentally with the digital medium. It is true that the new digital products have helped designers focus on interaction and the experience of human beings as they use products. However, the concepts of interaction have deep roots in twentieth-century design thinking and have only recently emerged from the shadows of our

> preoccupation with 'visual symbols' and 'things'.
> *(Buchanan 2001, p. 11)*

Interaction design is, in this sense, a basic component of a more general design process. It is a matter of designing the acts that defines intended use of things and systems. Designing computer interfaces and computational interaction devices is a part of this, but it is not what defines interaction design as a specific area of design.

2
FOUNDATIONS

Practice rests on a foundation – implicit or explicit – that provides a rationale explaining the 'what's' and 'why's' of our work. It is a basic challenge for science and research in general to formulate the theories and methods that give us a solid foundation for work practice. What does this mean in the context of design practice?

2.1
FOUNDATIONS

When discussing the foundations of scientific practice, such as the practice of mathematics or physics, we usually refer to a collection, or system, of basic concepts that we can use to explain and justify constructions, theoretical considerations and arguments central to practice. It is a fundament on which we can build scientific practice; a fundament on which we build rigorous explanations of intuitive practice.

In daily practice we seldom bother about foundations. It is only the appearance of a lack of rigour, dilemmas, and apparent paradoxes in practical work that sooner or later seems to make us revisit the realm of foundational questions. But, even so, intuition is a strong force in the development of practice. Berkley, the philosopher, saw problems in foundations of calculus as it was introduced by Leibniz and Newton – a critique Berkley published in The Analyst in 1734. Although he was right in some sense it took more than hundred years before a rigorous foundation was given by Cauchy, Weierstrass and others – a rigorous interpretation of the mysterious infinitesimals was first given in 1966 by Abraham Robinson in his book Non-Standard Analysis *(Robinson 1966)*. Basic intuition was strong and guided the development in spite of a lacking proper foundation. So why bother about these foundational questions at all? What's the point, for example, with a rigorous definition of the

notion of continuity, the notion of a real number, etc. when intuitively established rules of calculation seem to work fine?

In mathematics we prove theorems; we use various constructions and arguments to establish the truth of certain claims. In daily practice this is based on informal rigour, a large system of known 'facts' and well established modes of reasoning. From time to time lack of rigour may leave clearly visible holes in arguments and constructions and that of course tends to make mathematicians nervous. In these situations there is obviously a need for foundational considerations. A foundational investigation is then a central component in developing practice; a rigorous explanation of intuitive practice can be a basis for the invention of new research methods and new research programs as well as providing a solid foundation for established areas. It is a bit ironical that the foundational crisis in mathematics at the end of the 19th century was initiated by efforts to provide a solid foundation for well established intuitive practice. As S.C. Kleene writes:

> In the arithmetization of analysis … an infinite collection …. is constituted as an object, and the set of all such objects is considered as a new collection. From this it is a natural step to Cantor´s general set theory. Hardly had these theories been consolidated, when the validity of the whole construction was cast into doubt by the discovery of paradoxes or antinomies in the fringes of the theory of sets. *(Kleene, 1952, p. 36)*

A foundational 'crisis' was thus the result of an effort to provide a solid fundament to intuitive practice. It seems a bit dangerous with foundational work. Maybe it is better to keep these questions under lock and key, trust intuition and be guided by aesthetical considerations…

If a foundational discussion seems rather natural in relation to mathematical practice, what could a foundation of design practice be all about and why would foundational issues be of interest at all with respect to design practice? Can we learn something from foundational discussions in mathematics, physics?

Design is always design of something given; we express function, materialize ideas, try to meet user requirements, provide solutions that conform to given specifications, solve problems, turn given abstractions into concrete expressions. It is basically a constructive and rational practice; we define things relating basic design variables to given abstractions. In design practice we then look for work methods that to some reasonable extent can help us ensure that a proposed design provide solutions that conforms to given specifications, meets user requirements, express given functions, materializes given ideas.

There is constantly also a need for new programs that can guide and develop practice by opening up new design spaces. These methods and programs rest on a, implicitly or explicitly given, foundation that paints a general picture of the design practice. A typical 'crisis' in design practice is initiated by questioning established work methods and design programs, i.e. we feel that something is wrong in present work practice or that design could also be something else.

There may be basic errors in the design we propose; things go wrong, systems break down, side effects we didn't reckon with occur, usability is nil. There may also be mistakes and misunderstandings in problem analysis; we may end up in 'solving' the wrong problem. The new car model, this year's spring collection turns out to be a failure on the market. Nobody wants to live in the houses we design. In all these cases it may well be that

we know what went wrong and how to deal with that. But it might also be the case that we see clear gaps in our work methods or that we simply don't understand what went wrong.

It is a situation where established work methods lead to errors, where guesswork, trial and error and hand-waving in a too obvious manner hide shortcomings. Given interpretations and explanations of basic axioms do not provide a sound foundation for present practice. There is a need to rethink matters once more, to bring out forgotten issues, to correct mistakes. To make explicit and precise what is wrong as well as to define new methods and initiate new programs, we need to revisit basic foundational questions and re-examine hidden assumptions.

What does it mean to provide a foundation of design practice? What are those hidden assumptions that practice rest on all about? What are the basic concepts we have to have a proper understanding of in order to be able to build a sound practice?

A design might, in a much idealized sense, be thought of as a concrete instance of a given abstraction – given in terms of specifications, user requirements, etc. Motivations *(Cf. Moran and Carroll 1996)* of the series of choices made in the design process should then provide a proof, in some sense, of this fact. That would be the perfect rational picture of design practice. A conceptual foundation of design practice is then a collection of concepts we can use to explain this picture and also use to develop methods, programs, etc., that support and further practice in a sound manner. What we do is actually just to, once again, explain the meaning of the mysterious axiom: design is always design of something given.

In mathematics, foundational issues concern the foundation for valid arguments and well defined concepts. But all efforts during the 20th century to provide a solid foundation of mathematics that start with simple ‘evident’ notions and successively build mathematics seem to have ended in an irritating circle; it seem as if we always have to intuitively understand the non-trivial notions we try to explain formally. There is something inherently impredicative – i.e. the formal concept needed to explain the given notion somehow already presupposes this notion itself – with even the most elementary non trivial notions.

Is all this foundational work totally meaningless? It does not relieve us of the burden to trust our intuition with respect to very abstract and difficult concepts, but it certainly helps us to sharpen our intuition, to bring out difficult matters in the open and to structure our knowledge, and thus it helps us to paint a clearer picture of intuitive practice. So in the end these types of investigations give us tools to develop practice although we still walk on shaky foundations.

The situation is somewhat similar in design practice. Foundational investigations, reflections, etc. strive to find work methods that can ensure “correct” design with respect to given specifications, etc. In mathematics we look for a foundation for well-defined concepts and valid arguments. This perhaps corresponds to well-defined and meaningful programs – both in the sense of general design programs and in the sense of a particular design brief – and sound methods in design practice, the what and the how of practice.
But even if it is obvious enough that design practice, due to its complex nature, always will be open for this type of questions, there seem to be basic inherent conceptual circles that as a matter of principle will guarantee that we always will walk on a “shaky foundation”.

In the end we have to trust our intuition…. But intuition is not a black box we have or have not. It is something we have to acquire, something we have to train, something we can understand, and something we can reflect on… *(Cf. Thornquist 2005.)*

The reasons for the importance of foundational investigations here are really the same as for foundational work in mathematics and other fields of human endeavour; to sharpen intuition through reflection on hidden assumptions. *(Cf. Poincaré 1914.)*

2.2
THE DESIGN CIRCLE

Design practice rests on several conceptual circles – or "antinomies" – that we somehow resolve in practice. These are all some kind of end points that seem to prevent us from getting hold of all the details of that perfect rational design practice…

Design is always design of something given. What does that mean? Jones describes what we might call the "design circle" as follows:

> The fundamental problem is that designers are obliged to use current information to predict a future state that will not come about unless their predictions are correct. The final outcome of designing has to be assumed before the means of achieving it can be explored: the designers have to work backwards in time from an assumed effect upon the world to the beginning of a chain of events that will bring the effect about. *(Jones 1992, p. 9f)*

The design process depends on a definition of what to design, the meaning of which we interpret through the design itself. …something given; the meaning of this seems to be a bit problematic…

Consider, for example, the design of a clothes hanger. We, of course, explain the notion of a clothes hanger referring to its general function, but the concrete acts that define the specific hanger in use – which is what demonstrates design functionality – becomes in some sense the intentional object that guided the design process itself. It is not only that it explains and motivates this particular design of a clothes hanger, it also explains what a clothes hanger is. This introduces a conceptual circle that obscures the meaning of this design of a clothes hanger.

Assume we want to design a chair. Intuitively this means that we know what a chair is and now we want to design yet another such a thing. How do we know whether this new thing is a chair or not? It might look like the other chairs we know of… It might be possible to use it as we use the other chairs we know of … Can such definitions of formal or functional appearance resolve this conceptual circle?

Take the notion of a bicycle as another example:

We know what a bicycle is, don't we? So this is something that we must be able to define in a precise manner. What is obvious is something like:

> Bicycle form; "a vehicle with two wheels tandem, a steering handle, a saddle seat, and pedals by which it is propelled" *(Merriam-Webster Online Dictionary)*,

Bicycle function; some means of transportation driven by pedals.

We just have to make this a bit more precise…

The problem with this idea is that such a definition will be full of variables we have to interpret in the process of designing a bicycle. Even if what we do essentially is a redesign it is still a result of an interpretation of basic formal and functional variables. As we design new things, no matter how small a change we initiate, we change the meaning of that 'something given'.

Design means defining the concrete appearance of something with respect to form, function etc. There is always a gap between abstractions and the concrete appearance of instances. Even if an abstraction gives a foundation for the design of a "new" thing, the concrete appearance of that "instance" will in some sense redefine the given abstraction. A design defines what that given could be as a thing, system, phenomenon – it defines what "a chair", "a program", "an idea" could be.

A design is always a design of something given, what that is will in some sense depend on the design itself. This is the basic design circle, a circle that characterises the notion of a design variable as an "open" variable – a variable that refers to an "intension", i.e. the definition itself – and not to an "extension" of given things. *(*cf. the notion of 'wicked problems', *e.g. Buchanan 1995, Coyne 2004)* The design gives an interpretation of something given that changes our view, our understanding of and our knowledge about, our opinion about which is given.

Even if the meaning of a given design variable is somewhat vague we strive of course to make the picture more precise through analysis of that given. In that turn from analysis to synthesis – definitions – we will get lost for a moment, a gap is visible here that we have to bridge through interpretations. Ideally we turn, in a systematic manner, a systematic analysis of that given into a systematic design of that given. What the circle does, is to open up

a gap in this picture. A gap that muddles the borders between analysis and design, a gap we somehow have to bridge in acts of turning analysis into design – crossing a border that sometimes is difficult to see.

In certain cases, in mathematics and physics for instance, we come to a stage when our formal interpretations seem to be stable; a somewhat mystical feeling that we actually see a definite piece of abstract reality – the definite notion of that given. Fascinating examples of this are the notion of the real numbers and the notion of mechanically computable functions. There is general agreement that the definitions – this is design (!) – of the real numbers given by Cantor and Dedekind are correct. It took a very long time to reach this point of formal – and metaphysical – precision and it was certainly not a trivial achievement. During 1930–40 Church, Markov, Post, Turing and others, put forward several suggestions for a precise definition of the notion of a mechanically computable function *(cf. Kleene, 1952)*. As through some kind of magic they all turned out to be equivalent which – together with convincing motivations given by for example Turing – gave a strong feeling of reality to the notion given by the proposed definitions. That the proposed definitions in fact completely capture the informal notion of a mechanically computable function is an axiom – Turings thesis *(cf. Kleene, 1952)* – and not a proposition we can prove.

The strongly predominant situation in the context of design is that of a vague somewhat indefinite given –a "wicked problem" *(cf. Buchanan 1995)*. In this context a proposed design clearly changes the meaning of that given in a more obvious way. The gap is perhaps more visible here than in mathematical practice, but it is not the vagueness and wickedness as such that draw the circles.

2.3
DESIGN AS DERIVATION

It is tempting to think that we can resolve the circle by proving a design, i.e. by proving that it actually is a design of that something given. As this establishes that the design satisfies initial requirements it would open up the circle; there seems then to be something definite given we actually can prove the design with respect to. And systematic methods for the derivation of a design, with respect to given initial formal specifications and requirements, can perhaps provide a solid foundation for practice; derivation by form, by functionality, by usability…

In terms of that perfect rational picture the series of choices that build the design process is then seen as a "derivation" of the design where motivations of derivation steps with respect to form, functionality, usability prove that the design in fact gives us a concrete instance of a given abstraction with reference to form, functionality, usability. We thus have the following, somewhat idealized, picture

the design D defines some given E.

A proof of (A) needs a, precise, definition of E. This definition must of course not depend on concrete instances, i.e. such as listing collections of things at hand etc. We rather think of something general like

D defines a camera

D defines the structure of a building.

Assume D defines some P. If we can prove that P is an E, then, providing this does not follow from some general axiom, P must be defined in the definition D' that introduces E, i.e. the design of P is given by D', at least in some abstract sense. Is this what we mean by that given? It is easy to see how this idea leads to an idea about the design process as a process of derivation with respect to given specifications and initial requirements.

One problem with this idea is that we try to resolve the circle by introducing yet another definition, yet another, perhaps more general, 'design'. A proof that D defines E merely states that the interpretation given by D conforms to the interpretation given by the definition D' introducing E, i.e. it is such a thing by definition. A proof of the correctness of D with respect to D' refers back to a question about the correctness of D', i.e. whether D' defines that given… Deriving a design D on basis of E it seems as if we define a concrete instance of something formally given by D'. We try, so to speak, to hide the circle by pushing it one step further back in what looks like an infinite regression. Formal specifications and requirements are themselves results of turning analysis into definitions.

But systematic design derivations will also provide a fine structure analysis of the logic provided by the definition of E. Is then design reduced to the mere search in the search tree given by D'? *(Cf. Simon 1996)* Here it is clear that not only choices of derivation steps, but furthermore also the actual definition of the basic derivation constructs at hand are central components within the design process itself. What is then analysis and what is then design?

2.4
DERIVATION BY FORM

Assume we have a 'proof' of a given design and assume that it is a proof with respect to some definition of the form of (a) E, i.e. that the design process is viewed as a derivation by form. We think of this as a process of step-by-step defining a concrete form of that something given; we 'prove' that D defines the form of (a) E.

The discussion that follows has its foundation in a basic axiom concerning compositionality:

> a form is something whole composed out of parts.

In the design process we start off with some general idea of that 'whole' and through the design of parts, refinement of composition, etc., we finally end up with a concrete gestalt of that 'whole'. This is the basic motivation for the idealized abstract picture of basic derivation steps as

> X = C(Y1…Yn)
>
> where X, Y1,…,Yn are design variables and C is some law of composition including the limiting case where C is an atomic form.

Extensionally these variables then 'seem' to range over 'things' – or 'forms' – in its most general sense, but intensionally – within the design process – it is natural to think of a design variable as a variable that range over design 'problems' in some sense. The same law of compositionality applies here; the solution to form problems depends on the solution of form problems for immediate parts of something whole. If we have things having the forms of walls, a roof etc. and we put them together as a house, then we get something having the form of a house – it might be just a model, but still something having the outer form of a house.

In a derivation by form, the central foundational issue concerns the way in which we motivate the definition of a design variable by reference to form.

A motivation of such a derivation step is based on definitions P, P1, …, Pn making explicit the formal references of given design variables and runs something like

> If Y1 is a P1, …, Yn is a Pn, then X = C(Y1…Yn) is a P.

Take the 'guitar' as an example. We 'know' what a guitar looks like, we know about the basic formal design variables; body, neck etc.

> Guitar = C_Guitar (Body, Neck)
>
> Neck = C_Guitar(Fingerboard, Frets, Headstock, Nut,…)

Motivations for this series of derivation steps should prove that the resulting design is a design of a guitar. In the case of a derivation by form this is to say that it is a guitar with respect to form.

E gives an interpretation – description – in abstractio of that given.

It defines what the form of a guitar is in general. D gives an interpretation – design – in concreto of that given. The design will tell us what the form of a guitar might be – the Fender Stratocaster design was a very good example of what that means when it once was introduced.

We might, in this manner, describe the design process in idealized terms as a derivation based on some general E we use to motivate basic derivation steps. But what is then analysis and what is then design? The design itself will be based on the definition we use to motivate the steps in the process. The derivation depends on laws of composition given by E. The design re-defines that given; a new guitar re-defines the notion of guitar form through the series of choices made within the design process. Defining E must then be part of that process of re-defining the notion of guitar form. How do we motivate the correctness of a derivation step in any other way than by saying that this is what we mean by a guitar form, i.e. by referring to a definition of guitar form as it is given as a basic assumption within the design process itself?

But I know, of course, what a guitar looks like, what it means to design a guitar – how could it otherwise be design of something given? I just cannot 'prove' the form with respect to a given form definition; the definition of 'that given' somehow depends on the form introduced by the design itself. From a logical point of view it doesn't matter then whether the design choices are based on personal observations and reflections or more systematically empirical investigations or a mix of both.

We have some initial informal understanding of what a guitar is and through the design process we try to imagine what a guitar could be. Central here is the interpretation of a given informal notion in terms of a collection of design variables and a step-by-

step interpretation of these variables. The design itself fills a gap between what was given and what is given. A derivation by form will give a fine structure analysis – in concreto – of the specific notion of form in question. Each derivation step introduces a component of this analysis and if we consider the various choices we view as acceptable in each step, the result of the process is not only a definition of a specific guitar by form, but also an analysis of the notion of guitar form in more general terms.

A design defines a particular form, .i.e. the appearance of a certain form. This concrete form is the form of something given. That this is the case is an initial assumption – this is the 'formal' design circle. In what sense is this something we can prove?

It is tempting to view a design variable as an abstraction we only define locally by example – yet another strange antinomy. The notion of a chair is an abstraction of given things, but also a design variable we instantiate by designing chairs – circles, circles…

So we design a chair. Given the chair itself we can check that it is brown in colour and that it is made out of wood with respect to precise definitions of what that means, but it is also clear that we can not prove that it is a chair, i.e. that the chair proves the given design variable. We cannot prove that this particular form is what makes it a chair.

Design is in some sense a matter of product definition, 'thing' definition. What is given is really a problem of interpreting certain design variables; a derivation by formal appearance gives a specific form definition as a result of this interpretation. A design variable states a problem of reinterpretation. This problem itself is circular in nature; reinterpret A through a design that satisfies A.

A derivation by form depends on laws of composition, including atomic forms. If a definition of that given turns this into a proof, then this definition must 'prove' the laws of composition in question. This means the design is somehow already given – which is one way of formulating the circle. What we do in acts of defining is not proving, but proposing. We formulate propositions rather than construct proofs. An idea about a form is then already a step within the design process, not a canonical picture of that given.

2.5 DERIVATION BY FUNCTIONALITY, BY PROBLEM SOLVING

In a derivation by functionality basic steps of derivation are motivated with reference to function. The idea here is that we prove that the design perform certain functions in use, something that takes pictures, measures radiation etc. We motivate derivation steps through function analysis *(cf. Cross 2000)*, i.e. the function of something whole in terms of a composition of the functionality of its components.

AutomaticWashing = C_AutomaticWashing
(Rinsing, Washing, Spin-drying, Drying…)

If we have defined components that automatically perform rinsing, washing, spin-drying, drying and we know how to compose these in an automatic system, then we can define a machine that performs automatic washing.

To prove that D defines the functions of (a) E we need a precise definition D' of E that describes what performing automatic washing means. Thus D' gives a general interpretation of something given in terms of functionality and the design gives an interpretation in concreto of that given etc. A motivation by function analysis gives a fine structure analysis with respect to functionality and deepens our understanding of given things, but it does not resolve the basic design circle.

The situation here is more or less the same as with respect to derivations by form; the design itself will tell us what the functional appearance of automatic washing might be.

A design defines certain functions, i.e. the particular appearance of certain functions. This functional behaviour defines the functional appearance of something given. That this is the case is an initial assumption – this is the functional design circle. In what sense is this something we can prove?

Take a camera. With respect to functionality the lens focuses the light, the shutter opens for exposure etc. The 'camera' builds on a general idea – design – of what it means to 'take a picture'. This idea – the definition D' – gives the foundation for motivating constructional choices with respect to function. Using this to prove that D defines a 'camera' is a mere tautology. More important is of course that any functional innovation will change the picture of what a camera might be, i.e. we redefine E through D. The invention of Auto Focus-systems clearly changed the meaning of camera functionality, not to mention the radical change introduced by digital cameras.

Similar to a derivation by functionality, we often consider various forms of derivation by problem solving. We go one step further to prove that defined functionality solves given problems. It could be the problem of people getting back and forth across a river; a bridge, a boat, a tunnel, re-routing the river etc. A proof that D defines a solution to the problem E must also that be based on some precise definition of what constitutes a possible solution and so the circles persist?

That perfect rational picture brakes down in all these cases in the following sense: a proof that D defines – a concrete instance of – that given seems to end up in a tautology, a circle. What we prove is merely that the interpretation given by D conforms to another, perhaps more general, interpretation of that given. Which mean that what D actually 'defines' is inherently given in the proof, the correctness of one definition refers back to the correctness of another definition.

The method of developing a program along with a proof of its correctness – introduced by Dijkstra and others *(cf. Dasgupta, 1991)* – is an example par excellence of derivation by functionality/problem solving.

But a formal proof – derivation – of program correctness needs an interpretation and that is where the foundational issues turn up. We need to bridge a gap. The interesting question here is what the specification we use in the proof of the program actually states, where it comes from, etc. This is a matter of definition, a matter of design, a matter of interpretation.

This is of course not unique in any sense for design practice. As soon as we set up a formally precise theory we encounter these issues of the correctness of formalization with respect to what is informally given. What is a bit different here is that definitions occupy a rather special place in design practice, they are so to speak end results in the design process.

D' is in some sense a general design – definition – on which we build the proof that D defines such a thing. What is central in the design process is not a process of derivation, but a process of defining. An act of defining fills a gap between what is possible and what is actual through an interpretation of that mysterious given.

It is here we find the basic foundational issues of design practice; in pictures, theories of this hermenutical gap that explains what it could mean to turn analysis into synthesis through a definition.

Viewing the inherent circles in the idea of a derivation by… it might be tempting to look for a foundation of design practice in theories about empirical testing. We prove functionality, problem solving through empirical testing. We test the design and what we need is simply a solid foundation for such testing. If we have precise problem formulations, precise requirements and test that the design solves the problems, meet the requirements is this not a proof of the design? What does testing of a design prove with respect to functionality, problem solving – that is, with respect to the basic metaphysical assumption "a design is always design of something given"?

Say the given problem is to design a drug that cures a specific disease S and suppose we find, through iterated testing, that the proposed drug in fact seems to cure the disease in question… Empirical tests show that the proposed drug cures the disease S as it is known and defined today. This is of course a typical example of how we in practice "resolve" the design circle through empirical studies. The test defines what it means for the design to satisfy that given.

To test a design with respect to some requirements means we have to set up a test. To prove a design with respect to some specification we have to define a framework within which we can perform the proof. In both cases we define the design in some general sense, i.e. we decide what type of interpretation of the given the design will give. We define that given in terms of the type of solutions we have in mind, as if the circle is still there…

Testing and formal verification both have their foundations in

definitions that, in one way or another, interprets that given. The idea of an absolute proof that opens up and resolves the circle seems to be an idea that tends to obscure the proposing and interpretative nature of the design process.

That it is in fact a house the architect design is an initial assumption the meaning of which we may use to explain the design itself. That the blue print really defines a boat satisfying the 12-meter rule is also a sort of initial assumption. An assumption we check by computing a formula with respect to the definition of given design variables. The 12-meter rule is a design requirement part of the initial brief, i.e. something given. Checking that the design meets this requirement is merely to check the design with respect to given initial restrictions on design variables.

Now what is the relevance of this Herecleitian hair-splitting with regards to practice?

What we believe to provide a good foundation for practice of course influence to a great extent how practice is carried out, what is considered to be good practice etc. It is natural that we look for a solid foundation where we can measure things, test things, prove things, calculate things and be sure that the design is correct. It is then easy to sometimes forget about the basic duality between analysis and synthesis, between rational design and empirical studies that bears up the design practice as well as scientific practice. We have to balance in between and in design practice this means being a bit up side down as compared to scientific practice, which mean we have to look for a foundation in the opposite direction so to speak… The logic of expression, i.e. aesthetics, plays a basic role here as we go from the abstract to the concrete, from ideas about functionality to expression of function, from requirements to suggestions.

Even if that perfect rational picture of design breaks down, it is still basically a rational constructive practice and it is the foundation of such a practice we have to look for…

2.6 DERIVATION BY USABILITY

A derivation by usability is a proof of the design that refers to use qualities, i.e. it introduces, besides that something given, also that someone given – the mysterious user, that someone using some thing for something.

Usability refers to properties of a design that characterize the ways in which we do something specific with a given thing, system, tool, etc. – those properties that characterize use for something. It usually refers to qualities of use such as easy to learn, efficient in use, robust in use, different sorts of use experience, etc.

Use means that we – the users – do something with a thing. Use is always also use for something – not just of something. Just being a user – i.e. merely doing whatever with something – does not characterize any deep relationship with things. It merely states the fact that I do certain things. But behind the mere 'use' of something there is that someone doing something with specific intentions.

Use thus indirectly refers to what we do with things.

> Washing = C_Washing(Load the washing machine, Set the appropriate washing program, Wait, Open the machine and take out the clothes…)

It is always specific intentions of use that give the acts defining intended use their meaning. This is also what we refer to when we speak about what we do with things. When we do things, use things for this or that, we express intentions; we perform the design as an expression of form, function, usability; here we are not the users as objects, but the performers as subjects.

Derivation by usability refers to a process of defining something that is useful for someone given with respect to that something given; we try to define something that is useful for X in accomplishing Y: a cork screw to open a bottle of wine, a political system to organize the ruling of society, etc. Motivations for steps in the process that proves usability of the design must rely on some, general enough, definition of 'use for'. Common practice is here to rely on some sort of 'proof' by evaluation.

Evaluation means that we let the given someone 'use' the design to do that something given at some stages in the design process in order to see to in what sense the design meet usability criteria and requirements. Ideally we would like to prove that the design defines things like an efficient work method, an informative and intuitive interface, etc.

To motivate, or prove, a derivation by usability we 'test' derivation steps through evaluation. The derivation itself can then be seen as a usability analysis that provides the foundation for empirical user evaluations.

There are several problems with this idea of proof by evaluation. To be able to evaluate the design in a precise manner we have to make the notions of "efficient work method", "informative and intuitive interface" precise which involves answering basic questions like "for what?" and "for whom?". This is quite similar to the formal-

and functional design circles; the design we in fact evaluate will depend on the general definitions we need for the proof.

Derivation by usability can not, for reasons to be discussed later on, relate to the actual intentions of people using the thing. Rather, our notions of 'use' in derivation by usability relate to intended use and thus also to intended intentions behind such forms of use. In many ways, what we really deal with here is therefore the functionality and performance of the coupled man-thing system, i.e. an extension of the derivation by functionality perspective that centres on just the 'thing' part of this system. This is evident in typical usability questions such as "does the user understand what to do and how to do A?". How could we ever ask such a question if we did not assume that there was an intention to do A? In many ways, the inscription of such intentions becomes a part of our design just as certain functions are being implemented.

Design is what makes use and user possible. Use and user are at the same time concepts we need to define in the design process itself. This is one way of expressing the usability design circle, which points to basic issues that makes design conceptually difficult with respect to notions of use and users.

The realm of aesthetics is not far away here, especially if considered as an epistemological project. The 'circles' discussed above are in many ways related to the Kantian antinomies on how we are able to make aesthetic judgements and on what principal grounds we do so.

One of the basic problems he tries to resolve is what he refers to the 'antinomy of taste' *(Kant 1987, p. 338f)*:

1. Thesis: A judgement of taste is not based on concepts;

> for otherwise one could dispute about it (decide by means of proofs).
>
> 2. Antithesis: A judgement of taste is based on concepts; for otherwise, regardless of the variation among [such judgements], one could not even so much as quarrel about them (lay claim to other people's necessary assent to one's judgement).

This is a precise description of one such circle, i.e., how our judgement of taste somehow both assumes a concept and yet precedes (any proper definition of) it. As Kant's project was one of trying to reconcile notions of an 'objective reality' with notions of 'subjective experience', this becomes a question of how we come to experience, and have knowledge about, the world. In some sense, this turns aesthetics into an epistemological project, i.e. a question not so much about what we like or not, but about the basic 'what' we make such judgements about and how we do so. Of special interest here, is the idea that the aesthetic judgement is about the world, as an early stage of conceptualisation; as when we use notions of 'beauty' to guide our search for what is 'true' or what 'works'. Even though the aesthetic experience per se is subjective, there is a nevertheless something external present, i.e., object being experienced. And it is about this object we enquiry here.

With respect to such an understanding, aesthetics becomes central to design not only because of the aesthetic judgements designers and users make about the things designed, but as a foundation for reasoning about design decisions. As an example, we might try to substitute the 'judgement of taste' in Kant's description of the antinomy above, for something like 'design decision':

> Thesis: A design decision is not based on concepts; for otherwise one could dispute about it (decide by means of proofs).
>
> Antithesis: A design decision is based on concepts; for otherwise, regardless of the variation among [such decisions], one could not even so much as quarrel about them.

Here, a certain resemblance to the circles discussed previously becomes clearly visible; the issue of how we design something 'given', though it is through our design that we define what that 'given' is. Or, we can compare it to Jones' statement that a basic problem in design is that the outcome has to be anticipated before the means for achieving it can be explored. In this sense, aesthetics is the basis for design.

There is, however, one important difference between the judgement of taste and the design decision, and that is how it is resolved. Kant resolves his circle by making a distinction between determinative and reflective judgements, the aesthetic being of the latter kind. The design decision circle, however, is resolved through the process of making, the actual crafting of the object. As such it is more than reflective; it is not only about laying claims about the state of things, it is about *changing* the state of things. As such, they point to another aspect of the relation between aesthetic experience and the world experienced, and in this case also made.

Aesthetic judgements are not to be confused with statements of subjective experience in general *(cf. Habermas 1981)* as they make claims about structures and properties of the object as such. As such, these judgements have a somewhat special status. Now, one question, given this idea of design decisions being closely related to aesthetic judgements, would be whether design decisions also hold such a special cognitive and epistemological status. Given our increasingly man-made world and the relation between decisions in design and how our life-worlds actually turn out, this is indeed an important question – but also one to be addressed elsewhere.

3

FOUNDATIONAL ISSUES

The perfect rational picture of interaction design practice is that of derivation by usability. In a foundational sense this is a logical illusion – an illusion revealed by the design circles related to the notions of use and users. Is this visible in practice? What types of foundational issues occur in practice?

3.1
THE DISAPPEARING USER

A general understanding of interaction design is that it concerns the design of computer based systems and products with a central focus on use in some sense. The basic metaphysical assumption speaks of “that given”, that is the what we design. In the design process this what is a concept we define. Derivation by usability introduces also that someone; the user, that who that is implicit in the acts defining intended use.

The basic design circle with respect to use and users, as it is expressed in previous chapters, is simply that while the design is what makes use and users possible, it is at the same time something we need to define in the process of designing. And to make the picture even more complicated it is something that is defined also in actual ‘use’.

Interaction design has to some extent developed within a tradition strongly dominated by behavioural science and social science, with respect to methods and foundational thinking – the tradition of human factors engineering and human-computer interaction. This has sometimes led to certain conceptual problems in proposed foundations of interaction design as a design practice. The clear distinction between an analytic empirical scientific practice and a constructive rational design practice has sometimes been blurred

with strange consequences. These problems are centred on two common types of category mistakes:

(A) *The empirical fallacy* – the idea that use is an activity open for empirical investigations and not a concept we define,

(B) *The interactivity fallacy* – the idea that the objective of interaction design is to design “interactive” systems where the user is yet another component.

In behavioural- and social sciences, use of various artefacts in a given context is a basic activity we investigate through empirical studies, i.e. we study the use of mobile phones in a public space, the way we use computers in school, etc. But in the acts of designing, use and users can only exists in terms of concepts we define as we state the objective of these acts, i.e. there is at this stage really nothing to use. This distinction may seem utterly trivial, but it is certainly a mistake to conclude that this also means that it is of minor importance. One important consequence of this is that we cannot look for a foundation of interaction design practice in the practice of empirical sciences. Design is not science; its practice is not scientific. Designing things can never be a deductive correlate to empirical investigations. As design involves basic elements of interpretation and aesthetical choices there will always be hermeneutical gaps in all attempts to build a web of quantifiable science covering the design process.

Here is a striking parallel with ‘theoretical’ sciences like mathematics. In empirical studies the results are obtained by ‘scientific’ methods – that is why descriptions of experimental methods, the setups of experiments etc are important ingredients of papers in these fields. We have to convince the reader that the proposed result in fact is true. In mathematics the proof is of course the basic argument that is supposed to convince us, as readers, that the proposed theorem in fact is true. But the proof does not describe how the result is obtained; it shows that the result, the theorem, has a certain property, that of being true. The result is not obtained by derivation, but shown to be derivable. The central components of the process that leads to a mathematical result are interpretations in terms of definitions and constructions. It is much like the general design process where we look for very specific provable properties of these definitions and constructions. As for practice it is not much more scientific than that of design, it rests on intuition, tradition, training, the ability to turn things up side down etc. It rests, just like design, on a shaky foundation.

We design experimental methods and experiments, thus design practice is an important part of empirical scientific practice. We use these methods, rely on these experiments only if we are convinced that they are 'scientific' in nature, i.e. valid as methods to obtain 'scientific' results. How could design be a deductive correlate to empirical investigations when found-ationally speaking, it seems rather to be the other way around somehow?

In interaction design theory it is natural to focus the design circle on the notion of a 'user'. At a certain stage in the design process the 'user' disappears as an empirical collective of people and reappears as a defined concept. The notion of basic acts that define a thing in use is of central importance in the definitions of what to design in interaction design. Here the 'user' is most present, but in order to resolve the circle we have to see that there is as yet nothing to use and thus the 'user' is a concept we have to define and not an empirical population we may study.

In the design process the user disappears in the mist surrounding that something and that someone given…

3.2
THE EMPIRICAL FALLACY

…the idea that use is an activity open for empirical investigations and not a concept we define.

The sirens of empirical science are lurking in the background here; the idea of providing a 'proper' scientific foundation for the design process. It is a fallacy because it overlooks basic problems in resolving the design circles by means of empirical user studies. This is clearly visible in examples such as

> (i) the idea that empirically based user requirements defines the design objectives, i.e. that given, with respect to usability.

Empirical investigations of given 'users' can of course inform the design in crucial ways, but we can not resolve the design circle in this way. There is a hermeneutical gap here. The 'users' behind user requirements are not the users that we define in the design. Empirical investigations of user requirements can not provide a foundation of derivation by usability.

> (ii) the idea that we can prove the design with respect to usability on basis of empirical user evaluations.

People that may become 'real' users of a design are also not the user we define in the design process. So we can not resolve the circle in this way either.

The main problem here is that empirical studies of users do not give us tools we can use to motivate derivations by usability, i.e. empirical behavioural science and social science can not provide a sound foundation for interaction design practice.

The notion of a 'user' and that of 'use', as central conceptual components of the interaction design process, are both basically logical notions we define in the process of designing, i.e. it concerns the form of the acts that define intended use. The design of a car is, explicitly or implicitly, based on some notion of driving. Driving and driver then refers to the way in which the car builds the acts that defines its intended use.

The mere need for, say some means of transportation does, of course, not tell us what to do and how to do it. We need to turn this requirement into a design concept, a design solution, a design suggestion. It is as if the 'user' transcends this process, being the empirical invariant against which we at any given stage can measure success and design correctness. There is something completely arbitrary and contingent about this. It is clear that if we try to meet the requirements of X, suggesting a special sort of vehicle Y as a solution to the problem of transportation, we can ask if this suggestion satisfies the needs of X. But in doing so we have to explain the use of Y to X, i.e. how it functions as a means of transportation, and this means we refer to intended use and the related defined notion of a user; we invite X to become a user. Something happens in the process of designing and X – whether this is a particular person or a given group of people – is not an external invariant with respect to this transformation. As a logical notion, the user we define is absolute in some sense, whereas the empirical user always is accidental. This is a distinction we can not dissolve with reference to empirical user requirements and evaluations.

3.3
THE INTERACTIVITY FALLACY

…the idea that the objective of interaction design is to design 'interactive' systems where the user is yet another component.

The human user as a component of the interactive system we design; we may think of humans as material we use to design the system. This material can then be studied on basis of behavioural science and social science which will give a proper scientific foundation for the design process.

There are several problems in this picture. Even if we could provide an empirical scientific foundation for a study of human 'material' this doesn't give as a key to how to bridge the hermeneutical gap which still is there. So the situation, in this respect, is similar to problems related with the empirical fallacy. But there is also a logical problem here. If the user is a component of the system designed, then questions about usability will reduce to questions about functionality of the system. So there will be no distinction between use and function internally with respect to human components. A 'real' user will always be external to the system. Isn't there a basic difference between function and interaction?

From a more programmatic point of view this idea of the user as a component of an interactive system is also a somewhat strange idea. The user will, like other technical components, be an object that functions in certain ways rather than a subject that expresses intentions through use. This is a picture of the completely "alienated" user *(*cf. the development of critical theory at the Hochschule für Gestaltung in Ulm, *Frampton 1991)*.

As Mark Weiser wrote about the notion of "interaction" in the context of Ubiquitous Computing:

> Over the next twenty years computers will inhabit the most trivial things: clothes labels (to track washing), coffee cups (to alert cleaning staff to mouldy cups), light switches (to save energy if no one is in the room), and pencils (to digitize everything we draw). In such a world, we must dwell with computers, not just interact with them.
>
> Interacting with something keeps it distant and foreign. If you are only interacting with your spouse the relationship may be in trouble. We dwell with nature, and roommates and anything that we let enter us, and we it. Dwelling with computers means that they have their place, and we ours, and we co-exist comfortably. Unfortunately, our existing metaphors for computers (and nature, for that matter) are inadequate to describe the 'dwelling' relationship. And no metaphor is more misleading than 'smart'. *(Weiser 1996)*

3.4 THE HERMENEUTICAL GAP

The hermeneutical gap is the gap between what is actually given and what we actually design; the gap that exists between our present understanding of a given design variable and the interpretation given by the design itself, a gap between analysis and synthesis, a gap between the actual users of given things and the 'user' we define within the design process, a gap between the 'user' we define and an actual user in being. It is a gap that opens up as we draw the different design circles. It is a hermeneutical gap since it is bridged through interpretations in a process of designing; the very meaning of design is that this gap is bridged through an interpretative act in terms of a definition. This is a logical gap, but there is also a historical dimension here; a gap between what in fact is given here and now and the change of meaning that the design will bring about. Or as Jones put it:

> It is still difficult to accept the, by now, rational view that the investigation of existing needs is not necessarily any guide to what people will want to do when new technical possibilities become available. Of what use, to Henry Ford, would have been a market survey of the pre-1914 demand for private cars? *(Jones 1992, p. 33)*

Basic to design practice is the way in which we turn analysis into definition. These hermeneutical gaps of the design process are in some sense hidden within dualities of analysis and definition. To go from an analysis of user requirements, initial design brief, user needs, given tasks etc. to a design suggestion involves the interpretation of analytical information in terms of design choices. This process of turning analysis into definition is a process of defining and the logic of the definition is what traces the way in which we turn, i.e. explains the way in which we bridge the gap and thus motivates the design with respect to given analysis.

In interaction design practice the most obvious gaps are those that concerns 'use' and 'users' in various forms;

- actual users of given things – users as logical entities in the design,
- actual use of things – intended use as a logical concept,
- etc.

In the design process we turn analysis of actual users and use into definitions of users and use which means we change things.

Whereas notions of intended use are central to the design, actual use can, obviously, not come about until the design is finished. Now, what characterises actual use often differs from intended use in that 'users' make their own interpretations and re-appropriations as they start using the thing *(e.g. Akrich 1992)*. It may even be that actual use defies and counteracts intended use to the extent that the object is more or less completely re-interpreted. One such example could perhaps be the use of the turntable as a musical instrument in Hip Hop music: the way it is used to play back sound

by "scratching" the record not only questions the normal hands-off operation aimed at avoiding damage to the record, but also the basic intention of making the device accurately playing back a recorded piece of music. Now, does examples such as the turntable tell us that it is in principle pointless to try to define a design with respect to intended use as it what actually happens as people start using it is beyond our reach? Not necessarily. The use of the turntable by "turntablists" still relates to the basic acts of intended use – though in a radically new way – and so this re-interpretation somehow depends and builds on the logic behind these acts. But it does tell us not to confuse intended use with actual use, as that means confusing what we define in design with what we may predict about its outcome.

It is clear that there is a gap between acts defining intended use and acts of actual use. It is the difference between definition by design and definition by use. This distinction, this gap, this difference is of basic importance for the methodological use of notions such as 'user requirement', 'user test', 'user evaluation', 'user experience' etc.

User requirement: Assume we are in the process of designing a new computer-based medical journal to be used in daily clinical practice. We can now ask medical personnel working at the big nearby hospital what they would require from such a system as a medical journal that would improve daily practice. They are of course 'users' in the sense that they use a medical journal in their actual daily practice and they are also 'potential users' of the new system in being. What we ask them to do is to imagine what a definition by use of a new computer based medical journal could be like and from that draw conclusions concerning central issues in a definition by design. This is a difficult task where blurring basic distinctions doesn't make things easier.

User test: Now assume we have made a first prototype of a module in the medical journal and want to test it. So we ask some nurses and doctors to 'use' the module so that we can test how it works in practice – if this is a controlled experimental test or just some more informal testing doesn't matter here. Since this is a first prototype we test we obviously want feedback into the design process for further improvements. What we try to do here is to 'test' definitions by design through definitions by use. We so to speak try to test if the acts defining intended use make sense in actual use. The gap is quite visible here.

User evaluation: As soon as a first version of the system is ready it can be put into 'use' and feedback for further improvements can be given in terms of 'user' evaluations. What does this mean in terms of the basic distinction discussed here? Is it the 'potential users' testing design definitions through actual use? If so, what design definitions? Is it design definitions implicit in a notion of 'medical journal' underlying daily practice at the hospital? What do we then mean by 'daily practice'? The concept of 'user evaluation' may seem unproblematic from a more pragmatic point of view, but it is from a foundational point of view a very problematic concept. The idea that user evaluations in some sense prove the design is, to say the least, problematic.

User experience: Designing for user experience, designing the user experience *(cf. Mitchell 1993)*. Take the design of modern cars as an example. The idea is that we do not, at least not just, design a car, but a driving experience. The 'users' we refer to is of course future actual users driving the car? But there must also be 'users' in our definition of a driving experience. How do we link these two?

Any derivation by usability depends on references to "users". In design practice this reference will vacillate between definitions by design and definitions by actual use. Circles, circles…

If psychology, ethnography, cultural studies etc. can provide foundations for the analytical components of the design process, the central logical foundation that explains what it means to bridge the hermeneutical gap will still be missing.

4
ACT DESIGN

… the empirical fallacy, the interactivity fallacy; somewhat idealized pictures of rather prominent and recurring themes that raises foundational questions about interaction design. How could we understand 'use', 'users', 'usability' in relation to the interaction design process? What is it really that we design in interaction design, what is it all about? When focusing on use one possible answer is that of act design. This chapter presents one way of dealing with the empirical fallacy.

4.1
ACTS DEFINING INTENDED USE

If the notion of use, as it appears as a central notion in the interaction design process, can not directly be understood in terms of 'empirical' use, what is it then?

As we bridge the hermeneutical gap through interpreting given 'interaction' design variables we introduce acts that define intended use. This is a logical notion; it concerns the form of intended use – what corresponds to the form of correct arguments in formal logic.

When we use a thing the acts of actual use define what it is in use – a definition of what this particular thing is in my lifeworld. These acts are what forms actual use, i.e. it is a matter of performance. The acts defining intended use – a logical construction – shape, form the gestalt of intended use, i.e. use as it is defined in the process of designing. Intended use is a concept, not defined by acts of use, but by act definitions. The logic of these definitions is also the basic formal interaction design rationale.

Let us consider the operating instructions of a typical digital music-player. In the manual we might find headings like "Locating a specific track", "Creating your own program", "Falling asleep to music", "Waking up to music" etc. In themselves these headings

name act abstractions that characterize intended use of the music-player on a rather high level of abstraction. The acts that define intended use are then given by definitions that provide interpretations of these act abstractions in relation to a specific design object.

"Waking up to music" might be defined as

1. Prepare the music you want to play – insert a CD, locate the track etc.

2. Press TIMER/CLOCK to display the time indication

3. Press back/- or forward/+ until "PLAY" appears in the display and press DISPLAY/ENTER

4. Set the timer to the hour and minutes you want the music to go on:

– Press back/- or forward/+ to set hour and press DISPLAY/ENTER

– Press back/- or forward/+ to set minutes and press DISPLAY/ENTER

– Etc.

This definition refers to other act-definitions, like "insert a CD", and atomic acts, like "press DISPLAY/ENTER".

In such definitions we define use and obviously assume a 'user'; Set the timer…etc. An act involves actors and things, tools; someone is doing something with some things. These acts defining intended use obviously interpret that given with respect to usability in some sense, i.e. the way in which the design in fact defines something as useful. The user is often referred to as the one that will use the thing, system to perform some given task or to simply use the thing, system for this or that in a given context. But act design also, more or less implicitly, defines the user as it defines what it is to use the things, systems. In the process of designing, the 'user' is a logical abstraction that is either explicitly defined as we describe a 'user' context or implicitly given by act definitions, inviting us to become 'users'.

Intended use is the concept that defines what a design is as a thing or system to use, but it is also a basic concept that guides the design process. It is what defines that given in relation to use, but also something we define and shape in the process of designing.

In the design of a camera, for example, we start off with general ideas about acts of use that relates to "shooting", "focus operation", "exposure compensation", "flash photography" etc. The design will then provide specific interpretations of these notions of use, not only through technical implementation, but furthermore through of a conceptual framework that explains and motivates the use of the design as a camera.

All this can be understood in terms of act design; a design determine not only a thing, system, but also the acts that defines it as something to use.

4.2
ACTS

With regards to acts of actual use we may make a distinction between

- the act intention, the intended meaning, what I intentionally do acting; open the door, looking out to check the weather,

- the act itself as a formal and expressional entity, the way in which I actually open the door; put my hand on the handle, press it downwards, push the door open, let go of the handle. The way in which I actually do look out to check the weather; how I draw the curtain to one side and look out into the street through the window,

- the act extension, the act result, what I want to accomplish acting the way I do; to let somebody in, to see if I can wear my new garment etc.

That is a distinction between what we do, how we do it and why we do it.

This distinction between act, act intention and act extension is closely related to the distinction Austin makes between locutionary acts, illocutionary acts and perlocutionary acts in his theory of linguistic performatives *(cf. Austin 1962)*.

There are also obvious connections with basic ideas and conceptual schemes in activity theory and symbolic interactionism.In activity theory there is a central focus on the notion of activity as directed towards material or ideal objects and mediated by artefacts, a notion which can be analysed within a three-level hierarchy corresponding to the analytic questions how, what and why; operations, actions, activities. *(Bertelsen, Bödker 2003)* Basic principles of symbolic interactionism sets the notion of act intention in a specific sociological context where interpretations plays a central role in "design by use" *(cf. Blumer 1969)*;

- human beings acts towards things on basis of the meaning these things have for them,

- the meaning of things arises out of, or is derived from, social interaction with one fellows,

- meanings are handled in, and modified through, an interpretative process.

In the process of designing things, systems it is through act definitions we interpret what it is we design, i.e. determine the acts defining intended use. It is these definitions that introduce and interpret basic act abstractions – the interaction design variables.

The distinction between act, act intention and act extension correspond, within the design process, to a distinction between act definition, act abstractions and act rationale:

- Act abstraction; the variables defining that given, i.e. use,

- Act definition; the interpretation of given variables that defines the act in abstractio,

- Act rationale; the explanation, the logic of it all that motivates and guides basic design choices.

Act abstractions refer to the concepts that abstract what is general and common among concrete acts, i.e. sitting, walking, etc. As such they give an interpretation of the act as a concrete expression of action; they represent act intentions. Take the notion of 'running' as an example. In shaping our ways of moving this is an initial act abstraction, but it can also explain what somebody might be doing. In analysis it is perhaps natural to start with what is concretely there – acts, act results – and look for intentions that explains the given, but in the context of design the situation is somehow reversed; in interaction design the act abstractions, the interaction design variables, is what we start with and explanations and motivations are what guide our search for suitable concrete act interpretations.

Act definitions define acts. One way to view this is that it is a form of instructions telling us how to perform certain acts of use; in the manual I can read how to use the washing machine step by step. But they also define acts in a more abstract sense, i.e. the act as an abstract concept. There is a notion of driving this new car that somehow measures my performance when I, following the manual, try to drive the car. In sports wear design we interpret and shape such notions as 'running', 'jumping' etc. Defining an act of running can be to define how to dress and wear specific garment in Track & Field games.

Act rationale is what gives the reasons explaining the logic of act definitions, as well as the initial choice of act abstractions. But, as this also guides the design work, it is an open notion that changes and is being step-wise refined throughout the process from analysis of the design brief to motivation of the design proposal. Rationale explaining an act of running can for example refer to specific expressions of moving garment, i.e. it paints a white streak in the air.

Let us consider the door again with respect to the border between definition by design and by use. The general act intention – to open or close the door – has been given a concrete interpretation in terms of a collection of concrete acts – grab the handle, push it downwards, push the door, etc. – but is does not necessarily specify our intention in doing so. We design the door to allow people to effortlessly pass in and out of a room, but in actual use these acts will sometimes have additional/other meanings: for instance, I might use the door to express my mood by slamming the door shut, I might indicate that visitors are invited to enter my room by leaving it slightly open, etc. Though we define concrete acts by design, this does not mean that we fixate the intention with doing so – concrete acts are often as open to interpretation with respect to general intention and meaning as are 'things'. This is similar to the difference between function and purpose when answering 'what' a thing does.

Acts of actual use mostly refer back to act definitions at hand, in one way or another, thus being consistent with intended use. But act intentions and act extensions might still introduce new act abstractions and a new act rationale providing a re-interpretation of a given act design; the acts, as such, are the same, but intentions and motivations differs. The present use of the mobile sms service is one example of this. This is in turn very different from playing music on a saw, which is straight out inconsistent with intended use. Typical examples of interaction design understood as act design

are methods for playing an instrument; where to put what finger playing a Beethoven sonata as part of a logical system linking act – intention – extension in intricate patterns. Interaction design is here clearly visible as a distinct form of design different from the instrument design itself. Methods for playing have little meaning without an instrument and vice versa, but as designs there is a clear distinction between them.

In other cases interaction design is wholly integrated in an overall process of industrial design, perhaps visible under the headings of ergonomic issues, i.e. when designing a chair we naturally ask questions about how we sit, what we do when we sit and why – what we define is not only a chair as a thing, but also, implicitly, the act of sitting. Consider the Stokke *Variable chair* as an example; a chair where we sit on our knees thus achieving a more ergonomic posture.

The basic distinction between design by definition and design by use is clearly visible in musical practice (or staging a theatre play, the choreography of a dance performance etc.).

In writing music – using a system of notation – we define a piece of music in some abstract sense, but also how to perform it, i.e. how to realize it as "töndend bewegte Formen" *(cf. Glatt 1972)*. This is certainly act design – act design with a foundation in general methodology for performing music and playing certain instruments.

There is an act definition, that at the same time defines intended act result in an abstract sense. There are clearly act abstractions referring to playing and performing. There is an act rationale that motivates the logic of the given act definition and also relate it to the defined music.

The gap between analysis and design can here be visualized in arrows linking intention-act-extension with act abstraction-act definition-act rationale. If activity theory, symbolic interactionism, etc. provide a theoretical foundation for analysis, there is still a challenge to further develop corresponding theories that can provide a foundation for act design as design practice.

Intention – act – extension

↑ ↑

Act abstraction – act definition – act rationale

4.3
FUNCTION AND INTERACTION

If function refers to what a given thing does when we use it, then interaction refers to what we do when we use the given thing. This distinction has its design-counterpart in the distinction between definition of things by design and definition of use by design *(cf. Hallnäs 2004)*.

Consider a modern washing machine. When we use the machine it washes, and so do we. But 'washes'' here refers to somewhat different things. The machine washes the clothes while we manage the machine using some sort of man-machine interface.

The notion of 'interaction' in relation to the use of computational things indicates joint actions between these things and us. Looking up the word 'interaction' in the dictionary we see things like "reciprocal action or influence", i.e. action "given, felt, or done in return". This suggests a complex of actions and re-actions; we do something intentionally directed towards some thing, or someone, and then that thing, or that someone, in turn re-acts. It is us together with something else, or someone else, that acts together in patterns of actions and re-actions.

We act and so does the washing machine, it is a matter of interaction. But, still, what defines this is what we do and the intentions that guides this. It is not really a combination of our acting and machine functionality that makes up what we do. We use machine functionality when we wash, but that might to a large extent be hidden and implicit. So there is a natural distinction between what we do and what the machine does. Interaction then is what we do as we use the machine, which includes all sorts of patterns of action-reaction visible to us.

The example of shutting down the computer by starting a program in the START menu in a Windows interface is also a canonical example. It is clear that what the computer does is shutting itself down, but is it that what we do? It is certainly a difference between starting a program that shuts down the computer and shutting down the computer, a difference that is essential for the way in which we design the interface.

Corresponding to this there is a natural distinction between function analysis and interaction analysis.

4.4 INTERACTION CALCULUS

Interaction design as it is recorded in manuals, tutorials etc. can, in various ways, be studied and discussed more formally *(cf. Dix 1991)*. The issue is then to discuss formal and logical matters in more detail as well as to develop foundations for conceptual frameworks we can use to describe and communicate interaction design matters; to discuss the logic of a design, to support more formal reason within the design process, i.e. a formal design rationale *(cf. Moran and Carroll 1996)*.

The main issue here is to make logical matters more visible in interaction design aesthetics and to provide a model of act design. When introducing formal notions it is essential to find the right level of abstraction. In a too detailed model we easily get lost in a jungle of formal nonsense, a too general conceptual framework makes the model weak. What an interaction calculus, like the one sketched below, gives is the foundation for more formally precise discussions about the logic of act definitions on a rather abstract level with a conceptual focus on the duality between open and closed acts, open and closed designs.

Throughout this text we emphasize that a design, as a logical entity, essentially is a definition. In interaction various actors act through actions – reactions. The actors being people, machines, animals, things etc. Any action can be a reaction and any reaction is of course an action. For this to make sense actions must always be something 'visible' to all actors, internal functionality consequently does not count as actions in this context; what we do here is to define interaction.

We may think of act design as definitions of actions in terms of a collection of reactions

a = (A1,…,An)

i.e. in the definition **a** defines **A1**,…,**An** as, possible logically complex, reactions.

Actions are atoms and can be given at any level of abstraction. For the purpose of making this clear in detail through some examples we use a calculus of definitions developed elsewhere and for somewhat different reasons *(Hallnäs 1991)*.

A definition D is a collection of equations

a =A

where **a** is a given atom and **A** a defining condition built from atoms using the following constructions

True – true by definition, here indicating that an act is closed,

False – false by definition, here indicating that an act is open,

(A1,…,An) – a list of conditions,

A ⇨ B – the conditional condition.

D(a) is the collection of conditions defining **a** in D – we assume that D(a) always is non empty.

Given a definition D over a set of atomic actions U. The logic of D is given by a notion of consequence, (T:A), inductively defined as follows

(T,a:a),

(T:True),

(T, False:A),

(T:(A1,…,An)) if (T:Ai) i ≤ n,

(T,(A1,…,An):B) if (T,Ai:B) for some i ≤ n,

(T:A⇨B) if (T,A:B),

(T,A⇨B:C) if (T:A) and (T,B:C),

(T:a) if (T:A) for some A in D(a),

(T,a:C) if (T,A:C) for all A in D(a).

The idea is here that (T:A) describes the logic of a design, i.e. how actions and reactions logically connect to each other; (a:b) means that given the action **a** we can derive the action **b** in D. D is then an act definition based on some collection U of atomic actions – where Cond(U) denotes the collection of defining condition constructed from U using the constructions True, False, (…), ⇨.

Actions, in U, are definitional variables with regards to a given act definition.

a = True

means simply that **a** is completely described in terms of its meaning as an atomic act, i.e. it states a closed endpoint of an act. Assume we buy a ticket using a ticket machine. Designing the interaction we assume an action like "take the ticket" to close the act of buying a ticket using the machine, i.e. "take the ticket" = True. Logically speaking we state that this action – within the design – is true by definition; it is a closed endpoint, the act is complete.

a = False

on the other hand indicates an open endpoint in the design, i.e. there is no information about the meaning of **a** within the design. **a** is logically speaking false by definition. Say we design a washing machine. The very idea here is to relieve us from work. Thus a typical open endpoint is "press start" ("machine starts"). The intention here is of course to start the machine and the extension to get the machine going. Within the act of washing this is an initial action and not a closed endpoint. It would also be bad design to define the action "press start" by a reaction "wait until it stops". What we mean is "now forget about the machine and do other things". To say "you are free to do other things until the machine stops" is also misleading as it indicates that there is a free action bounded by the running time of the machine which goes against the very idea with these sorts of machines.

If "start machine" is an open endpoint, then the question is how we define the action "open machine"? Given that "start machine" is an open endpoint it would perhaps be logical to define "open

machine" in terms of "if machine stops and …, then open hatch"

open machine = machine stops,… ⇨ open hatch

which gives an example of a conditional defining condition. If we prove (True:open machine) that would indicate that "machine stops,…" is logically connected to "open hatch" – which we would assume from a "smart" washing machine. In that case "open machine" is a closed endpoint. If we, on the other hand, prove (open machine:b), for some action **b**, then that indicates that **b** is some sort of reaction connected to "open machine".

For the washing machine it might seem easier to just define "start machine" as a closed endpoint

start machine = True

Many instruction manuals that accompany consumer products are formulated that way, as a collection of complete descriptions. To "start" perform this series of actions, to "stop" perform that series of actions etc. One reason for this is perhaps that interaction design here in many cases is seen as a step-wise derivative of technical function analysis. But interaction problems are in general a bit more logically complex than that.

(True:a) means that **a** is completely determined, described, in D logically speaking. The typical example is acts defining the use of, say, a parking meter

pay = press button

press button = machine delivers ticket

machine delivers ticket = take ticket

take ticket = True

A series of actions where the reaction is the "next" action.

(a:False) means that **a**, logically speaking, is completely undetermined by reactions with in the given act definition, i.e. all logically necessary consequences **B** of **a**, (a:B), are trivial in the sense that everything follows from a.

(a:b) means in general

assume an action **a**, then that entails the action **b** within the given logic of intended use,

to prove an action **b** within the given logic of intended use it is enough to assume the action **a**.

A complete description of an action **a** with respect to a given design mean there are no loose – open – endpoints in the definition of **a**. Thus we may think of

{A | (a:A)} as the open cover, O(a), of a,

{A | (A:a)} as the closed cover, C(a), of a.

If **a** is open, then O(a) = Cond(U), and if **a** is closed, then C(a) = Cond(U) for the given collection of atomic actions U.

A typical mobile phone interface could be seen as defining a series of step wise actions all ending up either in

press yes = True

or

press no = False

Continuous interaction with a computer could be seen as defining acts with no closed or open endpoints; it is an "infinite" act of use where there is always a connection to some further actions.

If a design is intended to have open endpoints and in interaction we behave as if we constantly wait, there must be some mismatch between intended use and the construction of technical functionality interpreting given interaction. For a continuous interaction we probably think of an action like "press send" as

press send = computer confirms

and then

computer confirms = computer confirms

which means we merely say that "computer confirms" is neither an open endpoint nor a closed endpoint of the act we engage in.

An action is defined in terms its reactions. This means that there is an implicit direction here; from action to reaction. Assuming **a** means that we unfold the definition D to see what reactions the action **a** entails; assume I perform **a**, then what…

Proving **a** on the other hand means folding D to see what actions **a** defines as reactions; given an action **b** performed, what other action defines this as a reaction…

It is a matter of dual readings that explores the logic in different ways where the conditional construction switches between them. To the right of (T:A) we fold the definition; we read conditions conjunctively. To the left of (T:A) we unfold the definition; we read conditions disjunctively. Reading an act definition in terms of unfolding is perhaps natural in some sense in view of the inherent direction from action to reaction. This means that we then read (A1,…An) disjunctively in

a = (A1,…,An)

while (A1,…,An) conjunctively and (B1,…,Bn) disjunctively in

a = (A1,…,An) ⇨ (B1,…,Bm)

etc.

As 'pure' interaction design this is still rather abstract. For all this to make sense in concreto the functionality of the things we design must interpret this logic of use in a meaningful way. (Here is a vast area of theories and studies in psychology, ergonomics etc. on design issues, i.e. theories and studies related to feedback, affordances.)

It is clear that a definitional calculus like the one sketched here can be used to link function analysis and interaction analysis. Formally defining function and interaction results in two definitions that we can link through action-reaction equations.

Let us consider acts partially defining the use of a camera as an example. We assume the following given actions

SOC – switch on camera

SFC – switch off camera

AF – adjust focus

SA – set aperture
PSW – press shutter release button halfway

PS – press shutter release button

CVF – check viewfinder for focus information

CVT – check viewfinder for shutter time information

CL – check LCD screen for shutter time information

Now consider the following definition

SOC = SOC

PSW = PSW

SFC = True

AF = CVF

SA = CVT

SA = CL

CVF = (F,OF)

CVT = (SOC, PSW) ⇨ (PLUS, MINUS, ZERO)

CL = (SOC, PSW) ⇨ (1,…,1000)

SOC is neither an open nor a closed endpoint. SFC is a closed endpoint, we close the act of using the camera by switching off the camera. The reaction to adjusting focus is checking viewfinder for focus information. The reactions to setting the aperture is checking the viewfinder and checking the LCD screen, both with respect to shutter time information. The reaction to checking the viewfinder for focus information is F (in focus) or OF (out of focus). The reaction to checking the viewfinder for shutter time information is PLUS or MINUS or ZERO provided that the camera is switched on and the shutter release button is pressed half way. The reaction to checking the LCD screen for shutter time information is 1 or,…, or 1000 provided that the camera is switched on and the shutter release button is pressed half way.

This reading of the definition clauses is based on the duality introduced by (T:A). Explaining the meaning of the definition of CVT we read (SOC, PSW) conjunctively and (PLUS, MINUS, ZERO) disjunctively unfolding the definition.

Now assume we define "take photo", TP, in the following way

TP = ((AF ⇨ OK),(SA ⇨ OK)) ⇨ PS

We then define "values" for checking focus and viewfinder shutter time information

OF = OF

F = OK

PLUS = PLUS

MINUS = MINUS

ZERO = OK

And for a specific situation we might set "values" for LCD screen shutter time information

125 = OK, … ,1000 = OK

It is then clear that TP entails PS assuming SOC and PSW. With reasonable assumptions it is also clear that for such a proof we have to prove both (CVT:OK) and (CL:OK). This means that TP, logically, presupposes that we check shutter time information both on the LCD screen and in the viewfinder. This is then a rather strong characteristic of the form of interaction. It might indicate inconsistencies in design or a camera design assuming a tripod where off-camera control of scene is important.

To describe interaction in terms of a definition D is one way to make the notion of intended use formally precise on a suitable level of abstraction. It is also a valuable exercise in checking complexity and logical coherence of a design.

5

COMPUTATIONAL THINGS

…when focusing on the design of computer based products and systems one possible answer is that of design of computational things. This chapter presents one way of dealing with the interactivity fallacy.

5.1
COMPUTATIONAL THINGS

The idea of interaction design as a subject and practice in its own right has its roots in the design of computer based products and systems with a specific focus on use, e.g. designing the user interface etc.

When designing computer-based products there is a special interest in the way in which use of a product depends on the execution of programs, which to some extent defines use itself. The products and systems we design are computational in nature; they are computational things.

This notion is found in the literature in several forms. Suchman uses the term "computational artefacts" *(Suchman 1987)*, Lars Erik Janlert introduced the term "computer things" *(Janlert 1993)* – this is the literal translation from the Swedish term "datorsaker". To point out what they are as we meet them in daily life – what they are in our life worlds – we prefer to mix these two terms and talk about computational things. It is a matter of things that in an essential way are computational in nature. What we directly see are things, that they are computational in nature is perhaps more hidden, but something that is essential as for what they are; for the way in which we use them and they us, for the way in which they present themselves to us *(cf. Akrich 1992)*.

Such things are not more 'interactive' in nature than an ordinary door or an old-fashioned electric floor lamp. We use them and they us, but there is nothing particular about that which makes them special in relation to other things, What makes them special is the way in which computational technology builds them as things, just as there is a difference between my acoustic guitar and my electric guitar.

The digital cameras, the CD- and DVD players, the Mp3-players, the digital pianos, the modern cars… Typical examples of computational things; they are all new things and yet the digital camera is a camera, the CD player is a record player, the digital piano is a piano, that modern car is a car etc. Is it just that we use modern technology to construct and implement things in a new way? The digital piano is not just a piano, but also a harpsichord. By pressing a button we change it from a piano to a harpsichord or a vintage electric piano. The digital camera gives us the pictures almost at once; we just connect the camera to the computer and download the picture files. Is that all? Redesign through modern technology. Technology that vanishes into the background becoming invisible to us in use, only as it breaks down we notice it is there…

What does it mean to 'redesign' things as electrical things? From an acoustic guitar to an electric guitar, from the old fashioned toothbrush to a modern electric toothbrush…

Electricity is there all around us, we don't think much about it we just use it…just like the Herzian space we live in. That may be so, but there is also something misleading about this picture. Electricity has certainly changed basic expressional properties of 'given' things, it is certainly very much visible in the foreground through its various expressions *(cf. Dunne 1999, Dunne and Raby*

2001); it is not just that I use electricity when I play my electric guitar, it is also a way to express electricity. This is something that is most explicit in the process of designing, constructing things. The same is true of computational things, they express computational technology in use.

When we design a machine we do not only build a thing, but we also give an interpretation of some sort of activity. This is one of these conceptual circles; new design is based on some activity, which it will give a new meaning to.

The introduction of computer-based products will change the meaning of various activities; it is not just a matter of redesign of given things through modern technology. The CD changed the meaning of music listening; the digital cameras certainly changed the meaning of photography etc.

It may seem as if the introduction of the computational material into an existing object category often is less radical than, say, the use of electronics and amplifiers to re-design the acoustic guitar into an electric guitar as used in rock music. Perhaps we think that we just substitute a mechanical solution for a computational one. But consider, for instance, the digital camera and how using it differs from film-based photography: though the devices themselves might look almost the same, looking at someone taking a picture will reveal what kind of camera they are using, e.g, through the positioning of the camera in relation to the eye (as digital cameras typically have much better displays at the back than in the conventional viewfinder, and so many of us seem to be looking at that one rather than the viewfinder). Further, as the picture has been taken, friends might gather round the cameras to take a look at the picture – the corresponding act when using a film-based camera would take place much later and only after the

film has been developed and then printed. And so on. The digital camera provides an illustrative example of how the acts that define a thing in use have been transformed by computational technology to the extent that the practice of taking and sharing photographs has been fundamentally altered. Further, it is probably not unfair to assume that some of this change is more or less accidental and due to technical innovations rather than conscious aesthetic decisions about how the 'new' camera should appear in use.

Computational technology is central to the interaction design practice. Not mainly as a methodological tool, but as the basic technology that constructs the things we design; it is what builds these things as computational things.

In the design process we define how material shapes things, builds things. We have to know the material, how it builds, its expressiveness etc. That involves processes of construction as well as general understanding of basic materials as design materials. Viewing interaction design as design of computational things this puts focus on programming, electronics, mechatronics etc. as central processes of construction and of computational technology as a design material. *(Cf. Löwgren and Stolterman 1997, 2004.)*

5.2
COMPUTATIONAL TECHNOLOGY IS A DESIGN MATERIAL

A traditional view of materials is that of stationary matter that we use to shape, build and construct things; typically steel, concrete, wood, clay etc. Gasoline that in use depend on some chemical reaction is then usually not considered to be material we use to build a car for instance.

In design and especially in interaction design where acts of use are in focus this is a rather limiting view and also a very unpractical one. In design practice it is essential that we know the expressiveness of the material we work with and if we use a rather narrow view on what is and what is not material we may fall for the temptation to reduce important design decisions to be of a more neutral technical nature, i.e. we may leave important aesthetical decisions open to be consequences of pure technical considerations. When we refer to materials as components this is often a clear indication that we think of a technical solution with respect to given functionality rather than material that with a certain expressiveness builds given things through central defining acts.

Take a mobile phone and ask yourself what material builds it. Nothing could, from a design perspective, be more wrong than to answer that it is built out of metal, plastic etc. If form is the way in

which material build things and aesthetics in some sense is concerned with the logic of expressional appearance, then this would suggest that the aesthetics of a mobile phone stops with a box containing some electronic circuits. The rest – which is really what makes it into a phone – is then a matter of neutral technology?

It is clear that if we widen the notion of material to cover all sorts of things and phenomena that in some sense build things, then the question of what material we really use in the design process turns into a somewhat difficult problem. But a struggle with this question is a very useful methodological exercise in an overall effort to spot all the central aesthetical choices we have to make, i.e. all those decisions that are central to the expressional appearance of the design, its form; the way material builds the thing.

We may tackle the question of materials in the design process by frequently asking ourselves what it is that builds the things. It is for instance clear that programs builds a mobile phone in use, thus programs are material. It is also clear that the mobile phone itself builds the acts that defines it in use, thus the mobile phone itself is material. So the notion of design material is of course not an absolute notion, but depends on a given perspective. This is the case for instance when we speak of a collective of human individuals as constituting good material to form a football team out of. We speak of sports equipment as material in the same sense as we may speak of mobile phones as material etc.

What is computational technology as material?

It is what is needed to build programs, mechanisms to execute these programs, interface mechanisms and technologies to display the execution of programs.

A piano reveals itself as a piano when someone plays it. You press a key and a hammer strikes a string, oscillation of the string sets the air in motion and we hear the sound of a piano. The key, the hammer, the string, the oscillation of a string builds the piano in use: its material. Now take a PDA. You press a couple of buttons to look up a telephone number. A list of names is shown on the LCD-screen. You point on one of the names with a PDA-pen and a page of information is shown. One way of describing this is that you start the execution of programs, that are displayed on your LCD-screen in terms of lists of names and pages of information about specific people. Given this description of what is going on, what is material here? What builds the thing as we use it? An LCD-screen, IC-circuits, plastic housing, an LCD-pen, electric current, programs, program-executions, etc.

Consider a lamp. It may be clear that plastic, metal are materials that build the lamp. But essential to its appearance is also the way it illuminates the room, thus the flow of electricity is something that builds the lamp, i.e. it is material. In the same manner the flow of program executions build the PDA and are thus material.
From some specific philosophical point of view this may be considered as immaterial. But it is clearly something essential that builds the appearance of a computational thing and thus from a design perspective it is material.

How do we use this type of material in the design process? We set up a mechanism for the execution of programs, a hardware interface and we write program code to be executed. The material we really work with in the design process is best described using the term "computational technology". The material itself that really builds a thing as a computational thing shows itself only in actual use.

In music the flow of tones in time is material that builds the actual

appearance of a piece of music. When composing music, in contrast to 'real time' improvisation, we certainly work with this material but only in a sort of abstract manner – the actual compositional traces left are written instructions on how to perform the music, how to build its appearance.

To set up these instructions we work with music technology helping us to work with a material that in a certain sense is absent most of the time. This makes it different from wood, paper etc.

As design material computational technology is material in the same sense as compositional technology is material in composing music. When we test a computational thing we execute programs to have look at how the material builds the given thing.

Similarly, when we during the composition-process try to play parts of the music on a piano we try to listen to how the material builds the composition. Here is a main difference between designing computational things and designing things where the basic design material is textile, wood, paper, plastic etc.

When a piece of music or a computational thing appears and presents itself to us the material that builds them is actual and real, it is there building the things. But in the act of composing music or designing computational things the material is in a certain sense absent, it is conceptually present; it is conceptual material.

What we really work with is technology that represents and conceptualizes the real material. In the case of computational things it is programming code, mechanisms for the interpretation of program code etc. It is the elementary technology that implements a basic notion of computation and its appearance in space and time.

But just as music depends on instrumental performance a computational thing depends on spatial material for its appearance. Interaction design thus involves a subtle combination of shaping in space with composing in time.

> Design-by-drawing, the traditional design method, depends almost completely upon accurate modelling of dimension in space. The time dimension, if we may call it that, is left to take care of itself. As the scale of designing is increased (from the designing of objects to the designing of systems, programs, flows, communications, communi-ties, and the like) the way things are used, their life-cycles, become as much designed as do their shapes. At this point designers need to acknowledge their relative ignorance of "temporal design" and can perhaps learn from the "time arts" (music, dance, theatre, film, novel, poetry, etc) how to compose-in-time with some sense of beauty. To design in time is, more so than when designing objects, to design life itself, the very form of existence, and surely calls for a gentler touch than can be felt in the insensitive forms of our production-systems, legal-systems, timetables, schedules, distribution-systems, etc." *(Jones 1992, p. xxxii)*

How could we expect to make advances in interaction design practice, that is the design of computational things, without developing our feeling for this subtle combination of shaping in space with composing in time in relation to programming?

A central feature of any composition-in-time is rhythm – "the effect created by the elements in a play, movie, or novel that relate to the temporal development of the action" *(Merriam-Webster Online dictionary)*. Most things we do that involve bodily movement there is some kind of rhythm involved. When walking

or running, rhythm partly comes from cyclic behaviour. Also in single movements, such as when I reach out with my hand to grasp a glass of water standing beside me on the table, there is a certain rhythm to what I do. Due to certain physical constraints, I can only move my hand so and so quickly, in such angles, etc.

That physical properties of materials we use impose rhythm is also evident in the design of tools. When I choose what hammer to buy, I try to find one with the right balance, the right weight and weight distribution, that helps me hit something with precision with respect to the force and motion I'm comfortable with. In other cases, not only the material but also form has been designed to impose a certain rhythm. Different kinds of bicycles have different (sets of) gearwheels depending on what speed it is intended to be ridden in. Another example is the layout of the qwerty-keyboard as it originally was designed to prevent too fast writing that would result in types getting stuck in each other.

While it holds for most ordinary things that they impose rhythm, this is not necessarily the case with computational things. The only characteristic aspect of computer use related to rhythm is perhaps the occasional waiting we have to cope with as a program starts, a file is being saved, etc. Using a mouse or a keyboard also introduces some rudimentary rhythm in that they involve the movement of your hands (although within a very limited area). In general, one might say that most of the aspects of computational things that might impose rhythm has been eliminated: the screens we use have update rates faster than our eyes can perceive, we sit still in a more or less fixed position at our desk as we use them, etc. Besides this rather extensive lack of rhythm with regards to properties of the material used, there has also been a general ambition of reducing everything that might decrease speed in the use of computers. This principle of taking away as much time as possible in order to create efficient tools have often resulted in a very non-sensitive approach to the rhythm of computational things in use. When we think of time only in quantitative terms, we miss the subtleties of rhythm that are so important in everything we do. Thus, a more sensitive approach to the use of rhythm in interaction design is needed.

As we broaden our scope from designing for screen-based interaction and move towards thinking about computational technology as a more general design material, there are many possibilities for working with imposed rhythm using properties of materials. A great potential for investigating and using rhythm in interaction design lies in the combination of the temporal qualities of computational technology with the spatial qualities of other design materials.

Thinking about computational things as temporal gestalts presented on some spatial surface (in a broad sense of the two), it is clear that we can investigate different combinations of temporal structures with specific material properties of the spatial surface we are using. In the case of CRT-screens, we work with the physical properties of the cathode-ray tube to create certain expressions; questions such as refresh rate, pixel resolution and density seem important. In case we would use some other surface as 'display' other physical constraints would be introduced. Using for instance a speaker as a 'display' our information will appear as sound; questions regarding frequency spectrum, sound intensity and range seem relevant.

We can also experiment with other materials – what would it mean to build a display using concrete? Until it dries, new things can be introduced but once it grows stiff, what is there will be kept until the thing is broken. This material, concrete, certainly has a number

of physical properties that will affect what temporal structures we can manifest. What would it mean to build a display using air currents, or temperature variations in a room? By investigating how different materials can be used in the design of computational things, we open new possibilities for imposing rhythm in interaction design. And when we combine the possibilities with crafting temporal form inherent in the computational material with the properties of other design materials, we find very rich possibilities for expressive design.

5.3
PROGRAMMING, PROGRAMS

The notion of intended use refers to act abstractions that we, in one way or another, interpret in actual use. Typical for the computational material is that we partly inscribe intended use in things by programming. Interpretations in actual use will of course depend on these inscriptions, even if we completely reinterprets given things in relation to intended use. Actual use of computational things depends on program behaviour. When we for example try to check products with respect to program correctness in relation given specification of intended behaviour we, in some sense, check the form of computational things. Akrich uses the term "scripts" to describe this phenomenon *(Akrich 1992)*.

After the introduction of modern computer based cruise controls in cars, car manufacturers all over the world have from time to time been worried about correctness of cruise control systems with respect to intended behaviour. Software correctness depends on good specifications for development and checking. To produce such specifications is essentially interaction design with focus on computational technology as design material.

Design in general links basic research in science and engineering with product applications. Interaction design more specifically links basic research in computing science and computer

engineering with computational product applications: as we design a cruise control for a car, for example, we express both 'cruise control-function' and 'cruise control-interaction', i.e., what the control should do when it is used and what we do as we use it. This means that we conceptualise a product, a device we can use when we drive a car and derive certain technical specifications that link technical/scientific questions with expressions of use. The question about program correctness, for instance, only makes sense with respect to a given specification. This specification has its foundation in the intended function and use of a given product. Thus the specification link program correctness with expression of use. Ignoring program correctness in this case simply means ignoring the aesthetics of use, i.e., the expressional logic of use. A basic question is then how does interaction design in general link the aesthetics of use with basic issues of program correctness:

The modern computer based counter in super markets has introduced a specific asymmetric rhythm in the rituals of counter interaction that depends on waiting for transactions to be completed and a receipt to be printed out by the machine. Waiting is here a central form of interaction that initially must be something of a design bug, i.e., the aesthetical consequences of certain seemingly 'neutral' technical choices seem to have been overlooked. This example points at a 'missing' link between a product application and basic research in computing science and computer engineering. This is also where interaction design should make a difference. So, how does interaction design in general link the rhythm of work with basic issues of, say, distributed computing?

Algorithmic behaviour, the execution of programs is what characterises the way in which computational technology builds the use of computational things. Programming is a process of forming algorithmic behaviour. A program works on data with a certain internal structure. As we use computational things we handle data: when we press a button, activate a sensor or whatever we initiate the execution of programs producing data to be further processed. Computational technology gives us a very rich and expressive material to express intrinsic interaction (design) form in terms of computations over internal data structures representing basic interaction data. As we build digital products we use programs to formalise function-interaction patterns and to more or less indirectly formulate fragments of a logic that builds the 'instruments' to perform the acts that define intended use.

When we view computational technology as a design material we acknowledge its expressiveness as a material that makes a difference in terms of expressions and meaningfulness.

In order to make sense of the design links between basic research in computing science/computer engineering and product applications, we have to widen our views; using computational technology to implement 'technical' functionality we have to acknowledge and try to understand consequences with respect to the expressions of usability.

5.4 FUNCTION AND BEHAVIOUR

If function refers to what a thing does as we use it, behaviour then refers to how. The idea of computational things as interactive products certainly refers to a specific acting behaviour; we act as we use these things, they themselves show a certain acting behaviour and acting together is a matter of interacting. This metaphorical picture entails distinctions that become somewhat difficult to handle at a closer look; why is the TV set acting and the floor lamp not, why is my modern car, that mobile distributed computer system, acting more than my former old, all mechanical, car? There is a basic distinction in behaviour, but that concerns computational behaviour and not acting behaviour.

If there is a basic distinction between my old, all mechanical, car and my new computerized car with respect to computational behaviour how does that show? Within the design- and construction process the distinction is more than obvious; the design and construction is just basically different. If we look under the hood with the intention to repair the car the difference is also more than obvious. But if we, revisiting behaviourism, ask for the visible behaviour that makes the distinction; what is it? Maybe this is the wrong question to ask.

Perhaps this situation can be compared to when we use new materials to imitate old ones, e.g., as when we use plastic imitations of leather or wood. When successful, when we do not detect such imitations, there is no perceivable difference between the imitation and original. Yet, we do think the distinction is valid and when, say, buying a product it does seem to matter what materials were used. One reason is what happens when the thing ages and generally changes through wear and tear. Under the identical surface, certain differences exist that motivate us to shift from describing the thing in terms of how it looks or behaves to be specific about what materials are being used as this says something about what might happen over time or when the thing gets broken.

Something related could perhaps be said about computational material. Driving a car with a completely mechanical engine compared to a computer-controlled one may seem almost identical at first, but these are certainly two different things when performance degrades, e.g., when the engine is very cold or damp. In such instances we might, just as when comparing a thing made from plastic and leather respectively, turn towards the materials used to understand and relate to what is going on and what might happen next. But this is not like asking for the visible behaviour that makes the distinction valid; it is a shift in attention towards the materials used and the expressions that define them in use.

PART 2

EXPERIMENTS

6
INTERACTION DESIGN RESEARCH

6.1
OBJECTIVES

What is design research? Obviously this question has many answers. Not only because these types of questions *(quidditas)* are difficult ones, but also because we can mean very different things. It can be research about design practice, just as musicology is research about musical practice. In that case the objective is of course to obtain knowledge about design practice; it can be in the form of design history, design aesthetics, the sociology of design, the psychology of design etc. But by design research we can also mean systematic experiments, theoretical reflections, etc. aimed at developing design practice itself. Typical exponents of design research in the latter sense is, the by now "classical", *Design Methods Movements (e.g., Cross 1984, Jones 1992)*, the *Scandinavian approach* and *Participatory Design* movements *(e.g., Bødker et. Al. 1987)* and areas such as *product semiotics (cf. Bense 1971, Monö 1997)* as well as ideas of a "science of the artificial" *(Simon 1996)*. Such dwelling on central matters of practice within practice itself is of course something that always is, more or less, present in all kinds of human practice. But it is not always we call it 'research', it is not always we publish our 'results' in scientific journals or at scientific forums.

So what did Bach for instance present as he 'published' *Die Wohltemperierte Klavier?* What is it that we publish as we print

Das Kunst der Fugue? What did the composers and musicians do at the Darmstadt meetings after the Second World War? *(cf. Stockhausen 1963, 1964, Xenakis 2001, Die Reihe 1955-1962)* What is Sergei Eisensteins book *Film Form (Eisensetin 1969)* all about? Etc. Is music theory, film theory, theatre theory, art theory in this sense the outcome of research?

Perhaps it is better to just cross out the word 'research' and make a distinction between design as an academic subject and design as work practice. It is clear that systematic experiments and theoretical reflection have their natural place in art and design as academic subjects. The important distinction seems to lie in a difference of objectives; musicology does not primarily ask questions to develop music practice, musical experiments and theoretical work on new composition methods aim on the other hand to just that.

The basic distinction between "design research" in the first sense – research about design – and in the second sense – systematic work to develop practice – is then seen in the questions asked and the reasons for asking them. But there is of course also a question about the type of knowledge obtained. What does it mean to develop practice as opposed to understanding actual practice? In a psychology of design we measure results by standards of psychology as a science, but by what standards do we measure suggestions for new design methods? The obvious answer is that we try them out – but perhaps this answer is a bit too hasty and too obvious… Perhaps it is wrong to talk about 'results', perhaps the idea of making this type of comparison is wrong… The suggestion for a new design method of some sort is the answer to a question asked in the context of developing design practice. It is not a result – in the sense of an answer to a scientific question – but a suggestion on how to change practice. Such a suggestion is of course not true or false – it might for sure be good or bad in a given context – it is rather suggestive or in-suggestive. This means that what we do is to show the possible in more or less systematic ways – in contrast to prove what is true or describe the actual. And what counts in the end is change in practice. It is clear that there is a difference in epistemology here, a difference in methods, difference in the meaning of experiments etc. *(Cf. Cross 1999, Glanville 1998, Grillnert, Ståhl 2003, Jones 1998, Owen 1998, Roth 1999, Seago, Dunne 1999, Swann 1998, UK Council for Graduate Education 1997).*

Is this science? Certainly not in the sense of natural science or in the sense of social science. It is simply not "knowledge production" in this sense. In the area of experimental design we do not perform experiments to obtain quantitative results. The status of empirical studies, quantitative as well as qualitative, within design research in the second sense, is also a difficult subject. The idea of verifiable knowledge about the design process, validated models and working methods etc. is simply wrong here. It is a different situation, we find ourselves so to speak on the opposite side; in some sense it is research through defining in contrast to research through analytical studies. It is like the difference between studying how people open a certain door and experimenting yourself with different ways of opening that particular door. In both cases we could say that it is research in answering to a question about what it means to open the given door. In the first case it is important that your studies rely on sound methodology, as you presumably want to derive some general knowledge from your work. In the second case the situation is different. A good method for opening the door is what you want to find through your experiments. The aim is not to derive general knowledge about door opening practice, but to define, to suggest, a particular way of opening that door. As for methods of conducting research it is not only that "anything goes" *(cf. Feyerabend 1975)*, but also that it is inherently difficult to say something precise about successful methods in advance, we might guess of course.

To change practice we must first understand practice. Some would claim that it is here we find the link between design research in the first and the second sense, between musicology and music practice etc. But some other would certainly object saying that it is a matter of different questions and a basic difference between understanding from within practice and from outside of practice. When we use the term 'design research' in what follows it is this practice based design research we refer to, i.e. a from within perspective. A perspective, although practice based, that in some strange sense is of a much more theoretical nature than that perspective which is based on empirical studies of given practice.

6.2
METHODS

The idea that science or a scientific area can be defined in terms of a collection of given methods, a given methodology is very strange. It is the results that count, i.e. it is the questions that define the area. As for methods "anything goes". That we always practice science in a given tradition full of methods and 'acceptable' ways of doing things is another matter. Once an area is established in a sort "normal science", main-stream research will define the normal way of doing things.

Although this certainly is true also for practice based research there is also something peculiar here. In practice based research we dwell on practice aiming to develop and change practice itself, it seems as if practice itself is a dominant method in research not by tradition, but by definition. 'Results' does not come in form of knowledge about things at hand, but in the form of suggestions for change of a present state, suggestions for a change in how things are done *(*cf. Jones on design as the initiation of change in man made things *(Jones 1992, p. 6))*. 'Results' will here always refer to methods of practice in some sense; methods are in research focus. Suggestions of change will always refer to 'new' ways of doing things, it can be a matter of very specific methods, general guidelines, new programs for practice, new material to work with etc.

In design research questions come from design practice and we answer them by suggesting a change in practice.

Design is above all about practice, about the work we do as we try to "change the state of man-made things". We search for foundations that can help us deepen our understanding of the problems at hand, and given the central role of the situation at hand, we are sometimes willing to borrow methods and approaches from a diverse selection of areas as we collect as rich a toolbox as we can and need.

Interaction design is often referred to as "interdisciplinary" or "multidisciplinary" because of its collection of methods and approaches from both engineering and behavioural sciences, from traditional design areas and art. As we search for a sound foundation for interaction design as it develops beyond initial fascination of new design opportunities, the question of how practice relate to theoretical foundations become increasingly important. Just as theoretical foundations can help us reflect upon certain things (as well as help us forget about others), so does the methods and design programs we use.

To probe this question, let us assume that a given method is composed of (at least) two parts: one describing what we do, one describing why it makes sense to do it that way. Consider a method for brushing teeth: start brushing upper front left, move to the right; switch to up, right, back and move left, switch to up, top, left and move right, etc. Now, this clearly describes as structured way in which all my teeth would be brushed and there is also a rather strong logic to this structure that makes the procedure easy to remember and perform. There are of course many other ways of structuring tooth brushing to ensure that all teeth get cleaned but the logic motivating them might differ. Thus, it is not hard to come up with methods that ensure all teeth will be brushed but that do not make sense in terms of their motivation (for instance, due to too high complexity). Thus, there is difference between 'what' we do and 'why'.

When it comes to methods embedded in practices, be it scientific or professional ones, the 'what' question is often much more present in everyday reflections upon the methods we use. We might frequently ask why a certain method was chosen, but issues related to the very logic of a given method is often hidden in the shared understanding of the frameworks our practices (in ways far more complex than how common sense grounded the tooth brushing example). And it is precisely this that is the role of frameworks and foundations: to provide that ground on which our practice can rest. In other words, what a foundation provides is a basic set of reasons that explain, motivate and answer basic questions regarding the logic of our practice.

These foundations do not only help us structure our work, taking some of the pain of coming up with answers to what to do away, they also provide us with a basic set of values and ideas about what is important and what is not, which helps us focus our work. The fact that these foundations are not value-neutral can be seen in all forms of work where different professions join to form a team around a common problem: both the appreciation of the problem itself, as well as what would count as a solution will frequently differ even though the team centres on an agreed structure of the work itself.

In terms of theory development, however, this separation of questions related to what and why in practice has far more complex consequences than difficulties in forming a common understanding in a multi-disciplinary team.

If our everyday understanding of a given method centres on the question of what to do and how, whereas the question of why is much more implicit as it belongs to, and is answered by, the general framework in which our practice exists, what happens when we borrow methods from other areas? This is the problem of theory development in an inter- or multidisciplinary setting as there is not one but many different frameworks to relate back to, none of which really encompasses the practice that is developing as a result of the cross-fertilisation between areas.

A central question will be: how far from the original context can a given method be removed and still make sense in terms of the logic explaining its structure? A central theme in this book has been the critique of the idea that empirical investigations can serve as a foundation for design work. This is one example of a set of methods that makes perfect sense in their original context but where their basic answers to why do not necessarily work in a design context. One of the most interesting examples of a discussion of this problem in design of when and how methods need to be reinterpreted with respect to theoretical frameworks is the one on the use of ethnographic methodology to inform systems development *(e.g. Button 2000)*.

It might seem that we paint a rather pessimistic picture of what interdisciplinary research and practice is like, but we would argue the contrary. While it seems to be the case the we, by borrowing methods and approaches from many different areas, risk to become shallow as we lack a proper foundation, another interpretation would be that this situation presents us with rich opportunities to re-think basic issues as we try to develop our practice. In many ways, this opens up for design research, i.e., research where we through design work, development of methodology and design programs, examine basic foundational issues that in this way become exposed.

In other words, we turn the process around: through practice we expose basic questions related to the 'why' normally implicit in our foundations, thereby using design practice as a way to perform experiments to develop theory.

In the following chapters we will present some of the methods and programs we have developed to do just this; to probe the theoretical foundations of interaction design. Thus, they have been formed to expose certain problems, questions and issues, rather than to help us solve given practical problems. As such, they are perhaps better described as design experiments than as methods for everyday practice even though we would like to think of the two as much more closely related to each other than what is often thought.

6.3 EXPERIMENTS

Experimental design research can be many things; tests, explorations and refinement of material from various aspects, explorations and refinement of methods, experimental work to open up new design spaces, experimental explorations of given design spaces and given design programs, experimental aesthetics, experimental methodology, etc.

Experiments in all forms of science involve design and in design research this introduces yet another circle; focus of the experiments is in some sense the experimental practice itself. Experimental design research is thus design research by design, i.e. design as research.

The essential components in such experimental work have their natural counterparts in traditional experimental scientific practice, as in the experimental practice of the natural sciences:

- *Experimental design programs* – what corresponds to general experimental research programs,

- *Experimental design methods* – what corresponds to methods of experimental scientific practice.

We make an experiment and we ask about the result of the experiment. What does that mean? The experiment depends on the definition and construction of some operation T – that is what we do in the experiment – and some data A – that is the actual situation we test. The result is then

$$T(A) = B$$

Although this is a schematic picture on a high level of abstraction it tells us what is the important thing here; we do something specific with some given data – this is data in a very general sense – and we record the result of this experiment.

It is important to note that such an experiment depends on the definition of a test operation T, i.e. an experiment has always its foundation in the design of something.

A design experiment can mean rather different things:

It can be a matter of testing a design. In this case the design is a proposed solution to given problems. We construct a prototype and design a test T in which we test the proposed design. In this case the prototype is part of the data we perform our test on. This is what we do when we propose a design and test it in user evaluations.

It can also be a matter of probing, exploring, presenting a notion. In this case the design presents a given notion providing a foundation for, or a guiding example of, the given concept, idea etc. In this case it does not make much sense to talk about the result of an experiment. It is more appropriate to ask about the meaning the design gives to the notion in question and the form in which it presents it. What we then know is that the notion has a foundation,

in general terms or in the form of a guiding example telling us what such a thing could be like.

In the first case we draw conclusions about the performance of the design prototype and in the second case we open up, and provide a foundation, for questions.

Design research by design… What is the basic difference between experimental design and empirical observations of given practice in combination with theoretical reflections?

Results from analysis do not give methods or directions for a change and development of practice. There is still the need for bridging the hermeneutical gap and it is here that experimental practice plays a fundamental role.

As suggestions are not true or false, but rather suggestive or in-suggestive, it is clear that the rhetoric of design has a given role to play here. The experimental examples fulfil two major tasks in the this context:

> To be the canonical examples that show directions of given suggestions,

In design experiments we present suggestions; they illustrate and show the direction of a proposed program, methods, new design materials . Experiments present suggestions.

> To highlight hidden problems, forgotten issues, open up new perspectives, ask the new questions, define and present basic concepts.

In design experiments we investigate given questions from various perspectives. The experiments are in some sense the 'material' out of which we build the resulting suggestions. Experiments build suggestions.

What about the experiment as a test of a given hypothesis, what could that mean here? The notion that corresponds to a hypothesis here should roughly be the notion of an initial suggestion; a proposed method, program etc. As far as a suggestion for change of practice refers to a problem in present practice, or to some question, we express an implicit promise or challenge when we suggest a certain change of practice; follow our suggestion and practice will change in this or that direction. As an answer to this challenge we might say ok let us do an experiment and see if the suggestion holds what it promises. But what we then test is this promise, this challenge and not the suggestiveness of the suggestion.

The design experiments discussed in this book are all, in one way or another, concerned with basic aesthetical issues of interaction design.

These are experiments where we on one hand try to explore the expressiveness of a design material, i.e. the way in which a given material allows us to build expressions, and on the other hand where try to explore the *expressional logic of act definitions,* i.e. the way in which definitions build and define act expressions.

There are two basic leitmotifs for these experiments:

- A focus on expressional design – where use disappears,
- A focus on act definitions – where the user disappears.

Experiments that follow the "expressional design" leitmotif are all

about bracketing use in one way or another. The idea is to explore expressiveness of material by turning appliances into "expressionals"; the 'given' not defined in terms of intended use, but rather through basic expression abstractions, not in terms what we intend to do using the thing, but how it presents itself to us.

The 'given' thing, system that guides the act of designing determines a collection of design variables. These variables present the basic design intentions explicitly on a certain level of abstraction.

The design process is in an abstract sense the process of instantiating these variables; from the abstract form given by initial variables to a complete design that defines a thing or a system. It is a recursive process where the definition of a given variable depends on the definition of component variables or on certain atomic components, i.e. where we simply decide to stop.

Now we may describe and explain this process on basis of functionality and intended use – a derivation by functionality, by usability – but also with respect to expressions, the way in which a thing, system presents itself to us.

As we disregard functional and existential definitions, the pure appearance of a thing, a system is what defines the thing, the system as an abstract *expressional*, a bearer of those basic expressional properties that constitutes its expression identity. This abstract *expressional* determines in a certain sense the concrete thing, system that is invariant across the many different existential and functional definitions; it is what defines the thing, the system itself *(cf. Hallnäs and Redström 2002)*.

An appliance is a thing, system designed to perform certain functions. Similarly we may think of an expressional as a thing, system designed to express a certain logic of appearance. The word ‘expressional’ is then used in the same manner as we use the word ‘confessional’ for “a place wheere a priest hears confessions” *(Merriam-Webster Online Dictionary)*, i.e. a thing designed to be a room for confessions.

To bracket use by expressional design is to experimentally explore the way in which material expressions build a design.

Expressional design means that we focus on the thing itself forgetting what it is in terms of functionality, use etc. We bracket use exploring the expressiveness of given design material. Here this refers to experiments exploring the specific material expressiveness of computational technology. It is experiments that interpret and illustrate material expressiveness through design examples.

If a focus on expressional design is a way to bracket use, then a focus on act definitions is a way to bracket the user; we focus on the logic of act definitions rather than on the analysis of given acting. Actual ‘users’ disappear, as that which bears up acts of use, is being replaced by the logic of given act definitions. This is a focus on the basic act expressions at hand in the design process which is what makes the difference between design aesthetics and aesthetics of design.

We look for ways to frame, interpret and explore acts as definitional expressions, i.e. act definitions, which perhaps makes the experiments following this leitmotif more conceptual in nature.

The next step is then to use experiments in both these categories as guiding examples for the development of design programs and design methods and for the development of systematic aesthetics.

We may think of an expression as the presentation of a structure in a given space of design variables. The design itself can be seen as an act or a process that defines the expression. To understand and describe such phenomena are in a certain sense a matter of logic. Logic in a broad sense deals with formal matters, the general forms of certain specific things such as the forms of correct arguments, but also the form of things and the form of interaction. Aesthetics, as we understand it in this context, is concerned with how material builds expressive things, with the inherent logic of act definitions, i.e., a logic of *expressionals*. The experiments discussed here are thus not empirical experiments in the sense that they provide material for empirical analysis. It is probably more correct to describe them as foundational experiments in search for guiding examples, not very different from what we do in mathematics when we search for examples that can show us the way.

The experimental examples we discuss all concern visiting the boundaries of a design space in some sense. From a methodological point of view it is a situation that asks us to try to

- turn things up side down and inside out,
- go at least four steps further (if things seem crazy they are probably not crazy enough, if things seem unrealistic or impossible they are probably not unrealistic or impossible enough),
- see through ‘neutral’ technical solutions,
- forget what is given and question the obvious.

It is really a question about ‘experimental’ design, probing and exploring through design. It is our conviction that we need this type of experiments revisiting foundations, i.e. when we deal with matters as if they were neglected matters where foundational issues are still unclear and where the outlook is a bit foggy. We need bright colours and a bright flashlight to find the way.

What is the difference between this type of design experiments and art? A basic difference between design and art is that design is always design (oh! these persistent circles) of something given, we express function or define products, whereas in art there is nothing given – a derivation by pure aesthetics is what is left here. As a 'definition' of art this distinction is of course completely meaningless, but it points to a definitive borderline we cannot cross and still claim that we deal with design. So these design experiments with a strong focus on aesthetics are still a matter of design, i.e. it is in each experiment design of something given.

6.4
THEORY

What is really the role of theory in practice based research?

Theoretical reflection on practice, experimental practice or professional work practice, is what we need for:

- the formulation of new design programs,
- the formulation of new design methods,
- the formulation of new teaching methods.

but also with respect to

- the issue of a systematic design aesthetics,
- the issue of systematic design critique,
- the issue of foundations.

The practice of theory is to some extent concerned with definitional matters. Within practice based design research this again hints at a circular phenomenon; the practice of theory, as far as it is concerned with defining, is practice itself in some sense. This means that we often enough find ourselves at the end, or beginning, of a loop as we try to answer questions about why and what. It also means that the border between theoretical practice and experimental practice is somewhat blurred and vague. A design is in some sense a definition of a basic notion; this is also one way to interpret the idea of the design object as a material thesis (cf. the discussion in *Seago and Dunne 1999)*.

It is instructive to compare with the situation in mathematics. In mathematical practice we try to solve problems by applying and combining established methods and constructions in an innovative way and by introducing new methods and new types of constructions. The role of theory is basically to provide the definitions and axioms that introduce new notions, new theories that give a sound foundation for intuitive notions, but also to provide a critique of practice. That is to answer questions like; in what sense is the Dirac delta construction a function? What are the basic axioms of set theory? What is really a real number? What are the true implications of the foundational paradoxes of set theory?

Results in mathematical practice is a matter of presenting proofs, counter examples, computation methods, constructions etc.

This is not very far from what we do in the practice of design research; experimental design examples present notions, show constructions, exemplify methods etc. They construct that given by example and thus by interpretation 'prove' that given.

The task for theoretical work is then to provide the definitions that in a more formal sense introduce new notions, new methods, new programs, and also to nourish and further critique, and aesthetics as well as from time to time revisit the foundations of practice.

A frequent component of definitions and descriptions of design is that design is about problem-solving, and thus a basic question is what kind of problems design deal with and what solving them really means *(cf. Coyne 2004, Friedman 2003, Schön 1984)*. In many ways, the question of the nature of design problems and design knowledge seem to stem from a discussion essentially about predictability, i.e., that design, as a practice, needs methods that produce predictable outcomes through a more or less transparent procedure (cf. also *Jones 1992, Simon 1996)*.

Simon suggested that such predictability and transparency could be achieved through systematic search for solutions in a defined problem space. Arguing that is not so much the search for a satisfying solution that is the problem, but the formulation of the problem itself, Rittel and Weber *(1973)* presented the idea that design problems are wicked, and that they resist precise definition. A related view can be found in Schön's notion of reflection in action, and the idea that a design process is a continuous dialogue between problem formulation and solution *(Schön 1984)*. Since these basic ideas were presented, the discussion has developed and expanded but the core questions seem to remain *(cf. Coyne 2004)*.

The perspective on issues of problem formulation, of predictability and transparency, becomes somewhat different as we consider design to essentially be a matter of proposing definitions rather than deriving solutions. Does it make sense to talk about the predictability of a way of coming up with definitions? With respect to what would such predictability be measured? Again, we hear the sirens of empirical research here; the idea that it is the process behind (the outcome of) a given design that needs to be justified.

It makes, however, sense to talk about transparency to some extent, i.e., that we have to justify on what grounds our definition is made, how it is made and so on. Thus, the approach presented here centres on precisely that: what makes up the definition we make and how. As such it may seem that we disregard that fact the designs often are meant to make a difference to someone by solving their problem.

But clearly, design is not about just solving a problem, but about proposing something to someone *(cf. Buchanan 1989)*. Whereas the notion of 'problem solving' directs our attention towards the objectives of design, the notion of definition by design used here turns our attention towards the internal properties of designs, i.e., towards the logic behind their appearance. As such it is not an instrumental, but rather an aesthetic perspective.

Does a basically aesthetic approach – including a partial refutation of an instrumental understanding – make the ideas proposed here essentially introspective, into design (research) for design (research)'s own sake? Aesthetics, here, has little to do with intentions of making designs beautiful and attractive; this is a question of what traditions of knowledge and practice we position ourselves in relation to.

As a comparison, consider what happened in e.g. painting as it made a shift from the more or less depicting to something (everything?) else. It is not so much the change in the relation to visual representation that is of interest here, but the way that this development created a critical discourse around what could be considered art. A central component of much contemporary art is this self-critical question of 'is this art?' Or, as Adorno begins his Aesthetic Theory *(Adorno 1997)*: "It is self-evident that nothing concerning art is self-evident anymore, not its inner life, not its relation to the world, not even its right to exist."

One interpretation, then, of what is happening in design research in general, and in approaches such as critical and experimental design in particular *(cf. Blauvelt 2003, Dunne 1999)*, is that this kind of self-critical space is being opened up as a response to questions about the role of design, its means and methods, its possibilities and shortcomings, and as a response to a need to develop design education and practice. As an example, think of how design frequently enters the realm of art in terms of presentation, e.g., as exhibitions in art museums where the designed objects were not ever meant to be 'used' in any other sense than this. Here, it is clear that notions of design as problem-solving will not cover what is under way, as this in many ways is an example of attempts to break away from the focus on practical problems. Perhaps, this new relation to 'functions' and 'use' is somewhat like when painting once turned away from the (more or less accurate) portrait.

One obvious explanation of what is going on here would be to say that phenomena such as 'critical design' is just another example of the long standing relations between art and design, and the sometimes fuzzy border in-between. A more intriguing interpretation, however, is that there indeed is something happening as a result of our increasing awareness of how design literally forms our life-worlds, and that there is a need to question not only the instrumental and often commercial understanding of design as such, but also our understanding of the designed things themselves. Again, we can see traces of 'old' ideas here: the programs for societal transformation suggested by for instance the Bauhaus and le Corbusier on one side; the notion of the yearly new car model and streamlined products on the other.

Thus, the work presented here relates to aesthetics not in the sense of the beautiful, but in the sense of the critical *(cf. Habermas 1981)*.

This is perhaps sometimes seemingly introspective, but more generally this is about the development of a more general critical discourse about the role of design. Further, this is also to say that when developing design research, there are very long traditions of knowledge, research and practice in aesthetics that play a central role here *(cf. Cazeaux 2000)*.

7

PROGRAMS

7.1
THE DESIGN PROGRAM

We can think of the design process as interplay between defining and interpreting, between deciding 'what' it is that we design and 'how' we think it should be. Since designing is about creating something concrete, a thing, a system, it is sometimes hard to see how more general ideas, such as a more general design philosophy can be expressed in a given design. We might think that these questions of defining and interpreting are only about the very specific design choices. However, these acts of defining and interpreting are made on many different levels in parallel, and we need methods that help us see more clearly what decisions are made at each of these and how they are reflected in the final design.

A design program can be seen as a description of design intention on a rather general level, where we state some position regarding our basic approach and ways of looking at the designed thing. Ideally, a design program will help us focus on the design decisions that are crucial for how our general design intention will be manifest in the resulting design. Of course, this emphasis on certain design problems will be at the expense of others.

The idea that design programs state design intentions also points to the fact that they are normative; they state a way of seeing the designed thing where some things will be important, others

irrelevant. Therefore, being aware of in relation to what programs one is working, and how is an important step towards a conscious aesthetics. The fact that they are normative also makes it important to build a basic awareness of how design programs and general answers to basic questions of 'what' and 'how' affect the end result of the design process.

Consider, for instance, design for usability according to the ISO standard *(cf. ISO 9241-11)* as a design program. What is it we design? Tools for manipulating information. How? We think of good design of tools in terms of their efficiency, effectiveness and how satisfying they are to use. We then form more detailed definitions of what we mean by these terms. Central design outcomes that we focus on in the design process will then be aspects related to how easy or hard the thing is to learn to use, how much effort it takes to remember its modes of operation, how many errors occur as we use it, how accessible the thing is for people with certain background knowledge, how fast you are able to work given a certain amount of training, etc. When we approach the question of defining 'what' this specific thing is that we are going to design, these questions form the basis in relation to which we form our question; they help us determine what the central design problems are as they govern what questions we ask as we try to define what to design and how to interpret it.

Later, when we look at the designed thing we can trace its appearance back to these questions and they help us understand the logic behind its expressions. The thing is a concrete result of the interpretations of 'what' this thing should be with respect to the central ideas of the design program. And whenever there is a strong logic of appearance, we should be able to see the design program through the designed thing in front of us.

Considering the example with design for usability as a design program, one might argue that a successful design of a tool makes it 'disappear' in the hands of the user and indeed, if this is case, the underlying design program will be very visible! Just consider what the difference it would be in case the design program had been to consciously slow the user down making it hard to use the thing. That the thing is really hard to use might of course be the result of a lack of expression logic and poor design (in which case the underlying design program will not be that visible) but it might also be the case that there is a strong logic behind these expressions and that the difficulties are intentional.

In some cases, things are hard to use because it takes training to see and understand the logic of appearance, but once we see it, it seems very clear and obvious. For instance, playing the violin might at first seem unnecessary hard: why are the strings placed the way they are, why are there no frets making intonation easier, why do I need to hold it against my shoulder in this strange position, why is the bow constructed the way it is? etc. As we learn to play the instrument, we realise that these decisions all come from the basic design intention of creating an instrument for artistic expression and that there is a strong logic behind its design when seen from this perspective. The violin clearly illustrates that the given expression logic does not have to be immediately obvious in order to be very strong.

Design programs support us in the design process in the sense that they provide a framework for what questions we ask as we define and interpret what to design. They also serve as a framework for evaluation in the sense that they help us see the logic of appearance in relation to the basic design intention, as when we try to see the design program through the designed thing.

In experimental design research, the design program is what lays out the foundation for a series of design experiments. It is in some sense the general experimental interpretation of a research program. In sections *(2) – (6)* we describe five such programs; the general program theme, basic motivations, an example story and illustrating examples of design experiments. Together they sketch the general context for a series of design experiments with main focus on interaction design aesthetics:

Slow Technology,

Abstract Information Displays,

Design for Sound Hiders,

Zero Expression Fashion,

IT+Textiles

7.2
SLOW TECHNOLOGY

7.2.1 Program theme

Slow Technology refers to the design of computational things with a strong focus on time presence; a focus on time appearance as a central design variable. The central theme is design for reflective use with a clear focus on the appearance of time rather than design for efficient use with its focus on time disappearance –the presence of time versus the absence of time. It is a program that reverses the standards of HCI-usability: easy to use, easy to learn, efficient, measurable etc. A basic concern for efficiency in use turns into a basic concern for reflection in use. Slow technology is technology that is slow in the sense that it takes time to use it, to learn how to use it and to understand what it is. As opposed to fast and efficient technology designed to reduce the time it takes to do something, this is technology where we slow things down in order to make room for reflection upon the workings and expressions of devices and systems.

To slow things down is one way of introducing a shift in focus from practical functionality to expression of use since instead of disappearing as an efficient tool in your hand, it appears as something that makes you stop for a moment. It is like writing with a pen where you suddenly begins to think about the pen itself, how

it feels in your hand, how it shapes the letters you are writing, etc. The writing of a particular text is irrelevant – only writing itself matters. To use slowness in learning, in use, understanding, etc. as a way of preventing quick and easy acceptance.

To slow things down is also one way to expose the material expressiveness that builds the expression of things and systems in use. What makes the pen feel the way it feels? How does the pen shape the letters I write? …

When a thing suddenly does not work the way expected, we suddenly 're-discover' it. When a car that always starts at our first attempt in the morning one day doesn't even make a sound it makes us stop and think – what is this? We might think about outdoor temperature (is it too cold for the battery to work?), gas (did I fill it up last time as I had to?), lights (has the lights been left on, draining the battery?), etc. In this case, these reflections come from a breakdown but they could as well have come from a conscious design intention, namely that the object has been designed to promote moments of reflection upon this technology's – this material's – properties, consequences of its use, my relation to it, etc.

7.2.2 Basic motivations

As a program for experimental design Slow Technology is concerned with expressional design as well as act expressions with particular emphasis on the type of time design that computational technology introduces. The basic characteristics of computational things lie in the fact that their expressiveness, their appearance in use, depend on the execution of programs. Design of computational things thus necessarily involves components of time-design; questions about working models for a design practice where the logic of time-structure appearance and the expressiveness of computational technology as a design material are central issues. This motivates experimental work where we pay special attention to time as a basic design parameter.

7.2.3 Example story

A fine music instrument is a typical example of slow technology; it takes time to learn how to use it, it takes time to understand how it functions, it is designed for reflective use… It is craft for artistic use. Now assume we would live our everyday life surrounded by things designed for artistic use. Everything I do would be based on intense training; the aesthetics of use would be present at all times… What could design of computational things mean in this context? How can we expose time design using the computational material?

7.2.4 Design examples

The art of use – design of everyday things for artistic use

A waiting tube – design for waiting

As we implement new computer based systems in our everyday rooms – shops, offices, our homes, public spaces – we initiate new forms of waiting; waiting for a system to respond in various ways. People are waiting for tickets, for money, receipts, connections etc. What is typical for this waiting is that we leave 'our' time to the computer system, we do nothing since we have no time to do something. Now if we reverse the situation we could think of 'waiting' as something we actually do allowing the system to compute; nothing happens unless we are 'waiting'. And to go one step further we turn waiting into an art. So the challenge is to design things for artistic use that we can use for the performance of 'waiting', i.e. for letting the computer systems compute.

The waiting tube is simply a two meter long tube with a diameter of about 4–5 centimetres. Inside the tube there are sensitive microphones and the tube is equipped with some cordless communication device. The tube is open in both ends. To 'wait' we put a steel marble into the tube and balance it in front of us keeping the marble in constant motion. The microphones listens to the sound of the rolling marble and a message that we are waiting is sent to the computer system allowing it to compute. If the balance act fails and the marble falls out of the tube, then waiting stops and so does the computing. We can also stop waiting through complete equilibrium – an act of somewhat delicate instability.

We see them in the streets, in shops, the reflective 'waiters'; not the nervous, irritated stop waiting as doing nothing, rather the intense reflective acts of allowing time for computation. Some pick up their waiting tubes…

A free antenna – design for communication

The systems working behind the scene in the world of telecommunication are certainly very complex things, but mobile phones and other types of sophisticated telecommunication equipment is often enough very simple to use. Just press some buttons and you establish communication across mountains and oceans. What could it be like if the act of establishing communication were an act of artistry, a difficult art to master? The challenge here is to design communication devices for artistic use and in particular to design for establishing communication.

The free antenna is a long stick – 1,5–2 meters – equipped with accelerometers and touch sensitive everywhere except at one of its tips. The antenna is also equipped with some cordless communication device. The antenna sends out a message "open for communication" when it is in motion and not blocked by a touch sensor, i.e. as long as it balanced in the palm of our hands. The antenna is then connected to some standard communication device, typically your mobile phone. Instead of pressing a couple of buttons to connect your phone you use the antenna to announce that your mobile phone is open for communication.

We see them in the streets, at work, the reflective "communicators"; not the alienated reflexive mobile-phoning, rather the intense concentration in performing the art of communication. Some pick up their free antennas…

Mysterious things –
design of everyday things with mysterious interfaces

A slow mirror – a sound mirror of some sort

Sonitures are 'things' we use to furnish our rooms with sounds; the sound of a clock, the ill oiled hinges of a door, the favourite chair, the stereo of course… Furniture is, implicitly or explicitly, also soniture. Now imagine a slow mirror that only gradually paints the mirrored picture. As soniture a slow mirror slowly furnishes the room with its own sounds – a mysterious circular interior interface telling the near history of the room.

We have done some experiments using very simple techniques of record-playback loops. The basic setup – which we used both in an office context and at several museum exhibitions – consists of a number of microphones and small near field studio monitors connected through mixers, amplifiers etc to a computer that runs a simple program implemented in Java using the JavaSound class library. The program administers a number of record-playback threads – we have tested typically 5–15 threads – in a canon like structure. The structure of the record-playback loops is completely determined and should be possible after some months of intense

listening to begin understanding the reflective behaviour of the mirror. It could be a rather 'cheap' mirror where its mirroring behaviour would depend also on defects in material and manufacturing, or perhaps it is an old mirror where defects in mirroring behaviour depends on aging material. To obtain these types of 'defects' – that in fact makes the mirror much more interesting and 'alive' – we used a very cheap and simple sound card that together with limitations in the JavaSound library resulted in a somewhat defect 15-channel digital recording machine – perhaps it was just a bit old or a bit too cheap…

The Klein clock – a clock of some sort

A clock measures time in some way or another. We use a clock or watch to measure time distance; how many hours before the TV-program starts, how long the lecture is, how long time before the train leaves the station, how long time before we reach the city etc. This is done in terms of an exact numerical value stating the actual time, i.e. using the clock face or by displaying time in numerals 11:20:22 etc. Now assume we want a clock intended for more reflective use where time is displayed as a puzzle, a mystery. Some would say that it perhaps would be a much truer clock, though perhaps not efficient in the way we usually understand that word today…

An example; the Klein clock. The idea here is to display time in terms of a colour puzzle. The clock display consists of two colour fields. The clock 'ticks' towards the collapsing of the two fields into a monochrome – that's where the name of the clock comes from, the monochromes of Yves Klein.

The left field displays a 'static' reference on basis of which the right field is 'ticking'. The RGB code of the displayed colours correspond to three "time" parameters *(p1,p2,p3)* – it can be (hours, minutes, seconds) for instance. In many cases the actual RGB code will be a constant function of given time parameters, i.e. when values differences will be too small to make a big enough difference in colour. Given a reference colour (a,b,c) and two initial colours *(a1,b1,c1)*, *(a2,b2,c2)* the right colour field "ticks" by adding modulo *(a,b,c)* starting with *(a1,b1,c1)* + *(a2,b2,c2) (mod(a,b,c))*. So the right colour field will present a structure of "colour symmetries" relative to *(a,b,c)*. The colour displayed in the right field is the sum of two preceding colours. Each coordinate has its own 'ticking' rate and the time a colour is shown is a simple function of two preceding colours.

The clock doesn't show time in 'real time', but during a period of time it shows a particular point in time or a given time distance. It can for instance be connected to an ordinary clock with reference to some time measure like *(24,60,60)* – 24 hours/day, 60 minutes/hour, 60 seconds/minute. Some external device could trigger the Klein clock to show the given time for say an hour or two – or a week or two – where the initial colour then would be *(00,00,00)* and *(12,00,00)* for 12 o'clock. It could also show the time distance between 'now' - 17:02:04 - and a given later time point – 19:08:02 – in which case the two initial colours would be given by *(17,02,04)* and *(19,08,02)*.

The clock is intuitively ticking towards a collapsing point where the colours in the two fields coincide. While ticking, the clock displays time structures of various kinds such as more or less complicated cycles of repetitions. From a mathematical point of view these structures are completely determined by initial data. But from a perceptual, or phenomenological, point of view they might look random at first. We can learn to read these structures and get an intuitive feeling for the time structures ticking with respect to its given collapsing point. Starting with what at first

looks like random noise we will gradually discover a predicable, and potentially very rich, structure.

Looking at ordinary time structures displayed we see for instance that 12:00:00 has a simple time structure whereas 03:00:00 is structurally much more complicated to recognize.

But time shown by the Klein clock could of course be something different from standard clock time. Given parameters *(p1,p2,p3)* assume *p1* measures the number of times I use my mobile phone during a day, *p2* measures the number of e-mails I receive and answer during a day and *p3* measures the number of times I click on the mouse attached to my computer. A suitable reference could be a measure done for a day off or a particular hard working day. The clock will then display working time in a certain sense. This type of time could of course be generated by all sorts of things I do, activity time.

The clock can also display computational structures, communication structures etc.

Whatever 'time' the clock displays it works in the same way, a no-real-time-clock stretching out given points of time to rich reflective structures, or for one who just passes by a random ticking of a simple colour field; a monochrome looking for its colour…

The Chatterbox – Some sort of messageboard

The Chatterbox is a system for sharing information in a public space, somewhat similar to an electronic messageboard. It was inspired by, and uses some of the techniques from, systems for community awareness for office spaces, e.g., systems for continuously posting information about ongoing activities. However, rather than presenting actual information, the Chatterbox messes things up by creating new and more or less random re-combinations of the information.

The Chatterbox continuously 'reads' office mailing lists, documents published online and text sent directly to its e-mail account. Using language parsing methods from computational linguistic, it analyses the material and stores it in a database. Based on this database, it then generates 'new' material by re-combining the material, by substituting words from one text with words from another, etc. The results are new texts that resemble texts submitted to it, but where text elements have been replaced (cf. the 'cut-up' technique used by for instance William S. Burroughs).

At first glance, the ChatterBox might appear as a random text generator, and though the sentences appear to be grammatically correct, they do not necessarily always make sense. As one gets to experience it over time, however, the first impression might be replaced as one begins to recognize fragments of texts, certain words, etc. And so over time one begins to understand the underlying structures and texts through the transformations of the material.

The initial ambition with the Chatterbox was to develop an entertaining information display that could inspire new ways of looking at the material produced at the office. As such, there was also was a another ambition; to use technology developed for efficient information distribution to do almost the opposite and it is thus also a kind of counter example to designs made to increase awareness at the workplace.

7.2.5 Discussion and references

The art of use combines a focus on expressional design with a focus on act definitions. The very idea of designing for artistic use means

that we move focus from use in a more general sense to the specific expressions of use. It is where we nourish and use material expressiveness to define and determine basic acts of use; the expressionals we design mirror certain act definitions with focus on the expressions of intended use. The free antenna defines acts of communication; the waiting tube defines acts of waiting etc.

The mysterious things concern expressional design asking questions about lost or forgotten act definitions. You say it is a mirror, but what does mirroring mean here? You say it is a clock, but what does watching time mean here? The Chatterbox is a kind of message board you say, but what is it, that are we supposed to do with it?

The initial inspiration to these experiments on more reflective use of computational things did not come from ideas such as the 'slow food' and the more recent 'slow design' movements; only later did we learn about their existence. Rather, our starting points were discussions about Weiser and Seely Brown's notion of 'calm technololgy' *(1996)* and how it, at the time, was interpreted in work on new forms of human-computer interaction such as 'graspable and tangible user interfaces' *(Fitzmaurice et. Al. 1995, Ishii and Ullmer 1997)*, 'ambient displays' *(Wisneski et. Al. 1998)* and related work. A central aspect of the notion of calm technology is the idea that technology, or rather the perception of technology mediated information, should shift to the background, or periphery, of our attention. Somewhat interestingly the attempts to make this happen instead brought other aspects of interaction design to the foreground. For instance, characteristics of spatial manifestations of information became central, in some cases even taking over completely as a result of very strong expressions. Thus, inherent in these design examples there seemed to be a opportunity to make a shift from concentrating on efficient information presentation in interaction design, to instead concentrate on the various possible spatial manifestations of information, perhaps even disregarding the actual information content as central to the design problem.

Another line of work that inspired these discussions came from the notion of 'focal things' by Borgmann *(1984)*, especially as interpreted by Verbeek and Kockelkoren *(1998)*. This work is in many ways a critique of the still prevailing ideology that technology should be transparent with respect to use, i.e. that the machine ideally becomes invisible in the hands of the user. As opposed to this perspective, the notion of focal things stresses the need for things that not only attract our attention, but even acts as centres for meaningful action and social interaction. The canonical example of a focal thing turning invisible due to technology development is how central heating replaced the hearth, and thus also a place for social gathering around certain activities related to the fireplace. Though we do not necessarily conform to Borgmann's view entirely, the idea of focal things suggests that how technology can, and sometimes need to, become the centre of our attention in meaningful ways is a rather neglected issue in design.

The design experiments discussed above are all part of experiments done at Interactive Institute – PLAY studio. The waiting tube and the free antenna are examples of experiments with "slow" abstract information appliances *(Hallnäs & Redström 2002)*. The sound mirror and the Klein clock is experimental work done by Lars Hallnäs *(Hallnäs and Redström 2001)*, and the Chatterbox is experimental work done by Patricia Jaksetic, Peter Ljungstrand and Johan Redström with additional input from Lars-Erik Holmquist *(Redström et. Al. 2000a)*.

7.3
ABSTRACT INFORMATION DISPLAYS

7.3.1 Program theme

Abstract Information Appliances as a program theme concerns the expressional interpretation of elementary acts of information technology use, interpretations through expressional design of computational things. We turn our attention to the aesthetics of elementary building blocks that constitute the acts defining use of given information appliances. It is an experimental program for turning information appliances into information expressionals; where function as a leitmotif turns into expression as a leitmotif.

An information appliance is something, i.e. usually a computational thing, we use for handling information of a specific form and in a specific context; it is something we use to write text with, something we use for verbal communication with people at distant places etc. An abstract information appliance is a computational thing designed to be the bearer of certain expressions of possible information appliances in use; something we can use in expressing acts of writing, reading, communicating etc. It is not designed on basis of functionality, but on basis of expressions of use.

Functionality, use, concerns what we can do with things in order to accomplish something, e.g. we move our legs in order to walk. An abstract information appliance is built around expressions of the elementary things we can do with information without regards to specific functionality. In an abstract information appliance we expose expressions of elementary information handling acts without any reference to specific applications.

7.3.2 Basic motivations

The basic motivation is best given through fragments of a manifest:

The decisions we make in the acts of designing cannot all be reduced to questions about functionality, usability testing, user requirements etc. An initial description of the design object might of course be given completely in functionality terms; say we want something that can be used to open wine bottles with. But to materialize this general description into a thing, a corkscrew, we have to consider various design variables and make decisions that cannot be reduced to simple questions about functionality. The utopian functionalist leitmotif "form follows function" is of course just a leitmotif that emphasizes functionality, usability. In HCI-related research and design other fundamental aspects of design such as the basic aesthetical choices involved have a tendency to be hidden behind a wall of thick usability bricks. We need to turn the functionalist leitmotif up side down and from the other end of the spectrum try to revisit basic design themes forgotten in the present HCI-tradition.

To expose aesthetics and aesthetical choices in the design of computational everyday things and environments we try to disregard functionality as a starting point and work with experimental design centred around the slogan "Functionality resides in the expression of things".

We walk, so to speak, backwards, up side down out of the factories of Bauhaus. We try to discover functionality in the expression of things.

Aesthetics, as we understand it here, concerns the logic of expressionals, i.e. the formal reasons explaining and motivating the expressional appearance of a design. To expose these matters in the design of say information appliances means imagining abstract information appliances inherent in given concrete examples. Thus the exercise with abstract information appliances is an experimental exercise in the systematics of defining the expressional design space of certain computational things. It is a methodological exercise in rediscovering and redefining the role of aesthetics in the design of computational things. A process that we have to repeat over and over again as we always have to secure foundations of work through rediscovery and redefining.

7.3.3 Example story

A display is an area, a region where representations of data are shown. It is information of some sort. Take a large old-fashioned garden. We look out into the garden and wonder what the patterns of leaves laying around tell us. Perhaps we instantly see a sign of laziness – we should have taken care of the garden with all its autumn leaves long ago. But we can also silently reflect on a possibly more hidden message, the garden then turns into a display for reflective use, the patterns of autumn leaves represent historical data on wind and rain, on the movements of people and animals, on the seasons and the meaning of time.

As a display shows representations of computational data and is controlled by a computer it is a matter of computer graphics. Taking inspiration from the large old-fashioned garden as a 'display' we may think of experiments with displays for reflective computer graphics using traditional design materials such as fabric, paper and everyday things such as a lamp, a tray, a piece of furniture, a door.

7.3.4 Design examples

Reading and writing

The elementary acts in focus are all fragments of acts defining use of things for reading and writing information in some sense.

The doorbell

We use a doorbell both to 'write' and 'read' information; somebody is here at your/my door. Most door bells are rather boring things; you press a button and some silly pling-plong signal is triggered announcing that somebody just pressed the button at the main entrance. You don't know who it is, the signal is heard through out the apartment. This makes the expressions of use very special; a sudden stop in activity and then a rush for the door to look who it is. It could be different, couldn't it?

Here is an example of things we might use in the elementary acts of 'writing' and 'reading' a doorbell.

Reading – The Fan House

The Fan House is based on a 3x3-matrix wooden rack with a fan mounted in each cell. Each fan is individually controlled by a microcontroller. Information is displayed through motion in layers of fabric hanging in front of each column in the matrix. On the one hand it is a nine pixel discrete display and on the other hand it is, through information displayed as it is written in the wind by fabric in motion, a continuous display. In some sense it is exact and precise and in another sense it is vague and imprecise. To read more

intricate information from the display requires much training and the choice of size and number of layers, texture of fabric etc makes it a complex display where the discreteness of digital information meets the continuity and complexity of textiles in motion.

'Reading' the signal of the doorbell, means here that we turn our attention to the Fan House and dwell on a given pattern of moving fabric. We choose colours, length, texture, layers of fabric ourselves for different reasons; to see certain patterns more clearly, following the shift of season, following our moods, matching the new wall paper… It is reflective use that demands our attention; we select a proper place where we go to look for a 'signal' from the doorbell. So why not just go to the door once in a while to have a look? Ah, certainly more efficient in some sense, but still something entirely different. Going to the door and have a look through some peep hole is an act of a completely different expression, the aesthetics is completely different.

Writing – The Sail House

The thing we use to 'write' the signal is also based on the same 3x3 matrix wooden rack. In each cell there is a light dependent resistor (LFR). Paper "sails" are mounted in front of the cells on wooden masts. As we rotate these masts a microcontroller measures the amount of light the sails lets through. We then connect The Fan House to The Sail House just as we connect the doorbell button with the bell itself.

So I arrive at the main entrance, sit down in a nice chair placed in front of the Sail House. I manipulate the sails setting up my personal pattern. This pattern is then mirrored by the corresponding pattern of moving fabric in the Fan House. The more light a sail let through the faster the corresponding fan will rotate. When I leave I can let the pattern of the Sail House remain telling others that come that I was there or I can I 'reset" the sails to some neutral zero pattern. After setting up my personal pattern – possible with additional information about this particular visit – I sit back and meditate waiting for the door to be opened later in the day, if not I may come back next day or wait for another day, another week…

Memories

I think of the garden that displays its history throughout the seasons, I see my furniture also displaying very slow histories of use… I have an ordinary somewhat dull floor lamp where I sit and read and suddenly I see how the lampshade falls to the floor and slowly dried autumn leaves blows out on the floor under the lamp shade displaying some secret history…

The Lamp Foot

It is an ordinary floor lamp where the lampshade has fallen down and placed itself just above the floor. Four small fans are placed inside the lampshade directed towards the downside perimeter of the shade, perpendicular to each other. Each fan is individually controlled via a micro controller. The light has gone out, what is left is the leaves painting an intricate pattern on the floor, left there as memories…

This is how I may think of 'reading' information about subtle things going on in my apartment, in my house… A piece of furniture suddenly falls apart in one way or another and fragments of the old garden appears through the ruins reminding me, telling me…

Balance

We work too much, we sleep too much, we worry too much, and we don't care enough…we eat too much of this or that, we go by car too much, we walk too little, we reflect too little on important things… Where is the balance in my life? I want to see the balance…

Aha, why don't you just hang a metal tray in four wires from the ceiling and connect your four main worries to these wires… You can put all sorts if things on the tray; your expensive porcelain – in case you have such things – you can use it to serve drinks at your big parties – in case you have such – or why not put a load of marbles on the tray… Couldn't that help you to find balance, to control the balance between your main worries… It is at least a sort of sport that could keep your mind on other things. At your next big party when all the nice drinks falls to the floor you could apologize by saying "oh, it is my life, there is no balance".

It is the shaky hands displayed in a more precise way.

The Tray

An ordinary metal tray hanging in four wires from the ceiling, stepper motors individually controls each wire with force transducers attached to the wires measuring the momentary force. Balance is computed by calculating the difference between wire forces. Marbles are used for fine-tuning the behaviour of the tray.

Reading information about myself in the behaviour of things that furnish my home, redefining interior design with respect to computational technology as a new design material? Or perhaps interior design that has gone wild in a state of complete technological alienation? Using computational technology in this way also redefines the idea of a tray; what it means to place the tray somewhere, what it means to place something on it, what it is, what it does.

Control

I give up, this remote control is impossible to understand…in the wall with it, crash! To expose the mysteries in handling these 'simple' and 'efficient' devices here is an example of a general purpose remote control, slider etc. entirely based on the notions of vagueness, inaccuracy, non-precision, complexity, etc.

All these pieces of paper lying around on my desk. Notes out of context that rarely makes sense any more – better throw them away in the recycling basket... But no – where's that note I wrote just before? Have to look through all the pieces again to find it…

The Block Bench
It is a small wooden bench. The bench has three tracks for sliders, four measuring units with infrared proximity sensors that can be placed anywhere on the bench. Big metal cylinders are used as sliders. The sensors can measure distances between 10 to 80 cm with any degree of imprecision. A micro controller is used to record these analogue distances. It is the true general purpose flexible slider input device, a design of that canonical general purpose remote control.

The sliders can be calibrated to provide different scales for the remote control of various devices with a rather extreme degree of imprecision, vagueness, complexity and unreliability.
It is in other words a first class remote control with respect to expression of use.

Looking closer we can see traces left by confused people that have tried to find – in vain of course – successful settings, some have written notes of warning, dates when they finally gave up, or just anything in silent desperation. It is a thing full of graffiti marking that it has turned into a place we visit rather than a tool we use…ruins of technological invention like that big integrated circuit from an old VAX computer hanging on my wall.

The Paper Recycler
The paper recycler is a cardboard box standing on the floor. At the bottom, there is a rack of fans. Filled with torn pieces of paper, sticky notes and other fragments of printed images and text, the Paper Recycler is a display based on the movements of a large number of small pieces of paper in different colours, sizes, shapes and mass. Depending on when the fans go on and off, different patterns of whirling pieces of paper can be seen. For instance, the Paper Recycler could be connected to the Block Bench or the Sail House to enable the user to tune in or look for a specific pattern.
In this mess of fragments blowing around, you have to look carefully to find the note you are looking for. Or maybe, one should just try to enjoy the mess in motion as such…

Information deliverance

Reading and writing information in one way or another relates to elementary acts of delivering and receiving information; we write a letter and put it in the mailbox or click on the send button, we read the letter we just received in the mailbox – be it an old fashioned one or the electronic one. What does this mean? How do we relate reading and writing to delivering and receiving? Is information just something blowing in the wind that we merely catch passing by…

The Information Deliverer
This installation fills a room with ten 2 m high transparent plastic tubes. Under each tube there is a matrix of fans controlled by a micro controller.

During 23 days this thing will step by step deliver a history of major news event during the second part of the 20^{th} century. During these days we will also step by step receive this history in reflections on the mysteries of information deliverance as we meditate in a Zen-like garden; it is a white room where information is pieces of white fabric that blows out of the tubes and slowly landing on the floor.

Each tube delivers about 50 pieces of fabric each day. Fragments of news texts are written with white UV-luminescent colour. To read we use long sticks with UV lamps carefully digging in the piles of fabric that builds up here and where on the floor.

To each tube corresponds a specific 'collection' of textiles unique in materials, folding, the way in which they float and flies through the tubes and the way in which they flies and lands.

Step by step we also note that each tube delivers news about a specific event; news about the first man on the moon, the assassination of president Kennedy, the Chernobyl nuclear accident, the wedding of Prince Charles and Lady Diana etc.

A radio news channel controls the delivery of information; several independent computer program "threads" records and play back the news. Each thread controls a given tube starting the fans when news is played back. A mismatch between software and hardware makes it difficult to say exactly when intended play back in fact will succeed, thus deliverance is more or less accidental depending somehow on low quality computational material. The idea that news 'right now' controls the delivery of historical news is filtered through and coloured by the fast-aging properties of technology as a design material.

The installation was set up to run for 23 days which means that there were approximately 11 500 unique pieces of fabric lying on the floor as all information finally was delivered; the floor changed

from an empty surface into a complex landscape of yesterdays news still lying there to be read and to be reflected upon.

7.3.5 Discussion and references

The reading and writing appliances are all examples of expressional design asking questions about the way in which computational technology relates to various spatial design materials, about the way in which computational technology interfere and intervene in design practice. What is a display as a thing? What is a remote control as a thing? Etc.

Again, these projects were inspired by research on alternative user interfaces discussed above, especially with respect to how they seemed to not only open up new design spaces, but also introduce a shift in what design problems come to the foreground. This shift also made certain issues in the development of interaction design visible, i.e., how it seems to be situated with human-computer interaction on one side and more general product and industrial design on the other. This particular bridging of traditions is, for instance, evident in another line of work that inspired us: the research by Djadjadinigrat, Frens, Overbeeke, Wensveen, and others at Delft and Eindhoven *(cf. Djadjadinigrat et. Al. 2004)* and how they have approached certain issues in interface design from a industrial design point of view.

The idea of working with a collection of design examples illustrating a given design space in this way partly came from the work by the Appliance Studio Ltd, presented in Gaver & Martin *(2000)*. Terming their approach 'value fiction' they set out to redesign existing technology with respect to novel social contexts and values (as opposed to science fiction which, according to Gaver & Martin, typically sets out to explore existing social issues using future projections of new technologies). Instead focusing on the aesthetics of technology in use, and especially how it relates to other materials in terms of expressions and aesthetics, our work explored various expressions in use thus using the design collection as way of painting an alternative picture of what computational things could be like.

The design experiments are all part of experiments done at Interactive Institute – Play studio. Examples discussed in section 1 were done by Lars Hallnäs, Patricia Jaksetic, Peter Ljungstrand, Johan Redström and Tobias Skog *(Hallnäs et. Al. 2001)*.

The Information Deliverer in section 2 is taken from an exhibition at the Borås Art Museum 2001. It is work done at the Interactive Institute – Play studio. It is joint work by Staffan Björk, Lars Hallnäs, Rebecka Hansson, Peter Ljungstrand, Johan Redström and Linda Worbin *(Hallnäs et. Al. 2002b)*.

7.4
DESIGN FOR SOUND HIDERS

7.4.1 Program theme

The basic idea here is to design appliances for the sound hiders, i.e. design for the hiders hiding sounds as the other things we hide; the secret present, that old jacket you don't want to wear and don't want to throw away, money under the mattress, the booze you try to hide away from curious teenagers…

It is difficult to hide sounds, to collect them and put them under lock and key. In a possible distant future sensor technology and computational technology will perhaps make this possible. What does it mean to design for sound hiding, to design for the connoisseurs of sound hiding, for the sound hiders?

Design for sound hiders is an exercise in the logic of act defining where material expressiveness plays a central role. The design objects express certain act definitions in relation to the stories we tell about the sound hiders. We turn material expressiveness into act definitions.

This story about the sound hiders was used as a conceptual background for experiments with the expressiveness of textiles as sound absorbing and sound reflecting material. These are experiments with the aesthetics of textile materials seen through acts of use, i.e. material experiments on the basis of interaction design aesthetics, or the other way around, interaction design experiments on the basis of material aesthetics.

7.4.2 Basic motivations

Using textiles as sound absorbing and sound reflecting materials in interior design means that we, of course, have to rely on acoustic measurements of materials and spaces. But with respect to design aesthetics this is not enough. It is one thing what the room we inhabit does – another thing is what we do as we visit the room. We simply have to listen also, to try to understand the sound gestalt we create from a more phenomenological point of view, i.e. what it is as a room where we dance, where we talk, where we read in silence, where we sing etc. It is in some sense a phenomenological classification problem; we need to find ways to describe the character of materials and constructions in relation to the expressiveness of given sound gestalt.

We can view a problem of sound design as a specific problem of functionality, the problem of muffling noise in the new library for example. But it is also as an interaction design issue; what does it mean to read in silence in the new library? Defining this involves the reference to a specific sound gestalt abstraction (silence), which links the phenomenological classification problem to act expressions and act definitions.

This is a typical situation in all those cases where material expressiveness is basic to act definitions – to define what we mean by playing the guitar we have to involve the guitar itself as a musical instrument. To develop this into a program for experimental design means that we focus on design experiments

where material expressiveness provides an explicit basis for act definitions. The central importance of time gestalt and "interactivity" in use for the expressiveness of computational technology makes the link between material expressiveness and act definitions, act expressions somehow basic in interaction design aesthetics.

7.4.3 Example story

Often enough sounds and noise makes us tired, we just want to hide from them. We put earplugs in our ears, we install triple glazed windows, we walk out into the woods, we hide under the pillow etc. The sound hiders they are different, it is no longer a matter of hiding from sound and noise, but to hide it. Sound hiding has become an art and they are the true connoisseurs.

7.4.4 Design examples

In design for the sound hiders we can focus on certain aspects of their behaviour and whereabouts and use this to characterize the expressiveness of textiles as sound design material. Here we sketch design examples focusing on hiding places and hiding manners.

Hiding places

Radka's box
Radka lives in a city apartment. She is getting more and more tired of all noise surrounding her. The traffic noise is there almost all the time, people shouting in the street…that's enough to make the signals from the phone or the door bell almost unbearably irritating…the radio, the TV…

She has a dream and that is to be able to just hide away all these sounds and this noise, to hide it somewhere so she can visit it instead of being haunted by it.

As a sound hider Radka will perhaps hide the sounds and the noise in a box she places in the middle of her living room. With a snap of her fingers the sound disappears into the box. Inside the box the sound bounces around in intricate patterns; distortion, reflection and slowly muffled by thick walls of textile materials. The box has all sorts of small doors and hatches for visiting the sounds inside.

A box has faces, it is something we can move around and put at different places in a room, it can leak, it is something we can open and close etc. With respect to all these things various textiles will have certain expressiveness as the material that builds the box and contains the sounds. What does it mean to design such a box for a sound hider?

Cajsa's chair

Cajsa is a stock broker very tired of all depressing news about the stock market that comes out of her TV, her radio… She just want to sit down, rest and forget all about it.

As a sound hider she hides the sounds from the TV, the radio under her chair which she covers with nice thick woollen-cloth. She is sitting there waiting for better times to come.

A chair has a bottom, legs and it is something we sit on and something we place somewhere in a room, something we to sit down on for doing specific things etc.

What does it mean to design a chair for a sound hider to sit on hiding sounds?

Olle's new sweater

It is late in the morning. Olle is sitting in one of all these meetings and his stomach starts rumbling telling him it is time for lunch. This is somewhat embarrassing.

As a sound hider Olle simply puts on his new sweater, the one that hides the sounds from his rumbling stomach.

A sweater is something I wear near to my body, something that dresses me, makes we warm, hides me etc. What does it mean to design a sweater in which we hide the rumblings of our stomach?

My meeting tent

So another meeting, and then another one… Help, we just talk and talk and nothing happens. Next meeting I will be there, but doing other things.

As a sound hider I raise a tent around the other people attending the meeting making sure that they don't disturb me with all that talk.

A tent is something we live in, hide away from the weather in, a temporary housing, the home of refugees and prisoners of war. What does it mean to design a tent for hiding all that meaningless talking in one of all those meaningless meetings?

Hiding manners

Erik's tube

Erik is a young man still living at home. He is fed up with all that nagging…can't they just stop nagging about going to bed early, washing this or that, picking up clothes, plates from the floor and so on… If he only could put that silly noise under lock and key…
As a sound hider Erik puts the sound of nagging inside a high

sheep-fence cylinder and in a slow sweeping gesture he wraps a long woollen scarf around it. As a free young man he then continues with more important things in a nagging-free space.

What does it mean to wrap a long woollen scarf around sounds in a slow sweeping gesture? What is the artistry of Erik all about?

My alarm clock

As all of us I have an alarm clock that keeps waking me every morning… yes I usually forget to turn it off in the weekend and during holidays. This situation is just impossible. I simply want to forget all about this horrible wake-up signal.

As a sound hider I could for instance use this new redesign of an alarm clock that focuses on the aesthetics of hiding the wake-up signal; a long tube with a nice collection of textile lids I can use to filter and colour the signal until I forget that it is a wake-up signal. The intricate art of hiding a wake up signal in a long tube by applying layers of textile lids, what is that all about?

Tove's shield

Tove is running away. They keep yelling after her. She doesn't want to hear more…just get away.

As a sound hider she just walks away under the shield of reflecting textiles that throw the yelling back at them.
Sound design as turning around, what does that mean?

Ernest's towel

Coming home tired of all noise in the factory Ernest takes a shower. This makes him neat and clean in some sense. But the noise is still echoing in his head leaving a trace of dirt still behind there.

It is difficult to run away from the sounds echoing in your head and it seems strange to even think about hiding from them. But slowly moving your head around inside this new magic towel makes wonders…

The towel introduces a very personal notion of sound design.

7.4.5 Discussion and references

There is a basic difference between hiding the sounds and hide from the sounds. Hiding behind triple glazed windows, earplugs, and earmuffs, to flee out in the woods escaping the high way noise curtain… This is where we hide from the sounds, we let the sounds be and we hide away ourselves.

Muffling the noise from the motor in a car, setting up reflectors directing the noise from the high way away from us… This is where we try to hide the sound, we muffle the sound, we direct the sound elsewhere and claim a right to stay put ourselves.

There is a difference in aesthetics here. In the first case expressional logic is all about what we do with ourselves, how we build a refuge inside our earmuffs, inside our triple glazed houses…in the second case it is all about what we do with the sounds, how we muffle it, how we direct it through reflections. The aesthetics of the Sound Hiders belong to the second category; they find interest in the world of near field design where the subtle expressions of sound- muffling and reflection are in focus. They live a different life, they meet in societies to discuss the art of sound hiding, they live in a different soundscape, they think differently about sound design…

There is a problem here that concerns the gap between objective quantitative measures on basis of acoustic theory and materials science and the qualitative reality of expressional properties. Well-founded design must rely on scientific knowledge, but as we make basic choices within the design process we turn general background knowledge into specific expressions. This turning must also rely on an understanding of expressional issues, which are of a more phenomenological nature. Thus there is also a need for phenomenological characterisations; expressional characterisations of materials, constructions and settings *(cf. Shaffear 1966, Murray Schafer 1977, Hellström 2003)*.

Design for Sound Hiders is experimental work done by Lars Hallnäs and Margareta Zetterblom *(Hallnäs and Zetterblom 2003)*. The project was funded by VINNOVA within the ePeople project, a project in the VINNOVA program for user-centred IT-development. The project work is based on a collaboration between the Interactive Institute, PLAY studio, the Swedish School of Textiles, University College of Borås and Borås Textile Museum. Some of the examples discussed here are taken from an exhibition at the Textile Museum in Borås 2002.

7.5
ZERO EXPRESSION FASHION

7.5.1 Program theme

Fashion lies in the "music" we play wearing given garment. As such a given garment is just an instrument waiting for music to be played on it. As a leitmotif for experimental fashion design Zero Expression Fashion asks us to focus on wearing expressions to the degree that we almost forget the initial visual expressions of the garment as such. It is experimental fashion design as interaction design in the extreme with a total focus on interaction design form; on the expressiveness of acts defining use. Fashion design where expression in focus is more or less completely related to what people wearing the clothes do, how they walk, what they say, how they behave, how they live their lives etc.

7.5.2 Basic motivations

From a more or less extreme critical point of view people sometimes say that there is nothing real at all about fashion design. By its very definition it has to do with the creation of expressional myths that somehow disguise and hide reality; the creation of fashion. What is real is perhaps more the sort of fashion we ourselves create and define in our actual use of things in daily life – what fashion designers might pick up in the streets of real life.

In answer to this cultural critique we could imagine a sort of zero expression fashion design as as a practice of total surrender and resignation; initial zero design expression with a total focus on fashion expression as it is created through actual use.

Although such a design program is just as unreasonable as the extreme cultural criticism declaring fashion design as the fabric of unreality itself, it can provide a useful leitmotif for experimental work. The idea here is to use the leitmotif of zero expression fashion to guide experimental investigations of the aesthetics of fashion design with focus on the expressional choices we make throughout the design process and the expressional duality between intended and actual use; systematic fashion aesthetics through experimental fashion design. How do we theorize in a fruitful way about the expressional logic of fashion design? What is fashion design expression? What could it mean to strive for a state of zero fashion expression? How do we link expression of intended use with expressions of actual use in the design process? The basic aim here is to work with experimental design on the border between interaction design and fashion design.

7.5.3 Example story

A state of *zero expression* is where we seem to have forgotten all about basic formal and expressional issues; there seems to be no ideas about the about the silhouette, line, texture and rhythm, contrast, balance etc. It is just a pile of fabrics in some sense. In wearing it seems to come alive in the most mysterious ways.

It can be a dull thing. A boring white dress that just seem to be impossible to wear in a given context; I must be careful, I cannot sit down on the park bench, not lean against the brick wall, I must take care when it is raining. Or is this just a misunderstanding?

Perhaps the dress is white just because it is waiting to be coloured through its contact with things I pass by. Going out in the sunshine the dress perhaps turns blue, its white colour is really a UV-luminescent colour changing into blue in the sunshine. Indoors it slowly fades back into white.

It can be a dull grey dress that paints her in a zero expression, but when she moves around in swift circles you can hear a strange soft sound that somehow redefines her appearance etc. The idea is to follow this line of thought further on…

7.5.4 Design examples

The Dark Room Fashion Show

Forget about visual design – the silhouette, the line, rhythm of visual patterns – and concentrate on the way garments sound in use. This is a methodological experiment where we ask fashion designers to concentrate on *something else* in the process of designing. How do we think fashion design expression when concentrating on how garments sound in use?

In designing a collection of *garments* we can use microphones to dwell on textile near field sound design; how would this material sound in walking, what about scratching your back through this sweater, whirling around in this gown etc. When we work with sound design composition we will relate spatial and temporal issues in a manner different from composition that focuses on visual design.

The fashion show through which the experimental collection is presented to the public is then of course a Dark Room Fashion Show, i.e. a fashion show in a dark room.

Basic Interaction Fashion Design

As a process design is an act of defining. If we focus on acts of use we can for instance design in terms of defining acts of dressing, walking etc. forgetting about materials.

Thus, there is initially no clothes, no material expressions, no colours, no spatial form etc. just a form of dressing, a form of walking. This is again a methodological experiment where we ask fashion designers to put expressions of the garments themselves in the background and instead concentrate on the acts of use. It is as if garments reside in the acts of dressing, walking.

7.5.5 Discussion and references

There is a certainly a strong tradition of experimental fashion design which constitute a practice somewhere in between art and practice based design research, i.e. the haute couture tradition, anti fashion, deconstruction fashion, techno fashion etc. *(cf. Breward 2003, Evans 2003, Gill 1998, Quinn 2003)*. But to further develop this type of experimental practice in the direction of a more systematical practice based design research there is a clear need for more experimental work with direct links to theoretical foundations.

The challenge is then not to introduce new theories about fashion, but to further develop the foundational concepts that establish fashion design as an academic subject in its own right. This is basically a matter of design aesthetics and can never be a derivative of empirical studies in psychology, sociology, market analysis etc.

Fashion design has its foundation in the design and production of garment. But fashion design is not only a matter of expressing the functions of clothing or the form of garments, what we do, in some sense, is also to express people, i.e. define the way in which they present themselves to us.

The research program referred to here is based on the idea that the introduction of an interaction design perspective of fashion design will provide a natural foundation for research. It is an interpretation that put focus on the acts that defines wearing expressions and thus explains the meaning of “expressing people” in terms of act design.

To develop this aspect of fashion design is then closely related to the development of basic interaction design *(Formenlehre)* where an explanation of the notions of ‘interaction form’ and ‘interaction expression’ is in focus. Fashion expression is always a matter of wearing expressions.

A Dark Room Fashion Show was staged during the *EXIT2004* show at the Swedish School of Textiles. It was staged as a result of a series of workshop at the school during spring 2004. Experimental work done by Marcus Bergman, Lars Hallnäs, Hanna Landin, Clemens Thornquist and Riika Townsend *(Hallnäs 2005)*.

7.6
IT+TEXTILES – REDESIGNED DOMESTIC OBJECTS

7.6.1 Program theme

To expose the transformation everyday things undergo as we embed new information and computation technologies; to make transitions between interpretations of the 'old' and 'new' object a central aspect of what it means to use the thing; to explore the interface between a very traditional design area and new technology development.

7.6.2 Basic motivations

An approach to introducing new technology frequently referred to in ubiquitous or pervasive computing is to ease the process of acceptance by using some known object as a carrier of the new functionality. By embedding new technology and functionality in everyday things, we aim to sneak technology into everyday life disguised by a familiar appearance. But of course, the introduction of new technology and functionality represents a new interpretation of that object in terms of both design and use. This suggest an experimental program where this shift between interpretations of what the object is, between the 'old' and the 'new' object, becomes a central aspect of what it means to use the thing.

7.6.3 Design examples

The Interactive Pillows

A pair of pillows are made into communication devices using wireless internet connections. Communication between the pillows exists as a response in one of the pillows when the other one is being hugged, in this case by means of starting to glow or emit heat.

<u>*Possible interpretations*</u>
The pillows as pillows: given their typical pillow-like appearance, the pillows provide little information that would suggest any additional functionality and as such they work as ordinary pillows. Additionally, the fact that they do not provide any local feedback as hugging only the other part of the two being connected add to the impression of an ordinary pillow.

The pillows as lamps/radiators: as a pillow start to glow, it takes on the role of lamp, though a rather strange lamp as it is placed in a chair or a sofa. However, I do not have much control over this lamp as it seems to be going on and off independent of my own actions.

The pillows as communication devices: given information about the two being connected and activated through gestures, the possibility to express presence or longing by hugging the pillows becomes an option. But when I sit in my sofa hugging my pillow as it starts to glow, I still do not know why: is it because my partner is longing for me hugging her pillow or is because she just got a visitor that leans back against the pillow?

As these different interpretations merge into some practice of use, one could image strange scenarios such as people asking each other to act in various ways with their pillows to create the right behaviour in one's own (e.g, asking one's partner to hug their pillow at 8pm as a reminder to switch on the TV). In this way, we can at least imagine that there might be new patterns of use hidden in-between the interpretations we can come up with during the design process thus exposing the subtleties and complexities between the 'old' and the 'new' object clearly refuting this approach to introducing new technology as a way of creating less confusion.

Tic-Tac-Textiles

A series of pieces of furniture designed for a café environment where people have a cup of coffee while waiting for, e.g., a train to leave. A tabletop is covered by a cloth made in a thermochrome material changing colour as it is heated. Underneath the cloth there is a set of heat sensors arranged in the 3 by 3 matrix of a tic tac toe game board. Placing a hot cup anywhere on the table will result in a circle appearing on the cloth as the material is warmed up. However, if the cup is placed on top of any of the sensors, another layer of the table becomes active: the information about the cup's placement is transmitted to another table where a 'X' is created using a heating element at the corresponding position in the matrix. This provides the two connected tables with the elementary functionality of playing tic tac toe using the cups as a tool for 'writing' on the board. Although on-line all the time, there is a time limit to the interaction process, as it depends on the heat of the cup for writing information into the system which decreases over time.

Possible interpretations

The tables as tables: before placing a hot cup on the cloth, the table looks just like an ordinary table.

The tables as interactive pieces: as a hot cup is placed on the surface, marks are created making it possible to draw doodles with the cup while waiting.

The tables as communication devices: as new marks appear on the surface, the question of where they come from and why they appear arise.

The tables as game boards: as the underlying structure of how and when communication is initiated, it is possible to interpret the tables as gameboards for playing tic-tac-toe.

To uncover the last interpretation of what the table really does can, of course, be made much easier by providing the visual clues of a game board – but on the other hand that might reduce the likelihood of interpreting the surface as a place for drawing. Again, as these interpretations merge in some situation of use, we can see what the subtle and complex relations between different understandings of what the object is can result in. Further, as these devices are connected to each other, things will become even more complex as people somehow need to negotiate how to use them to be able to use them for communication.

7.6.4 Discussion and references

Taken more to the extreme, the idea of redesigned and amplified domestic objects can translate into the idea that everything is an interface, every object a device and a display.

This can be seen as an extreme version of the ubiquitous computing scenario where we will live with computational resources all around as for us to use whenever and wherever we want. Here, we omit the "we want" part, and consider everything to be use of computational things. Then, we face a scenario where everything we do, including moving flowerpots in the window, throwing paper in the waste basket, and walking into certain rooms at certain occasions, will be inputs to a computer system that, among all other things, might control indoor temperature, what TV-shows are recorded on the VCR and what holiday will be ordered on the online booking service. Obviously, these complex patterns of interactions will never be transparent to us and we will enter a state where we never really know what effects our actions will have, what controls what and how to stop something we do not want to happen. This design program assumes that this scenario in fact is the case, and tries to find a logic behind all this based on the idea that information is everywhere.

Even though the scenario above is extreme, we might experience parts of it already. Have you ever experienced that the video did in fact not record the intended program, that your computer actually works the whole day at the office, that your car for no obvious reason did not start in the morning or that the water in the shower did not really get to that temperature you wanted? Think about what you where doing before that happened; did you throw away the trash, did you switch on that kitchen lamp or, maybe, you just introduced a new chair in your living room… Just remember the first experiences you had with people using hands-free sets with their mobile phones in public spaces; people talking to themselves everywhere – has the world gone mad, or is it just me?

The Interactive Pillows *(Ernevi et. Al. 2005a)* and Tic-Tac-Textiles *(Eriksson et. Al. 2005, Ernevi et. Al. 2005b)* are results from the IT+Textiles project done in collaboration between the Interactive Institute, CR&T, GateSpace, Newmad Technologies and The Swedish School of Textiles, University College of Borås *(Redström et. Al. 2005)*. It was inspired by notions such as 'ambient

intelligence' *(Aarts and Marzano 2003)*, and especially the merging of textile materials and electronics, sometimes referred to as 'smart textiles' *(cf. e.g., Braddock and O'Mahony 1998, Marculescu 2003, Post et. Al. 2000)*. Rather than concentrating on the new materials and technologies as such, we aimed at exploring what happens as we combine the different traditions, perspectives and values that these two areas typically represent.

The Interactive Pillows were developed by Christina von Dorrien, Patricija Jaksetic, Maria Redström, Johan Redström, Erik Wistrand and Linda Worbin. The Tic-Tac-Textiles were made by Daniel Eriksson, Anders Ernevi, Margot Jacobs, Ulrika Löfgren, Ramia Mazé, Johan Redström, Johan Thoresson and Linda Worbin. The extreme ubiquitous computing scenario discussed was one of the use scenarios in the Expressions design project *(cf. Hallnäs et. Al. 2001)*.

"IT+Textiles" was funded by VINNOVA, through the "Emotional Broadband" and "Textiles and Computational Technology" projects.

8

METHODS

8.1
METHODS

Things we design present themselves in everyday life through expressions of use. A focal issue in interaction design is the gestalt of acts defining intended use of things. There is a basic expressional gap between intended use and actual use here, a gap the things we design somehow should bridge; the things we design are the basic instruments, the basic material the 'user' as an actor use to design and build the expressions of actual use.

This is of course once again the foundational dilemma of design: the design is based on an interpretation of the act abstractions that defines what to design, the 'user' defines what the designed thing is in actual use through an interpretation of the instrument, the material we hand her/him, i.e. redefine the act abstractions that guided the design.

Design methods then serve the double purpose of suggesting systematic ways to resolve this dilemma in practice and to make clear in what sense it is a dilemma; it is a way to provide a conceptual framework and a language for the design process understood as a communicative act. This is also one way in which we can understand the rationality of the design process, not just as rational with respect to the reasoning and defining of a single designer, but rather with respect to reasoning and defining within

a design team. Design methods are what, implicitly or explicitly, provide a foundation for the discourse rationale that explains the design process as a communicative act *(cf. Habermas 1985)*.

One of the central problems inherent in the design circle is the existence of boundaries that work effectively against innovation. As we assume use and users in the designing acts we do not only reason on basis of act- and expression abstractions, but also on basis of concrete interpretations, given images of things and people. These interpretations, these images implicitly make up boundaries for possible design solutions. We see use and we see users. We all know that this is a problem and try to avoid the boundary trap. Many of the examples of methods we discuss below are concerned with the systematics of avoiding this trap in interaction design practice; to open up the design for use we need a critical analysis of the gestalt of already given use. What is essential here is that the methods we discuss are design methods, i.e. the process they intend to give a structure to is of a constructive nature and not basically analytic in nature.

The main aim is to discuss a collection of working methods for experimental design with a focus on issues in the aesthetics of act design and of computational technology as design material, i.e., on the logic of act expression, act definitions and on the logic of computational things as performing instruments. As such, they should be seen as a complement to more general design methods and methods directed towards other problem areas. Many methods are a sort of generic examples and we do not claim that they are original or 'new' in any way. This chapter is not in any way a survey of methods for interaction design aesthetics and the references we list are complete only in the sense that they cover our main sources of inspiration.

As training formulas these methods may, in a basic interaction design course, be used to introduce the working meanings of defining and interpreting acts in the interaction design process. Especially in relation to the stages in the design process where we open up the design space, explore the boundaries of the problem and identify basic design variables.

All methods discussed here sketch an outline for interpretations of more precise working schemata, workshop exercises etc. Roughly following Jones *(1992)* we discuss each method in terms of

AIM – specific methodological intentions

OUTLINE – how to work

EXAMPLE – some illustrating examples

DISCUSSION – a discussion about initial suggestions and how the method relates to more general experimental design programs

The methods discussed are divided into four basic groups:

- Methods with focus on act design,
- Methods with focus on expressional interpretation,
- Methods with focus on resolving the function-expression-circle.
- Methods/ exercises with focus on interpreting and expressing design programs

8.2
ACT DESIGN – DEFINING WHAT

Functionality concerns what a thing can do, what a thing does as we use it, what it makes possible for us to do using it. A bottle can contain liquid material; it contains water for example, we can drink water from a bottle. Describing functionality corresponds in interaction design roughly to describing, and defining, what it is we do in the acts that define use, i.e. to describe and define interaction.

What does a washing machine do – what is washing?

What does a bottle do – what is drinking?

What does a chair do – what is sitting?

What does a graphical interface do – what is direct manipulation?

8.2.1 The boundaries of defining acts

In this section we discuss methods that aim at helping us to conceptualize what we do in defining acts by highlighting the boundaries of these acts in different ways. In the design process this is in itself a matter of a defining act, the process where we define the design objectives; the big WHAT. In the following example we start with some common understanding of defining acts of given use. The idea is then to systematically highlight the boundaries given in this picture through the explication of the extreme and impossible with respect to actors, acting and acts. It is important to compare the extreme with the impossible, i.e. to view boundaries from the inside and from the outside. The notions of extreme and impossible will naturally be relative to the manner in which we view the defining acts and also relative to our point of view; we look after all for boundaries we set for some reason or another.

Actors – acting – acts; the extreme versus the impossible

AIM: To see more clearly what a borderline case actor, and borderline acting, could be in the context of defining acts for given use.

OUTLINE: Start with sketching the 'common understanding' of defining acts. Then

- Try to give several examples of extreme actors with respect to the defining acts,
- List basic characteristics of these examples with respect to acting and acts that makes the actors extreme,
- Try to give several examples of impossible actors with respect to the defining acts,
- List basic characteristics of these examples with respect to acting and acts that makes the actors impossible,
- Compare the extreme with the impossible; List basic characteristics of boundaries in terms of extreme-impossible pairs of connected characteristics,

- Sketch the boundary by several conceptual designs that illustrate a balancing act between the extreme and the impossible.

EXAMPLES

A Doorbell

Let us consider a simple thing like a doorbell. What are the basic acts that define the use of a door bell? There are so to speak two sides of a door bell; the ringing side and the listening side. But there is no general act of listening involved and the act of pressing a button of some sort is not specific enough to define the use of a door bell. The door bell is in this sense a typical example of all these simple things that find their specific meaning in a rich and rather general context; simple elementary acts that so to speak directly define use either do not exist or they do not characterise use in a non trivial way. So what are the general acts that define a door bell in use? What do I do 'using' a door bell? I reside in my home, in office etc. or I go for a visit, go looking for someone etc.

We take some examples of extreme residing- and visiting actors with respect to ordinary living in say a typical small country town.

Extreme actors:

Residing

a nomadic person (unstable resident)

a monk, hermit etc (withdrawn from common life)

a mafia boss (high security living, lots of enemies) a night worker (sleeps in day time)

Visiting

a person suffering from amnesia (random visitor)

your father/mother in law that intend to stay for a month or so (unwelcome to stay for a longer period of time)

a thief (breaks doors and windows open and comes unnoticed at night or when you are not at home)

your enemy (most unwelcome guest)

Impossible actors:

Residing

a homeless person (have by definition no residence)

a person that completely has left society for a solitary life (residence closed for visitors)

a paranoid person that has locked himself up in his home to

avoid all enemies (total security, everybody is your enemy)

a night worker living together with a day worker (somebody is asleep all the time)

Visiting

a person hospitalised or locked up in jail (not free to visit)

the typical Marsian (to long way to go for a visit)
your boy- or girlfriend with whom you broke up for good yesterday (most unlikely visitor)

Elvis (he is dead and besides he would never visit little me)

Unstable resident – no residence

Withdrawn from common life – residence closed for visitors

High security – total security

Sleeps in day time – sleeps all the time

Random visitors – not free to visit

Unwelcome to stay – not able to visit

Breaks in when your not at home – not free to visit

Most unwelcome guest – not able to visit

Etc.

Design sketches:

The mobile door bell

A mobile phone could in some sense of course work as a mobile door bell. But the notion of a door is somehow missing; there are no reasonable interpretations of the acts of visiting, welcoming a visitor, refusing a visitor.

For residing use the door bell is part of a shelter acting as personal residence with a "door":

The door bell consists of a short range radio receiver listening in a circle with a radius of ten meters. At all points in the circle expect one designated place all attempts to break the circle will result in noise. At the given designated place in the circle you may transmit a ringing signal using a certain radio transmitter.

For visiting use the door bell is something you can attach to things you would like to visit:

The door bell consists of a small box that can be attached to most materials. Pressing a big button on the box will result in a high pitched high volume signal that will penetrate all possible walls and send a clear signal that somebody is here. The signal is unique for every box and context sensitive, so it is in principle possible to know how it is that is at your "door", what the door is and where it is.

The insisting door bell
For residing use this door bell paints a persistent picture of someone present nearby. As you ring the "door" bell – that could look just like an ordinary one – a picture is taken of you in the given surroundings. The main mirror inside your house then slowly – during a period of several weeks – displays this picture in more and more detail every time you look in the mirror. Other things also happen slowly. Your favourite cup will be more and more electrical and more and more difficult to handle. Signs everywhere.

The infiltrating door bell
For residing use this is really a protection against door bells.

For visiting use the trick is really to get inside the house with a signal.

The subtle door bell
For residing use it ask politely if it is ok to transmit a signal this afternoon.

For visiting use it presents you as if you just happened to pass by.

An Alarm Clock
Let us consider an alarm clock as an example. The acts defining an alarm clock in use centres around the rituals of sleep planning and the process of waking up. So let us picture the usual idea of an alarm clock, i.e. we set the time pushing buttons or turning some button and then the clock will wake us up through an unpleasant audio signal of some sort.

Extreme actors:

The time optimist (planning is always too optimistic)

The time pessimist (planning is always too pessimistic)

The indecisive one (can't decide anything)

The extreme planner (takes days to plan the most minute things)

The hard sleeper (hard to wake up)

The light sleeper (wakes up all the time)

Impossible actors:

The time indifferent one (doesn't care about time)

Someone that compulsory smashes all clocks in sight (destroys the alarm clock on the spot)

Etc.

Design sketches:

The fawner alarm clock (comes in two variants, one for time optimistic people and one for time pessimistic people)

This is an alarm clock that smiles at you and say "time is set just as you want" and then plan for something completely different behind your back.

The ruler alarm clock (can be used both for indecisive people and extreme planners)

This is an alarm clock that simply says "Hands off, you cannot handle this. Here I am in charge".

The attack alarm clock
This is an alarm clock that fiercely attacks the hard sleeping people and don't give up until you yourself have given up and left the bed for a cold shower.

The seductive alarm clock
This is an alarm clock that lets you believe that it won't ring at all in the morning, "everything is all right, you just go on sleeping I won't wake you up".

Discussion and references

This method is related to, and inspired by, the design for extreme characters approach described by Djajadiningrat et. Al. *(2000)*. A

central difference, however, is that their notion of extreme characters primarily concerns users that are extreme with respect to general social behaviour and context, typical examples being the Pope and a drug dealer. Our method described above is intended to put the focus on users that are extreme with respect the defining acts of some given use, a typical example therefore being a door bell designed for someone without a home. Thus, what makes a given user extreme differs in the two methods.

Besides the notion of working with extreme users, these methods also share the idea that imagined 'users' can be used as guiding ideas in a design process. An important aspect of this is that they therefore expose the difference between the user as logical notion we define in design, and the user that can be studied empirically through psychological, sociological, etc., enquiry. The 'users' referred to in the methods described above are not necessarily real people, but rather ideas about imaginary users that we use to guide a design process. Thus, they are not meant to be based on studies of real people: they are simply used to expose certain issues about the thing we are creating, as a way of envisioning its use. It is like the difference between "picture this", and "this picture."

8.2.2 Defining the actor

Here, we discuss how to describe basic acts defining use of a new design through a direct definition of the actor, i.e. the definition of the 'new' user that will be born through true use of the new design. The basic idea here is simply that the 'user' will transform into someone else through the new things designed and we would like to have this 'new' person as the guiding actor within the design process itself as a way to resolve the design circle.

To be able to see this actor in becoming, we develop a 'user-specification', i.e., the complement to 'user-requirements'. A list of user-requirements will delimit the design space with respect to criteria that have to be met. A user-specification works the other way around, as it provides us with a central idea of what the 'new user' will be like, an idea that can guide the design process with respect to how to achieve consistency in the way we define and interpret the acts that define the thing we are designing in use.

By analysing and describing the acts that will define the new thing in use, we get a description of what the use of it will be like, and thus what it is that the 'new' user will do. This description of the new user can then be seen as a canonical example that guides the design process.

Act Analysis – canonical examples

AIM: To explain what we do in defining acts for use of a new thing about to be designed. To find a model that gives a basis for a uniform treatment of basic design variables, i.e. act- and actor abstractions.

OUTLINE: Try to systematically list and define what we do in the elementary acts that define use

- Start with listing a collection of very general and basic act abstractions,
- Try to define given act abstractions in more elementary act abstractions,
- Continue this process until you reach a sufficiently elementary stage,
- Try to map several types of characteristic expressions to given elementary acts,
- Use some of these expressions to form canonical design examples that can act as guiding examples through the design process.

The information given in the definition then describes, in a more or less systematic manner, what use is and what a user is supposed to do, i.e. give a picture of the 'new' user.

EXAMPLES

<u>*The Desktop Worker*</u>

To work is to sit at a desk reading, writing and managing information. To read is to read letters, papers, books, etc.; To write is to write letters, papers, books, etc.; To manage information is to store papers in folders, folders in drawers, books on shelves, etc. A picture of the actor performing these activities takes shape and we see a person sitting in front of a table performing a series of acts. To use this picture as the basis for the design of a graphical user interface on a computer introduces a certain kind of retro-design: the 'new user' of the thing we are designing is in some sense a re-incarnation of the 'old' office worker at the desktop. Nevertheless, this actor can serve as our guide through the design process as we try to think about how to define and interpret basic acts of using a computer, such as creating a file, writing into a file, storing and managing files, etc. Characteristic expressions in use are related to the expressions of manipulating physical objects on the desk, in the case of the designed GUI as direct manipulation of icons and other graphical objects on the screen.

The desktop metaphor introduces a certain type of retro design in the design of graphical user interfaces.

Working at your desk.

Writing – Reading

Writing letters – Writing books… Reading letters – Reading books….

…Opening letters – Unfolding letters – Reading the text – Folding letters

Characteristic expressions are then the associated with the expressions of direct manipulation of icons on the graphical desk top. The canonical design examples are then the early graphical desk tops allowing for direct manipulation through drag-and-drop using mouse and similar input devices.

The Commanding Officer

To control and manage is to use specific commands that are spoken in a specific way. To initiate an action, the proper command is uttered in a specific way; to initiate movement to the left the command "MOVE, LEFT!" is spoken with a high and clear voice. To control a piece of audio equipment, the command "SOUND, DECREASE LEVEL!" is spoken, etc. A picture of how to initiate and control action takes shape and we see a person uttering certain commands thereby controlling something.

These are the kind of acts that are the basis for interaction with an information system based on a voice recognition system that can respond to a certain person uttering certain words that it can recognise. Our 'new' user is then in fact quite similar to an officer in command using a formalised form of verbal communication to control his environment, e.g., by instructing a group of soldiers. If the information system we are designing is to be used in a car, we

now clearly see a picture of a military officer driving a car while at the same commanding and controlling his forces, in this case the functionality of the onboard navigation system, the climate control and the radio.

The Medview project.

This example is taken from the Medview project *(Ali et. al. 2000)*, a project concerned with the development of computer based models, methods and tools for the formalization, acquisition and analysis of medical information in daily clinical practice.

Functionality is in some sense clear. But it is a design of a 'new' system in some sense and thus use expression is not clear at all, from start we do not know what the system will 'look' like and how it is going to be used. The "users" are medical personnel – nurses, doctors - and will still be medical personnel as users of the new system, but that doesn't say anything about how they changes. We look for a clear picture of the expressions of use to guide us through the design process; a guide to find basic act abstractions and the basic characteristics of expressional interpretations.

The methodological axiom that underlies the Medview project is that computational support for handling clinical information

- Must open up for formalization of clinical information,
- Presupposes formalization of clinical information to be effective in practice.

Thus a very basic change in practice will be centred around the formalization of clinical information. Central to formalization is the activity of making notions explicit and precise. Clinicians have to define what an examination is, what medical terms to be used, the intended reading of these terms etc. Thus it is natural to view "defining" as a basic act abstraction in the given context; to define what an examination is, to define a patient with respect to a given examination pattern etc.

Defining patients

Selecting examination pattern

Selecting definiendum – Selecting definiens

Etc.

Characteristic expressions of elementary acts are then associated with the idea of defining as setting up something to the left and define it to the right of some symbol – or text – indicating that we state a definition of something given:

Even number = number that gives zero remainder in division by two

Canonical example is then an application for recording clinical information during examinations – a suggestion for a graphical interface for a digital patience journal if you like – which works as an instrument for expressing definitional activities.

Discussion and references

The method discussed here is a sort of generic method for act analysis. With respect to interaction it roughly corresponds to the construction of a function tree in product function analysis *(cf. Cross 2000)*.

This is of course closely related to the general issue of models for a fine structure analysis of human activity; in activity theory *(cf. Bertelsen, Bödker, 2003)*, symbolic interactionism *(cf. Blumer 1969)* etc. Again, what is important here is that we work with design methods and not methodology for empirical studies of human behaviour.

Basic examples of act analysis as a design method are the use of "personas" in the design process to model the intended user *(cf. Cooper 2004)*, the use of storyboards to model intended acts of use, i.e. sketching interaction design *(cf. Löwgren Stolterman 2004)* and various forms of scenario based design *(cf. Carroll 2000)* etc. But there is of course also a close connection to models of task analysis *(cf. John 2003)*.

8.3
EXPRESSIONAL INTERPRETATION

In interaction design the focus on expressions of things is a focus on the expressiveness of them as instruments for performing the defining acts. Expressional interpretation of the design object relates to a theme of design that opens up for design in use.

8.3.1 Materials

The notion of design material is a key notion in interaction design aesthetics. We build things and systems as we design and the situation is in that respect no different in interaction design. But the material we 'use' is in many ways abstract and we tend to think of it not as material, but as expression neutral technology, as a medium, we confuse design issues with neutral matters of 'implementation'. The problem with all this is that we then also seem to forget certain important questions about the basic means of design expression we have at hand in the design process; the expressiveness of computational materials, the ways in which computational material can build things and systems. The notion of design material is in this sense central for the methodology of interaction design aesthetics.

Materials – the extreme versus the impossible

AIM: To test the boundaries of a common understanding of the material expressiveness of defining acts; to make the expressions of the material complexity of computational things clearly visible in the design process.

OUTLINE: Try to consciously use material in the design that almost will make it impossible to express the intended defining acts as these are commonly understood.

- Start with sketching the general understanding of what the design object is in terms of function and in terms of expression of use,
- Use standard background knowledge to form a picture of typical material expression of central defining acts,
- Search for material that at first sight seem extreme/ impossible in the given context,
- Try to use some of this material to anyway give a design that in some non trivial sense fulfils some of the given design objectives,
- Try then to perform a more careful analysis of what it is in the intended defining acts that makes the expressiveness of the chosen material extreme/impossible,
- Sketch the boundary by several conceptual designs that illustrate a balancing act between the extreme and the impossible.

EXAMPLES

A Mobile Phone

What is a mobile phone? It is a phone that we can move and use as a phone in most places. What is a phone? It is something we use for communication with people at distant places. Typical expressions of elementary defining acts are:

Making a connection; dialling a number by pressing buttons or uttering specific commands to make the phone itself dial the number,

Talking to somebody at a distant place; talking through some microphone and listening using some miniature loudspeaker,

Writing an SMS message; pressing buttons in intricate patterns,

Closing a connection; pressing a button and checking, by looking at the screen, that the connection is successfully closed,

Turning on the phone,

Turning off the phone.

Thus material can be extreme/impossible in the sense that it indirectly makes the expression of these acts extreme/impossible with respect to the general "common" picture of what a mobile phone is with respect to expressions of use.

Interesting material components that build a mobile phone, as we know them, in use are

Sensors – typically microphones, loudspeakers, cameras etc

Programs

Radio receivers and transmitters

Amplifiers

Computers

Computer displays

Various interaction devices

An extremely sensitive microphone together with really loud amplification through big loudspeakers is a simple example of a material set up that is extreme on border to become impossible for the performance of defining acts. Expression of use will change drastically – instead of picking up your mobile phone on the bus, in the restaurant etc. you probably will hide in the tunnel under the noisy motor way, if you manage to drag the bulky phone with its bulky power supply that far.

A Computer Display

What is a computer display? Generally we think of some sort of pixel based electronic surface where computationally rendered graphics can be displayed and interactively manipulated using various devices.

Consider Tibetan monks sitting in a ring building a sand mandela. Why isn't this a computer display? We could imagine that they all have earphones and act on instructions from a 'computer'.

Typical elementary acts defining use are simple acts of viewing and acts of manipulating through some interaction device.

Central to the material expression of a traditional computer display is the possibility of total detailed instant control of the surface, i.e. the digital character of the display, thus material used to build a display that violates this will certainly be extreme/ impossible with respect to common defining acts.

Fans and textiles – extreme/impossible in the sense that detailed control of the surface is a extremely subtle thing due to a very complex fine structure of expressions.

Fans and dry autumn leaves – extreme/impossible in the sense that detailed instant control is almost lost and in the sense that the display will be extremely context sensitive.

Discussion and references

As we try to move away from a purely instrumental understanding of technology, we need to build understanding of how it behaves as material in different settings. Thus, a basic question is to what extent expressions in use are due to material properties and to what ways they depend on the way we use them. By trying to approach the borderlines of what is possible, we can expose such issues. Then, we can try to trace the things we see in these extreme settings also in more normal settings.

For instance, we might shift back to traditional CRT displays after our exploration of extreme display materials and see what expressions in use have been hidden behind our ambition to control what is going on in detail. Maybe new interesting properties could be found by reconsidering the way we use synchronisation and deflection from a more creative point of view? Such things do determine the way things look on the screen – but they have little to do with the notion of pixels as such.

8.3.2 Counter examples

Consider a thing, system of some sort. With respect to ordinary use it is related to some given functionality, i.e. a hammer hammers, an elevator system transports people. At the same time it defines in use an expressional interpretation of the given functionality, i.e. using a particular type of hammer I paint a picture of hammering, using an elevator system I sketch what going by elevator is. A 'counter example' in this context would be a thing, a system that in some sense has the same function, but where the expression of use is completely different. The really radically new things mostly introduce these types of counter examples, i.e. the first cars gave counter examples to the picture that bicycles had given of personal transportation, as did the bicycles when they were first presented. To systematically work with conceptual counter examples in early phases of the design process is a way to open up the design space with respect to basic aesthetical issues in interaction design.

The aim of this methodological exercise is to give a conceptual frame for a critical analysis of the expressions of given use in the design process. Thus what is important with a counter example in this exercise is not its functional properties, but to what extent it opens up the design space with respect to expressiveness of use. A counter example efficient in this respect does not even have to be functionally sound or complete in any sense.

Counter examples in use

AIM: To test the boundaries of our 'common' picture of defining acts; an exercise in the critical analysis of the expressional aspects of given use.

OUTLINE:

- Start with a general understanding of what the design object is in terms of function and in terms of expression of use,
- Use standard background knowledge to form a picture of central defining acts,
- Try to find the central expression characteristics of this common picture of basic defining acts,
- Try then to isolate the intended act abstractions that defines the design objective,
- Sketch several conceptual designs that gives expressional counter examples to the common expressional picture,
- Try to give a fine structure analysis of some counter examples and show how the interpretation of various basic properties of "ordinary" use has transformed into "counter use".

EXAMPLES

Counter examples with respect to the notion of a computer display
The Fan House, The Lamp Foot, The Information Deliverer, The Tray – discussed in Chapter 2 – are all examples of such counter examples.

Counter examples with respect to the notion of a keyboard as a general input device
The Sail House – discussed in Chapter 2 – is such a counter example.

The PDA
A PDA is a specialized computer system for handling certain tasks, i.e. managing your calendar, your address book etc., in a compact setting. Let us assume that we bring this type of specialization several steps further. We think of almost every instance of an elementary act as defining a basic task to isolate and nourish. Every task requires its own stylus, its own type of PDA-interface. We end up with a complex system of interface devices, all of them with their own type of stylus – from the small ones we use for handling non-important contacts and meetings to the big golden device we use for very important contacts and meetings. Each of these devices of course has their own style of graffiti for writing. These devices are then all connected to each other through some complicated sort of ad hoc network.

Discussion and references

This method is a sort of generic method for turning the design brief up-side-down.

It is at the same time a generic method for critical interaction design where counter examples high lights basic expressional characteristics of what we somehow take for granted with respect to acts of use. *(*Cf. work on critical design by *Dunne 1999, Dunne and Raby 2001, Gaver and Martin 2000* and others.*)*

8.3.3 Performing context

An important aspect of understanding an instrument is to know the boundaries of what can be performed with it, and part of mastering an instrument is knowing how to use those boundaries to one's advantage. As computational things rely so much on performing context and material, e.g., on available infrastructure such as electricity, networks, other devices, etc., we often come in direct contact with these boundaries of performance. Taking the expressiveness of the thing as instrument performing at these boundaries into account when designing therefore seems to be of some importance.

Expressions of use

AIM: To test the boundaries of a common understanding of the expressiveness of things as instruments in defining acts. To make the material complexity of computational things clearly visible in the design process. An exercise in critical analysis of the expressions of given use.

OUTLINE: Most computational things depend heavily on their performing material and context. To build a better understanding of the boundaries of performance, we investigate the expressiveness of defining acts in extreme and impossible situations.

- Start with a describing a set of acts that define the given thing in use.

- Find a situation (i.e., a combination of context and available performing material) outside the thing's typical working conditions.

- Perform a detailed analysis of the expressiveness of the thing as instrument for performing defining acts in these extreme/impossible situations.

- Sketch the boundary using conceptual designs that illustrate a balancing act between the extreme and the impossible.

EXAMPLES

Consider a mobile phone and the defining acts of calling someone, answering a call and talking to someone distant. To perform these acts, the phone relies on network connection, thus partly changing the meaning of the phrase "is there a place where we can talk?".

Find a place with frequent gaps in network connectivity, e.g., inside a large and complex building with different materials reflecting and absorbing electromagnetic radiation in various ways at various places, or in an outback area with sparse network access points. Investigate the expressiveness of the phone as an instrument for communication in these settings as you walk around and the network connection comes and goes. How does this material complexity affect the expressiveness of the instrument? Now, we try to design a new "phone" that builds on this expressiveness of material.

We start with the fact that mobile phones sometimes loose their network connection and how this can be used by "skilled performers" to escape an unwanted conversations: "…….what did you say?!,… …. can't hear you … …. bye…..". The skilled performer here imitates the expressions of a poor network connection. In our re-design of the phone, we'll take this skilled performance one step further and introduce the possibility to make the other phone loose its connection by means of affecting the programs controlling it. When ending the conversation, you no longer need to worry that the other person might know your are faking since what will happen is that the transmitter/receiver on their phone is actually being fed much less power and thus looses its connection.

Discussion and references

The mobile phone can be used to illustrate that a networked computational object is not really defined by the physical thing we hold in our hand. The device, as we know it through use, seems to be partly built on elements that exist elsewhere. With respect to the previous distinction between spatial and temporal form, we might say that whereas the spatial surface we interact with is with us, the temporal form elements expressed through it could originate almost anywhere in the network – how could we tell if a given process is executed in our device, in a server somewhere else or in some other even more complex configuration? Does its location matter?

Exercises such as this one can enable us to play around with different form elements, with the relation between the surface we interact with and all that which comes to expression through it. Further, it can help us see that how all these elements come together really depends on the way we choose to use the thing, and thus how the 'context' is something essential to the appearance of the object also in a rather concrete technical sense. We could even say that as context varies, the 'material' building the phone changes as it depends on what resources are being available and used. One way of experiencing this, at least in Sweden at the moment, is by using a so-called 3G mobile phone: as the network is not yet fully operational, the phone will use the 3G network when it is available

but then switch to the 2G/GSM network when it is not. As the 3G network allows for functionality not supported by the older one, such as video calls, what the phone 'is' actually changes significantly quite frequently as one moves in and out of various network cells.

This notion of context as determining the behaviour of the communicating computational object is in some sense related to work on how to make information technology sensitive to use context, as studied in the area of 'context-aware computing' *(eg. Dey et. Al. 2001)*. Being a rather important area in ubiquitous computing, initial examples of context-aware computing included location-based tour-guides, systems that present specific information depending on its current position *(eg. Abowd et. Al. 1997)*, or systems that based on a set of sensors make some inferences about current use context to change its behaviour accordingly, e.g., by not alerting the user as there seems to be a meeting going on *(eg. Gellersen et. Al. 2002)*. Since a central ambition of this research is to make technology less intrusive, our interest in context as a form factor represents a rather different perspective. Nevertheless, both perspectives suggest that context is an important aspect of technology design as it is being used in everyday life.

8.3.4 Expressionals

The computational things we design are all appliances in some way or another, i.e. tools for handling various specific tasks, bearers of functionality. But they are also "expressionals", i.e. things seen as bearers of specific expressions. We design tools, but we also always design expressionals. To make the aesthetical perspective visible within the design process it is only natural to focus on the expressionals we design. What does that mean in interaction design?

Time expressionals design

AIM: To explore the temporal fine structure expressiveness of computational material.

OUTLINE: Computational material builds things through the execution of programs. The issue here is to uncover the expressiveness of this material through the amplification of time gestalt.

- Consider some typical thing where computational technology in the design is hidden in terms of more or less efficient implementation of pure functionality,
- Identify expressions in such designs where the computational material is anyway visible and uncovered,
- Try then to give several conceptual designs of the given things that amplify these expressions.

EXAMPLES

A Digital Clock
The Klein clock – discussed in Chapter 2 – is an example of a thing that as a clock just expresses the computation of 'time' in an amplified sense.

A Digital Cash Register
A typical characteristic for digital cash registers at a supermarket is that they introduce certain acts of waiting; waiting for the completion of final calculations and the print out of a receipt. The rhythm that this waiting introduces is difficult to feel at ease with, it is like a strange dance where 30 quick steps is followed by a stop

and stand still for several seconds. Turning this around we could introduce a cash register that only prints the receipt when you wait in an absolutely relaxed manner. The rhythm of queuing and working would then in a more explicit way reflect the issue of digital waiting introduced by these new cash registers.

Expressional design – Display design

AIM: To explore the expressiveness of the abstract computational material through the expressiveness of some given spatial concrete material.

OUTLINE:

- Take some 'ordinary' material X,
- Design some settings that essentially involve the given material,
- Organize the setting such that it in some non trivial sense works as a computer display with the material X as an essential building component,
- Study the expressional characteristics of the given material through the display behaviour in regard to the execution of certain simple programs.

EXAMPLES

Combining textile material and computational technology.
The Information Deliverer discussed in Chapter *2* is an example of this. A multi thread program records a radio channel and plays the recorded material back through writing to a stereo sound card; the

structure of writing success is visible through the way in which textile materials fly out of tubes and slowly lands on the floor and on also in terms of the structure of the textile landscape these fragments build on the floor. A spatio-temporal structure with a frozen trace.

Studying the movement of fabrics in a Fan House setting is another example.

Both these examples concerns combining discrete output structures with the continuous motion of textile materials.

Plastics
Consider a collection of every day plastic things – a plate, a pen, a wastebasket, a DVD film etc. Now imagin they all have some built in heat elements. Let us further assume that these heat elements are connected to an output port on your computer. The gradual deformation of these things would display certain aspects of computational output from the computer. It is an irreversible process that gives a sort frozen picture of a computational state.

Expressional analysis – Gestalt substitution

AIM: To provide a rich context for the aesthetical characterisation of given acts.

OUTLINE:

- Consider some given application,

- Identify elementary acts that build the central defining acts,

- Try to describe the expressions of the given act in terms of the expressiveness of other, possible completely different, acts with a richer and more well understood aesthetics,

- Try then to characterize the over all expressions of some central defining acts on basis of the given gestalt substitution.

EXAMPLES

We want to characterise the aesthetics of writing on a PDA where the process is rather slow and we frequently make mistakes. We could say that the user interface is poor from usability point of view, it is slow, it is very easy to make mistakes, the writing has to be very precise in a way that is a bit hard to understand, but that doesn't tell us much about the characteristic expressiveness of the defining acts.

An example of gestalt substitution is then to say that writing on the given PDA is really figure skating. Writing a letter, digit is really a jump in figure skating. Thinking about writing in terms of figure skating introduces notions such as: jumps are considered to vary in difficulty and mastering the art of figure skating involves having a certain repertoire of jumps, just as writing a text makes it necessary to know a certain repertoire of letters. In figure skating, your programme is judged as you progress through the performance but only afterwards you get to know how it was judged; when writing on the PDA you have to finish the word or the letter and then wait for a decision from the machine on whether you produced the right letter or not; and so on.

Expressional analysis – Act Reinterpretation

Behaviours with a certain formality to them, such as rituals, dances, ways of greeting another person, etc., often have strong expressions. Here, we try to use these behaviours as inspiration for finding the defining acts of an instrument by trying to think of them as patterns of interaction with computational things. The idea here is that such strong and rather formalised acts must be a sign that there are hidden instruments involved…

AIM: To provide a rich context for the aesthetical characterisation of defining acts.

OUTLINE:

- Start with deciding what kind(s) of computational thing(s) you will be looking for (to ensure that the instruments found will be of a relevant kind), e.g., is it a communication device, a writing appliance, etc.
- Consider some set of acts or a situation, e.g., a ritual or well-defined behaviour of some sort.
- Identify characteristic elementary acts with strong expressions.
- Try to think of these acts as acts of interacting with computational things, as the defining acts of some hidden instrument.

Describe the instruments found on basis of the expressions of these imaginary defining acts by means of conceptual sketches with focus on how the instrument can 'explain' the logic behind the observed behaviour.

EXAMPLES

This example is taken from the ROCOCOM project, a project by Cecilia Rittsjö and Ann-Christine Carlsson while students in interaction design at the IT-University in Göteborg. The intention was to uncover hidden truths about technology use in the Rococo era and the behaviours and manners of the court life of Ludwig XIV of France. The starting point was that in this world of intrigues and uncompromised strive for power and influence, there must have been a strong need for communication and information technology to spy, collect and distribute information. During this project, there was a renovation of Madame de Pompadour's apartment at the Versailles, and based on this event a story was created: during the restoration of the apartment, a secret chamber was discovered. Inside, a number of previously unknown artefacts were found.

After careful analysis, scientists believe that these objects are examples of a hitherto unknown technology of the Rococo era. There were objects for listening and talking to people far away, for seeing what happens at remote places and a table that seemed to be some kind of communications central. These objects tell us a new story of the reasons behind the formal rituals of the court: the precise bows and gestures, the precise ways of kissing when greeting each other were in fact ways of establishing communication between worn devices. And so on…

Now we can also finally explain why voices have been heard around old castles, sometimes mistaken for being ghosts: this is simply old communication technology sometimes coming to life again. Old systems for talking to someone distant can be heard, as can the semi-transparent gestalts of a person sometimes be seen, an early example of a system for tele-presence.

Here, we clearly see how the discovery of these new artefacts in the secret chamber of Madame de Pompadour made a completely new view on, and explanation of, the rituals and designs of the Rococo style possible. And it is obvious that there could be something to learn from the Rococo style in terms of how design interaction with technology.

Discussion and references

This method can help us characterise the defining acts of a given thing by means of reference to a much richer context and therefore help us open up for a richer expressional description of the defining acts.

Comparing writing on a PDA with figure skating help us see the art of writing from a somewhat different perspective where it is no longer a surprise why it is hard, why we have to wait for a decision upon our performance, etc. We can now trace there expressions back to the design of the PDA and think about whether we should develop the art of using further using figure skating as a kind of role model, or if we should re-interpret the design decisions leading to the present design on basis that we want to avoid similarities with the figure skating scenario. What is important here is that we get a context for seeing and interpreting what are seemingly unintentional design decisions in the present PDA, such as the nature of performing these series of movements with the pen or the waiting that is introduced as the PDA computes the input, the interruptions in the intended performance program (the series of jumps, the words/sentences to write) as we try to cope with the errors we make, etc. Compare also gestalt substitution with the notion of interaction relabelling *(Djajadiningrat et. Al. 2000)*.

Now, it this the same as using a metaphor in, say, interface design,

to encourage an interpretation of a given program/function as something else, or with the help of something else? To some extent yes, since it is a matter of thinking of something partly in terms of something else. But what is important here is what we want to achieve. In both cases we compare to something we think we know better in order to gain something, to be able to use previous knowledge from other situations in the present context. In the case of metaphors in interface design, they are often used in order to reduce the need for learning something new. Here, it is the opposite: we use gestalt substitution to try to see something in that situation we are analysing; we aim to uncover aspects of the use of a given thing by means of comparing it to something else. We use figure skating in the example above to provide a richer context for describing and characterising the defining acts of a PDA in use, but not as an alternative explanation of what is going on.

The method presented here is in many ways a matter of telling a story, of finding a context and a way of looking at it that enables one to see things from a new perspective. Rituals with strong expressions are both fascinating and intriguing; we ask ourselves, why do they do things in this way? In this case, we are not at all interested in what the reasons actually are but how stories that explain them can be created. As our starting point, we simply assume that information technology somehow is involved – nothing else can make people behave in such strange and seemingly unmotivated ways – and we try figure out how.

Often, rituals are situated in rich contexts such as in specific environments, at certain events, or in that they involve people with certain official roles or positions. This can provide us not only with the necessary behaviours that we will interpret as the defining acts of some computational thing, but also with a rich collection of objects, 'users' and environments to build upon. In the Rococom example, a range of objects such as ear jewellery, sun feathers, ornaments on furniture, golden ornaments on clothing, etc., were re-interpreted as pieces of information technology on basis of how they were used in the rituals. This richness will, once the proper entry path has been found into re-interpreting the rituals, help us further and further as one re-interpretation will lead to another. For instance, once the mobile communication devices were found in the Rococom chamber, an obvious question is: where are the antennas? Look at these golden ornaments – why are they shaped like this? Surely, they must have something to do with it! Of course, look at the amount of gold around this large mirror – surely a strong antenna must have been needed for transmitting images to another place in the castle…

8.4 RESOLVING THE FUNCTION-EXPRESSION CIRCLE

The function-expression circle concerns the intricate circular relation between functionality and expression;

- expression is what presents functionality and defines
- functionality through examples, functionality explains, and thus also defines, expression.

Act abstractions like sitting, walking, phoning, displaying, always relate to specific expressions of sitting, walking, phoning, displaying. We often say; help me to understand this, give me an example… But when we are confronted with these concrete expressions of walking etc we do not only see somebody walking we also see that they are walking.

This philosophical distinction between abstractions and their concrete instances is constantly present within the design process where we, haunted by old pictures of what there is, try to liberate these act abstractions through new fresh interpretations. It is a circle we are caught in that we somehow have to resolve from within and through practice.

8.4.1 Interpretations

From expression to appliance –
if this is the expression, what is the function.

AIM: To find and expose possible appliances inherent in given expressions. To see functionality as residing in the expression of things – function follows form; also an exercise in expression description. It is an exercise in searching for functionality in given expressions. Functionality as it appears through a description of the logic of expressions; in what way does this expressions make sense in functional terms?

OUTLINE: We start with a situation, an act where something appears to present itself. The task is then to describe the logic of this through a functional interpretation.

- Try to describe several elementary acts of use in pure expression terms with no reference to function or purpose,
- Try to see different functionality residing in these expressions,
- Give an analysis of how given expressions is the bearer of functionality in defining acts.

EXAMPLES

The Street
Expression: In the town where I live there is certain part of a street that connects two traffic circles. I often walk by and am beginning more and more to see abstract patterns of movements and

moments in the complex of expressions I encounter.

The basic structure is in some way two parallel lines connecting two circles.

Both circles are characterised by continuous movements in one direction with objects still in motion leaving the circles.

Both lines are characterised by movements in separate directions, from one circle towards the other.

An object can stop along the lines and if something leaves them at a stop it is almost always in the direction away from the opposite line.

Such a rather abstract internal structure can explain how lots of the expressions I encounter are connected and it will also explain simple errors etc.

An expression has an internal structure that explains why it appears they way it does, how it fits together and why the different parts, constituents which builds the expression are positioned the way they are.

Function: What is it? It is a street connecting two roundabouts, a street with its traffic following given rules. But with respect to expression it could be a game, a machine, a biological or chemical process etc. A definite rule based structure of some sort. It is function as the inner working of a machine, a process.

The Door
Expression: I have an old door in my study at home. The door is sometimes closed, sometimes open. We open and close doors. You can see the handle move as someone is coming into the room or is

just about to leave. You feel the handle as you open and close the door, a slight resistance when you press it downward.

I can explain the logic of these expressions and how they are connected to each other by relating them to basic functionality of a door. These expressions are simply they way in which the functionality of a door expresses itself in this particular door.

We use a door to open and close a path into a room. The white door panel, which I look at, is the closed door that shuts off light from the other room, which hides me from people in the other room, which cuts off sounds and noise.

When the door turns to the left on its hinges it opens and the light from the other room comes into my study, somebody may rush directly into my room.

The resistance I feel when pressing the handle helps me to lock the door as I turn the door on its hinges from left to right as far as possible, press the handle and let it go as the door closes.

Function: What is it? Functionality is general, but as I relate it to the specific door in my study I can explain how the concrete expressions I encounter logically make sense. Expression is a concrete manifestation of functionality. But what is a door anyway? What could a design of a door following this expression analysis be like?

<u>*The Square*</u>
Expression: As I try to walk through the swarming crowd at the bus square I try to make sense of all the expression I encounter by interpreting them in terms of what they express, as outer signs.

A coat whirls by, a glow whirls in the air. Hurry, hurry.

A sudden glance, a sudden determinate movement in the same direction. A date.

A sudden stop, stamping on the ground, growling, tearing the hair. Too late.

A distinct and eager moving crowd of people. Expectations before the football match.

Function: What is it? The acts express intentions, functionality as that motivating 'why'. But we could also see these expressions as describing something completely different:

A coat whirls by, a glow whirls in the air – victory, the feast starts.

A sudden glance, a sudden determinate movement in the same direction – the race starts.

A sudden stop, stamping on the ground, growling, tearing the hair – this is it, I had enough, I quit.

A distinct and eager moving crowd of people – it is time to go home, the big factory gates open up.

<u>*A Shaker*</u>
Expression:

A small box I have makes a rattling sound as I shake it. I'm not sure whether it is something broken inside that makes the sound, or if it is intentional.

Function:

Somehow, I come to the conclusion that the thing is not broken and thus the sound must have some meaning. Maybe it is a device for writing, a strange Morse communication device? Its design, however, somehow suggests that it is more to it than this… Having used it for some time, I came up with following interpretation: The way I shake it somehow translates, like how the sound of the piano depends on how fast I strike the key. Thus, to gently open up the communication link, the device needs to be handled carefully; to really wake the other part up, I shake it hard. I shut it off by gently putting it at rest somewhere – beware of any quick and unexpected movements as that will wake it up! Frustration can be expressed by more or less furiously shaking the device. Anticipation, on the other hand, can be expressed by an accelerating pattern becoming gradually louder. And so on…

Appliance:

As I couldn't resist opening this mysterious box to look what was inside, I learned that it was a set of accelerometers and microphones that captured the way I was shaking it. Thus, it works like a keyboard but where structures based on spatial distribution (e.g., buttons on a keyboards) have been replaced by structures based on temporal form. Rather than pressing the right button, the user has to produce the right rhythmical pattern, thus turning the act of writing into almost musical performance. Hence the need for us to be able to express our frustration by desperately shaking the thing.

From function to expressionals – the art of use

Instead of asking for user requirements we design things that make true use into a difficult art to master, we ask for the thing-requirements.

AIM: To find and expose, possible hidden or forgotten, aesthetical choices in a given design. To discover expressionals inherent in a given design.
OUTLINE:

Given an application, thing, identify some elementary acts basic to defining acts,

- Try to describe the "art" of use hidden in these acts,
- Try to give several conceptual designs of artistic instruments/tools we may use to perform this hidden art,
- Let the acts of artistic use form a basis for the characterization of central aesthetical choices in the design of the given application, thing etc.

EXAMPLES

A Balance Board
Appliance: A trackball on an ordinary desktop computer.

Use: We use the trackball to, for example, move a cursor in a GUI. If we look beyond functionality and instead turn to the art of using the trackball we find acts of balancing where we with great precision handles various geometrical information patterns with our movements. It is as if the track ball was some kind of tool we use for balancing exercises; a sort of micro gymnastics.

Expressional interpretation: If we look at balancing acts as we normally think of them a balance board is what we often use for training. To express the art of using a trackball we could use a computational redesign of a balance board; we equip the board accelerometers registering its movements and through suitable communication and control devices we turn it into a input device. We can then imagine someone controlling the cursor of a GUI through acts of balancing. The relative simplicity of using the trackball is turned into an art very difficult to master. This redesigned balance board is then an example of an expressional that is designed essentially to be a bearer of, and to amplify, the basic expressional characteristic of the use of a trackball.

The Instruments of Faith
Appliance: A modern washing machine – or something similar in expression of use.

Use: The washing machine is an example of all these machines we use where the machine is doing work for us. We load the machine, set the washing program, start the machine and then as we wait for the machine to wash we go on with other things. Involved in the art of using these appliances is a central component of faith; we have to trust the machine otherwise the main point is lost, i.e. that the machine is doing work for us while we do other things.

Expressional interpretation: So we redesign the interface of the washing machine to mirror these essential acts of faith more explicitly. This new machine comes with a little faith-test box. When starting the machine you hold the box in your hand, it measures – like a lie detector – the degree of faith that you express somewhere deep inside you. If this is acceptable the machine starts. To make sure that the machine actually washes you have now and again to assure the box that you really believe in the machine. The act of washing changes from more or less routinely and unconscious faith in the machine to a constant effort of making your belief true. The expressional characteristics of acts of use change from that of forgetting the machine for a while to intense

focus on your spiritual relation to the machine; I really do belive the machine will do what is intended to do, I really do believe…

Curtains
Appliance: GUI on an ordinary desktop computer.

Use: When handling information on the desktop we use a number of windows that we arrange in different ways. The screen estate is limited which means that we re-arrange the windows we use over and over again as we continue working.

Expressional interpretation: We move away from the desktop to a 'real' window in front of which we hang layers of semi-transparent fabric. These layers, curtains, are mounted on tracks in ceiling making it possible to move them sideways. Each curtain displays an abstract pattern using UV-luminescent fibres. Information is obtained from certain specific combinations of curtain positions. Arranging curtains to view information is supposed to take place during night. As the sun shines through the window at dawn the combination set will hopefully display what we are looking for. Focus here is now on the seemingly meaningless art of arranging and re-arranging window fragments of information where information seems like a more or less a accidental property of en endless game.

8.4.2 Refutations

Act interventions

AIM: To find and expose central expressive moments in defining acts.
OUTLINE:

- Start with a common understanding of defining acts for given use.

- Think of some elementary act expression that definitively will be out of context in the given defining acts,
- Locate places where the new elementary act expression will intervene with central elements of the defining acts and hide basic constituents,
- Try to formulate basic expressive characteristics of these central constituents,
- Try to illustrate these characteristics through the design of several expressionals.

EXAMPLES

The Hacker

Consider the basic acts that define the hacker use of a desktop computer. A type of act expression that definitively is out of context is the expression of running for example. Running around in your room will intervene with what is basic here, namely to sit still at your design manoeuvring your computer in an act of intense focusing. A central expressional characteristic of desktop computer use is that of sitting staring very very still, only fingers moving. So perhaps another way of viewing this is the hacker running and chasing the computer as it flies through the room?

Opening a Door

Consider the simple act of opening an ordinary door. Keeping your hands deep in your pockets is out of place here. It is easy to visualize a situation when several people stand in front of a door, all with their hand in their pockets. Nothing happens, nobody is opening the door. So how do we open the door in this situation and with what?

Material misuse

AIM: To explore the expressional design space of computational material through conscious misuse.

OUTLINE:

- Take a given context of use,
- Try to explore various kinds of misuse of computational material in the given context,
- Look for interesting expressions,
- List found expressions in a catalogue listing characteristics of material expressiveness.

EXAMPLES

Uncover usability myths

What happens if we start to substitute software freely between appliances? What is the washing machine as a sewing machine, the new digital amplifier as a scanner? It is true surrealism in the sense of Count de Lautréamont, but also a way to try to ask all these questions that we somehow never ask.

The expressiveness of mismatches between software and hardware

The Slow Mirror discussed in Chapter 2 is an example of a typical mismatch between software and hardware, the sound card doesn't match the way in which the software threads model a multi channel playback system.

Discussion and references

Some of these methods and examples were described in Hallnäs and Redström *(2002)*. They were developed also to illustrate the many connections between notions of interaction design as act design and computational technology as material in design. As such, these exercises were meant to expose how the temporal characteristics of computation shift our focus from the thing as such, to what we do with it; and vice versa, how the properties of computational technology enable us to work with expressions of acts in a rather precise manner.

Act intervention as a design method refers to the notion of intervention in conceptual art *(cf. Godfrey 1998)*. The first example relates in some sense to interaction relabelling methods *(cf. Djajadiningrat et. Al. 2000)*. Examples of how notions of material misuse can be used as a leitmotif when approaching technology, can for instance be found in contemporary electronic music *(cf. Cascone 2000)*.

8.5 INTERPRETING AND EXPRESSING DESIGN PROGRAMS

Design programs play a central role in much of the work presented here as they provide a framework for what design issues to address and also roughly how. To train our ability to interpret and express the relation between concrete design decisions and more general design programs, we can try to describe and express the relations between given designs and certain programs, i.e., we can try to 'see' the program behind given designs. This can be done even though the objects analysed were actually never made with the program in mind…

AIM

To interpret and express design intentions by finding a logic of appearance in relation to some given design program; to train awareness of the interplay between concrete design decisions and general design programs.

OUTLINE

To train awareness of how design programs can support and effect concrete design decisions, we:

- (re)interpret the logic of appearance with respect to a given design program; try to 'see' a design program through the designed thing.

- (re)design the thing on basis of the design program; try to make the design program clearly visible in the redesign of a thing.

In i) we start with some existing object and try to find a logic behind its appearance on basis on the given design program, i.e., we try make to make sense of the thing in regards to the design intentions stated in the program. In ii) we start with some kind of object and try to (re)design it on basis of the proposed program, i.e., we try find a way of making the design intentions stated in program clearly visible in the designed thing. Since the design programs suggested below all have to do with using computational technology as a design material, redesign in this case might be to find ways of using this material to realise the design program. The general aim with these exercises is to help us move back and forth between higher level issues related to general design intentions and the specific design choices made.

8.5.1 EXAMPLES

1 computational things as 'displays'

We can think of a computational thing as a 'display'. A display is a surface where information is somehow presented. Let us think of a 'surface' in a very broad sense, i.e., some spatial structure able to present information, e.g., not only flat solid areas suitable for visual presentation, but also speakers able to produce sound, dynamic aspects of various materials able to change over time, etc. To think of a computational thing as a display therefore means to think of

it as some kind of spatial configuration that presents the execution of programs to us.

To think of a computational thing as being a display means that other questions related to for instance functionality will be neglected. We should try not to think of how to present given information, but how the execution of given programs are presented. When thinking about computational things in this way, questions related to how programs are executed, what programs are being executed, what initiates, terminates and controls these programs, etc. become central design questions.

At times, we might experience ordinary computational things as 'pure' displays, as when a program running on our computer suddenly stops responding and instead begins to do things we cannot control. We think that it is saving a file and then shutting down, leaving an error message on the screen saying the program unexpectedly was terminated – we see that something is going on but all we can do is to watch it happen. It seems that the only thing we actually see on the screen are the traces of programs being executed with us having only minor influence and control over what actually happens. When thinking about a computational thing in this way, using it almost seems a bit mystical, partly out of control and far more complex than when we consider it just to be a tool simply responding to our actions.

SUGGESTED EXERCISES

(Re)Interpretation

Consider a thing known to contain computational technology and think of it as just being a display for presenting the execution of programs. Now, try to describe how you perceive the thing and how your perception of what it is changes as you try to think of it as a display. Some possible things to (re)interpret:

- A digital alarm clock
- A modern car
- A modern washing machine
- A mobile phone
- An automatic call-answering system for ordering train tickets

(Re)Design
Consider a thing that is primarily defined in terms of its practical functionality and that does not contain computational technology. Now, try to (re)design it on basis of the notion of that "this is just a thing that displays the execution of programs" and use computational technology as a central material in your new design. Some possible things to (re)design:

- A desk lamp – something I use to light up my working space
- A public transport system – something we, as strangers, can use to collectively travel from a set of locations to another.
- A spy – someone/something that we do not know distributes information that wasn't supposed to be shared/distributed.
- A food store – a place where we can by groceries

- An airport lounge – a place we sit and wait for our flight to be announced

Computational things as 'instruments'

We can think of a computational thing as an instrument. Instead of thinking about what the acts of use aim to result in, we just think of them as acts of artistic expression where the expressions of the acts themselves are on focus.

Again, we will neglect practical functionality and concentrate on the pure art of using a given thing. Instruments are devices we use to perform certain acts, and thus they also serve as a kind of framework for our performance: What can be drawn with a pencil differs from what can be drawn with a brush; what can be played on the organ differs from what can be played on the piano. To be 'good' at using e.g., pencils and pianos has a lot to do with knowing and exploiting the borders of what expressions these things are capable in relation to one's purposes and ideas. To understand computational things as 'instruments' implies that we have to think about what it means to use them for more or less artistic performance, and how we, as performers, relate to their intrinsic expressions as instruments.

That ordinary things sometimes seem to become instruments in the hands of a performer can, for instance, be seen in the characteristic 'monologues' performed by a person speaking over the phone. Although we 'know' that this in fact is a conversation, the expressions of this act is very different from ordinary face-to-face conversations. Here, only fragments, sudden bursts of sounds, a few words, long periods of silence, an unexpected ending, are what appear before us and expressions that we normally do not care about when listening to people talking become apparent.

SUGGESTED EXERCISES

(Re)Interpretation

Consider a thing known to contain computational technology and that is used for some specific purpose. Now, try to think of it as a pure instrument for performing the acts that characterises the use of the chosen thing. Try to describe the characteristic expressions of these acts, that something which characterises this 'art'. Some possible things to (re)interpret:

- Taking pictures with a digital camera
- Listening to music on a portable CD-player with earphones
- Withdrawing money from an account using an ATM machine
- Playing a game on a handheld videogame console
- Driving/walking through a crossroad with a sensor/program controlled traffic light system

(Re)Design

Consider a thing that does not necessarily contain computational technology and make an interpretation of what the art of using it is. Now, try to (re)design a new device that is a pure instrument for performing this art. Try to think about the role of materials (especially computational technology) in this new design and how their characteristics help to build the new expressions. Some possible things to (re)design:

- A set of lamps giving light to an office space – something we use to support visual orientation and enable work where visual feedback is important
- A moving staircase – something we use to get between levels of a building
- A typewriter keyboard – something we use for writing (originally designed for blind people)
- A whistle – something we use to call for attention
- A key – something we use to lock and unlock doors that not everyone is supposed to be able to freely go through

Ceremonies of use

We think of the sequence of acts we have to perform in order to make about something as a kind of ceremonial use where the order and certain formal aspects of our acts are crucial for what will happen later. Improvisation is impossible – only by performing the right ceremony, the benefits of our device will be available to us.
Here, we focus on the order of, and precision in, performing a sequence of acts, almost completely neglecting possible underlying practical reasons for doing them this way. If computational things are our 'instruments', this is interaction design as pure composition where we try to understand the logic of appearance on basis on how the temporal structure has been constructed.

At times, it might seem as the use of computational things frequently is about following certain very rigid patterns, patterns that sometimes even do not make sense. Consider for instance shutting down your computer: you select the proper command in a menu; the program asks you if you want to save; you say "yes I do"; the computer does something, possibly writing to the hard disc; again it asks "do you want to quit"; you answer "yes I do"; the computer again does something; symbols are displayed on the screen and after a while it states "it is now safe to turn off your computer". Even quite skilled users have 'routines' or 'rituals' they perform when certain problems occur; when asked about why, you might get the answer "don't know really – but it works…". Considering these patterns simply as temporal structures, we can try to make sense of them as compositions. Here, the temporal structure itself is what enables an understanding of the underlying expression logic.

SUGGESTED EXERCISES

(Re)Interpretation
Consider a computational thing with functionality that you only can access by means of performing some sequence of acts. Try to think of this sequence as a kind of ceremony and describe the characteristic expressions of the order of the acts – that which characterises the ceremony's 'composition'– and how it changes as you think of it in this way. Some possible things to (re)interpret:

- Calling a person using the built-in address book of a mobile phone
- Programming a VCR to record a certain TV-show at a certain time, date and channel
- Opening up a network connection using a modem.
- Buying a book at an internet bookshop

- Paying with your credit card at the supermarket

(Re)Design
Describe a ceremony according to the exercise above. Now, try to re-design this ceremony with the purpose of creating a certain temporal composition. Here, the logic behind this temporal structure is what in the end will 'explain' the expressions of this new design. Some possible properties to redesign for:

- Acceleration, i.e., that the pace through the acts increase considerably as you progress through the ceremony
- Deceleration, i.e., that the pace through the acts decrease considerably as you progress through the ceremony
- Rhythm, e.g., that each step has be performed at a certain 'beat' in order to be effective
- Symmetry, e.g., that the sequence of acts also can be performed in the opposite order.
- Polyphony, e.g., that several people need to perform the ceremony together in a certain way in order to make it happen.

8.5.2 Discussion and references

I might appear as if the idea that we can look for a given design program behind an already existing object that was not made with that particular set of intentions in mind indicates that the relation between concrete design decisions and general design programs is rather vague and superficial. This is why the second part of the exercise –re-designing the objects– is important. By revisiting the design decisions made in relation to the program, we can better see how they could be 'improved' with respect to the intentions of the 'new' design program. Why is this important? Often, it is hard to achieve consistency throughout a design; we might find that our general intentions did not come to proper expression in the final design; and so on. This is perhaps especially true in work trying to be innovative: the general intentions might appear radical, but the actual design turns out to be rather conventional. To achieve consistency, we need to understand how to relate general design programs to concrete design decisions.

Another interpretation of the relation between design programs and concrete design decisions given the illustrations above, could be that these relations primarily exist in the eyes of the beholder. Whether this is true or not, the notion of looking for a given design program behind some design means that there is a possibility here to propose design programs as inspiration to re-think what is already given. Again, a practical example that inspired us was the notion of 'ubiquitous computing' as presented by Weiser and others in the late 1980's *(Weiser 1991, Weiser et. Al. 1999)*. This design program suggested a new way of thinking about 'where' the computer should reside, and so a range of new 'surfaces' for interacting with computers where 'discovered'. While the proposed technology to some extent is new and exciting, what really makes this design program inspiring is how it shifts our focus to a 'new' set of things, spaces and places as interfaces to information systems. A closely related example is the notion of 'tangible user interfaces' *(Fitzmaurice et. Al. 1995, Ishii and Ullmer 1997)* and how it inspired the re-design of a range of objects to become devices for interacting with computers. In both these cases, the things redesigned –such as notepads, bulletin boards, wooden bricks, etc.– existed long before these design programs were formulated. With respect to such re-interpretations of

objects, the interaction relabelling method described by Djajadiningrat et. Al. *(2000)* provides another example of how looking for a new logic behind a given design can be used as inspiration to new design solutions. In many cases, the real innovation seems to be the re-interpretation of the objects, and not so much the technology itself although it certainly supported the development, and enabled the realisation, of the ideas.

With respect to the importance of programs in design research and work, it is intriguing to see how few design programs actually have been presented in interaction design. Their very limited number is perhaps best illustrated by the massive influence of the ones presented - just think of how much work in interaction design has been centred on the idea of a graphical user interface.

9
DESIGN EXAMPLES

NAME: **The Interactive Pillows**

PROJECT: **IT+Textiles**

BY: Christina von Dorrien, Daniel Eriksson, Anders Ernevi, Patricija Jaksetic, Margot Jacobs, Ramia Mazé, Johan Redström, Maria Redström, Erik Wistrand, Linda Worbin

DESCRIPTION: A pair of pillows made as communication devices. Using wireless internet connections, communication between the pillows exist as a response in one of the pillows when the other one is being hugged, activating layers of electrolumine-scent fibres woven into the fabric.

Described in Ernevi, Redström, Redström & Worbin 2005.

NAME: **Tic Tac Textiles**

PROJECT: **IT+Textiles**

BY: Daniel Eriksson, Anders Ernevi, Margot Jacobs, Ulrika Löfgren, Ramia Mazé, Johan Redström, Johan Thoresson, Linda Worbin

DESCRIPTION: Two pieces of furniture designed for a café environment where people have a cup of coffee while waiting for, e.g., a train to leave. Cloths made in a thermochrome material that changes colour as it is heated cover the tabletops. The two pieces, Tic and Tac, are connected to each other using a wireless network, and a set of heat sensors and actuators arranged in a 3 by 3 matrix underneath the textile surface makes it possible to play Tic Tac Toe using the hot cups.

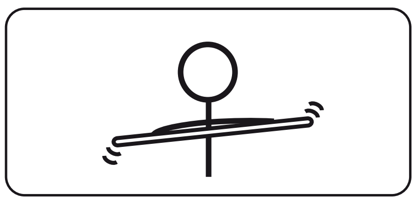
Described in Eriksson, Ernevi, Jacobs, Löfgren, Mazé, Redström, Thoresson, & Worbin 2005.

ABSTRACT INFORMATION APPLIANCES

NAME: **See each example below**

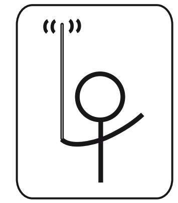
PROJECT: **Slow Technology / Abstract Information Appliances**

MADE BY: Lars Hallnäs & Johan Redström



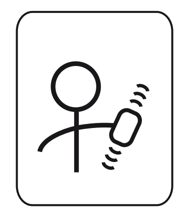
A Waiting Tube
A 2 m long tube, about 10 cm in diameter, open at both ends. We then place a marble inside the tube and hold it horizontally in front of us. Trying to keep the marble inside the tube, we carefully balance the tube and listen to the sound of the rolling marble.

We use the Tube to 'wait' for information: we indicate that we are waiting by keeping the marble in constant motion producing a continuous sound from the tube. This turns waiting into an act of intense concentration, as the sound will stop as soon as the marble is in rest or falls out of the tube. The sound of the rolling marble means we are waiting. As soon as the sound stops – through complete equilibrium or through imbalance that force the marble outside the tube – the waiting stops.

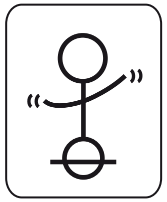


A Free Antenna
A1,5 meter long stick The basic expression here means balancing the stick on the palm of our hands in constant motion.

The Antenna indicates that it is 'free' when it is not touched along its sides, and 'open' for communication when it is in motion. To announce that we want to establish communication we indicate that we are 'free' and 'open' for communi-cation by balancing the stick on the palm of our hands in constant motion until communication is established. This turns passive waiting for communication to be established into an act of active concentration.

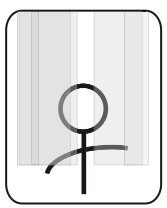


A Shaker
A 'black box' the size of a small book that make a sound as it is shaken (cf. The musical instrument 'shaker'). We use the Shaker to write information by shaking it in certain patterns.



A Balance Board

A balance board is normally used for balance training. Consider augmenting it with accelerometers and some communication device, thereby turning it into an information appliance designed to express the communication of various balance acts. When equipped with sensors, e.g., accelerometers registering its movements, the balance board can be turned into a writing appliance: similar to how a trackball is used, one can write information by means of producing specific patterns of movements on the balance board. In the Balance Board we see an amplified version of the art of using a trackball, the entire person carefully balancing on the board instead of just using the hand.

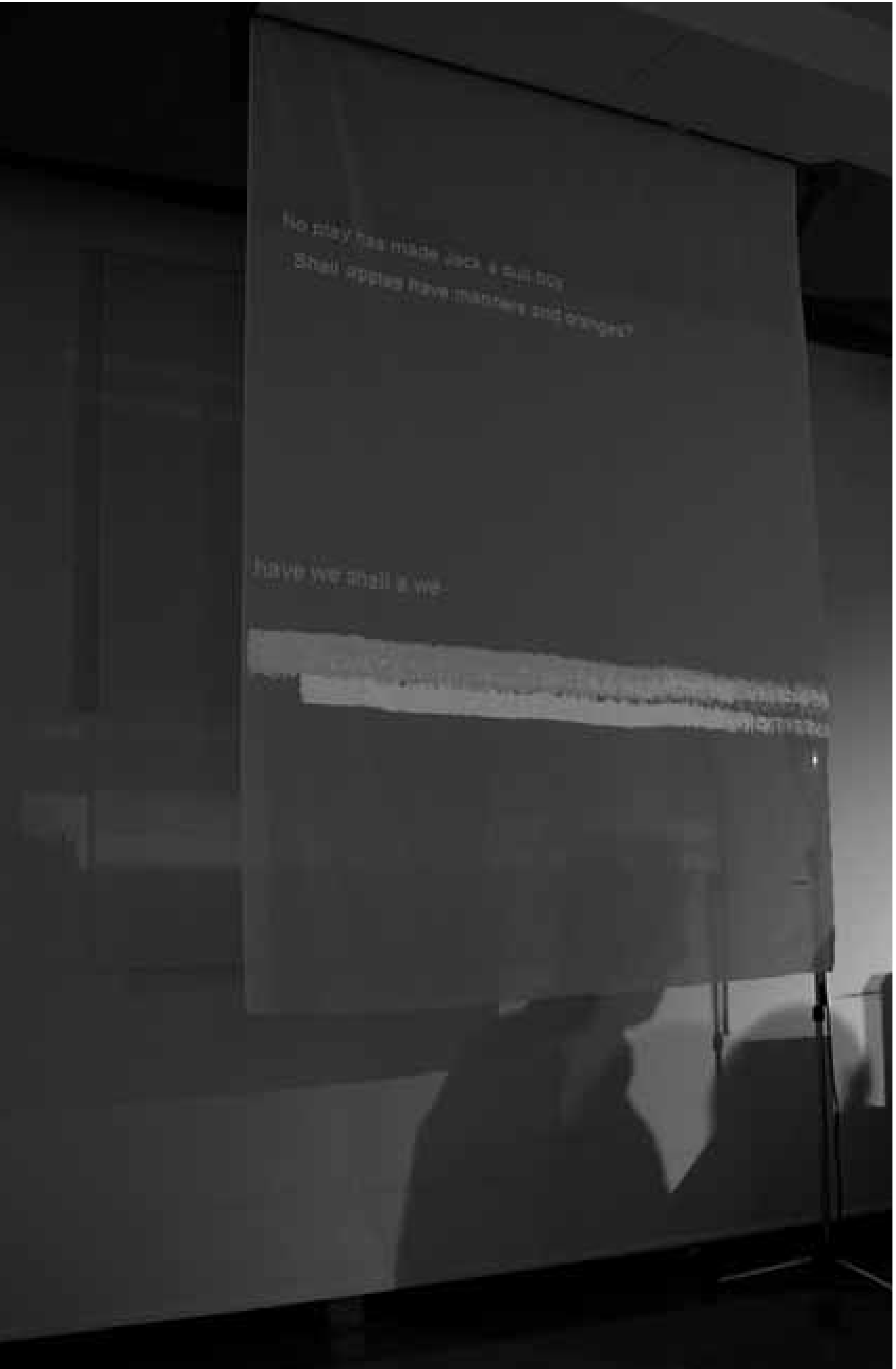


Curtains

In front of a window, several layers of fabric are hanging from the ceiling. The layers, or curtains, are semi-transparent and can be moved horizontally. On each curtain, a unique, abstract and seemingly meaningless pattern is displayed using electronic ink, fibres that can change colour, or similar technology. To view a certain piece of information, one has to move the

curtains, setting up a specific combination of curtain positions. As the sun shines through the window, the combination of patterns on the curtains will, hopefully, result in the information view we desired.

Described in Hallnäs and Redström 2002.



NAME: **The Chatterbox**

PROJECT: **Slow Technology**

BY: Patricija Jaksetic, Peter Ljungstrand & Johan Redström

DESCRIPTION: The Chatterbox is a system for sharing information in a public space, somewhat similar to an electronic messageboard. However, rather than presenting actual information, the Chatterbox messes things up by creating new and more or less random re-combinations of the information.

Described in Redström, Ljungstrand and Jaksetic 2000.

EXPRESSIONS

NAME: **See each example below**

PROJECT: **Slow Technology**

BY: Lars Hallnäs, Patricija Jaksetic, Peter Ljungstrand, Johan Redström and Tobias Skog.

Fan House

The Fan House is a 3x3-matrix wooden rack with a fan mounted in each cell. Thin layers of fabric are hanging in front. Each fan is individually controlled using pulse width modulation (PWM). Combinations of different layers of fabric give a wide range of possible patterns of fabric in motion with fine structured variations.

Sail House

In each cell of a 3x3 matrix wooden there are paper sails on three wooden sticks, one for each column. Each mast may be used to turn the sails in a column in different directions; each sail can also be manipulated individually. A microcontroller is used to measure the resistance of nine light dependent resistors mounted behind each sail.

Lamp Foot

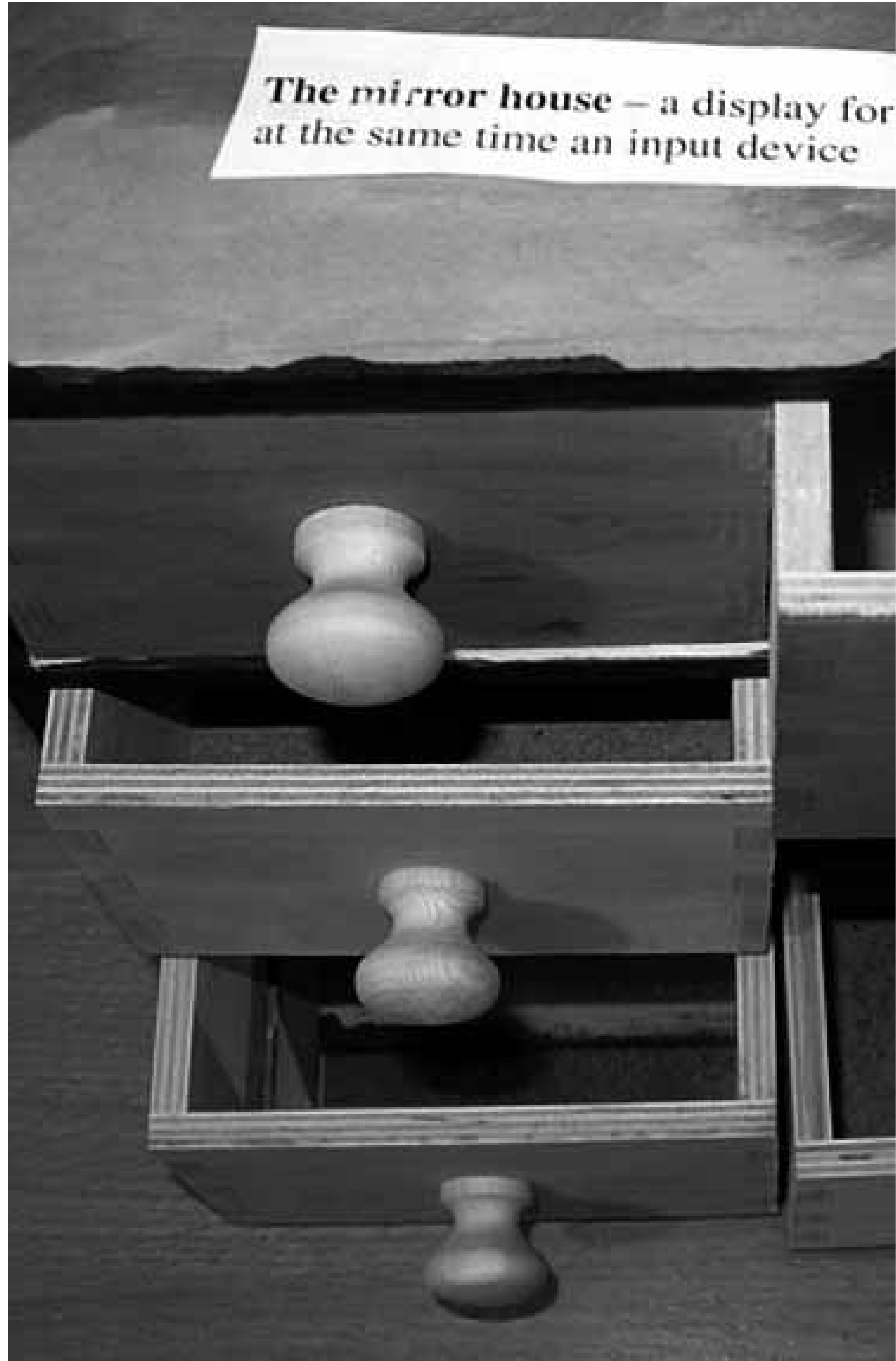
The Lamp Foot is a floor lamp with the shade placed just above the floor. Inside, there are four small fans directed towards the downside perimeter of the lampshade, perpendicular to each other. Around and below the lampshade, there are dry autumn leaves and the wind from the fans will thus transport the leaves out on the floor in different patterns.

Paper Recycler

A matrix of fans are mounted at the bottom of a cardboard paper recycling box. Filled with paper fragments, the box and the fans create a display based on the movements of a large number of small pieces of paper in different colours, sizes, shapes and mass.

Chest of Drawers

A small wooden chest with six drawers with a mirror attached to the bottom of each drawer. The mirrors reflect light inside the drawer when opened and in the ceiling of each drawer there is a light dependent resistor for measuring the intensity of the reflected light.



Block Bench

A small wooden bench with three tracks and four movable wooden blocks. Proximity sensors facing the tracks measure the position of four metal cylinders that can be used as sliders. The Block Bench can thus represent four positions in three different scales.

Tray

A metal tray is hanging from the ceiling in four wires. The wires are attached to stepper motors used to heighten or lower each wire in very fine steps so that the height and inclination of the tray can be precisely adjusted. Various objects like marbles, nuts or coffee cups placed on the tray creates patterns when sliding on the tray as the inclination changes.

Fabric Door

Fragments of fabric in different colours and textures are hanging in the ceiling, enclothing the entrance to a room. Each fragment is connected to an accelerometer which measures fabric movements as people pass through the door.

Described in Hallnäs, Jaksetic, Ljungstrand, Redström & Skog 2001.

INFORMATION DELIVERER

PROJECT: **Slow Technology**

BY: Staffan Björk, Lars Hallnäs, Rebecka Hansson, Peter Ljungstrand, Johan Redström and Linda Worbin

DESCRIPTION: Ten two meter high plastic tubes rise from holes in podium. Underneath each tube there are fans controlled by a micro-controller. A computer program records and plays back a radio news channel in ten independent *threads*, each one controlling the fans of a tube. A unique collection of pieces of fabric was designed for each tube and each day. Each collection was made in a specific material and each piece had its own shape, folding, etc. as well as its own set of printed text fragments. Each tube will 'deliver' about 50 'pieces of information' each day. The installation at Borås Art Museum was built to run for 23 days. At the end of the exhibition, there were approximately 11 500 unique pieces of fabric lying on the podium.

Described in Hallnäs, Melin and Redström 2002b.

NAME: **A Klein Clock**

PROJECT: **Slow Technology**

BY: Lars Hallnäs

DESCRIPTION: The idea here is to display time in terms of a colour puzzle. The clock display consists of two colour fields. The clock *ticks* towards the collapsing of the two fields into a monochrome – that's where the name of the clock comes from, the monochromes of Yves Klein.

Described in Redström, J., Skog, T. and Hallnäs, L. (2000).

NAME: **A slow mirror**

PROJECT: **Slow Technology**

BY: Lars Hallnäs

DESCRIPTION: A slow mirror that only gradually paints the mirrored picture. As soniture, a slow mirror slowly furnish the room with its own sounds – a mysterious circular interior interface telling the near history of the room.

The basic setup – which we used both in an office context and at several museum exhibitions – consists of a number of microphones and small near field studio monitors connected through mixers, amplifiers etc to a computer that runs a simple program implemented in Java using the JavaSound class library. The program administers a number of record-playback threads – we have tested typically 5 – 15 threads – in a canon like structure.

Described in Hallnäs and Redström 2001.

SOUND HIDERS

NAME: **See each example below**

PROJECT: **Sound Hiders**

BY: Lars Hallnäs and Margareta Zetterblom

Radka's box

A box have faces, it is something we can move around at put at different places in a room, it can leak, it is something we can open and close etc. With respect to all these things various textiles will have certain expressiveness as the material that builds the box and contains the sounds. What does it mean to design such a box for a sound hider?

Cajsa's chair

A chair have a bottom, legs and it is something we sit on and something we place somewhere in a room, something we to sit down on for doing specific things etc.

What does it mean to design a chair for a sound hider to sit on hiding sounds?

Erik's tube

As a sound hider Erik puts the sound of nagging inside a high sheep-fence cylinder and in a slow sweeping gesture he wraps a long woollen scarf around it. As a free young man he then continues with more important things in a nagging-free space. What does it mean to wrap a long woollen scarf around sounds in a slow sweeping gesture? What is the artistry of Erik all about?

My alarm clock

The intricate art of hiding a wake up signal in a long tube by applying layers of textile lids what is that all about?

Described in Hallnäs and Zetterblom (2003).

THE DARK ROOM FASHION SHOW

PROJECT: **Zero Expression Fashion**

BY: Marcus Bergman, Lars Hallnäs, Hanna Landin, Clemens Thornquist, Riika Townsend

Visual expressions are dominant in fashion aesthetics. The fashion show is visual, we show fashion in magazines, we show our new garment, we see the beautiful clothes of others etc. The basic design aesthetics we learn within the regular fashion design curriculum is all about spatial form and visual expression. It seems somehow natural to train our perception of forgotten aesthetical issues by bracketing these dominant perspectives. Garment sounds in use, this is not a focal issue but nevertheless basic to the way in which garment present themselves in use. So what could a fashion show in a dark room be all about?

Described in Hallnäs 2005.

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