THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

ANXIETY AND TRUST

AND OTHER EXPRESSIONS OF INTERACTION

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ABSTRACT

The thesis discusses and explores aesthetics within the field of interaction design. The most important contributions are: a) design experiments, as examples of work exploring aesthetics of interaction, b) a framework and concepts to support reflection on, and the understanding of forms and expressions of interactive computational devices, c) methods and exercises that exemplify how to develop a better sensibility to aesthetics of interaction.

The concepts and methods presented aim to contribute to a language that can be used in the design process, in personal reflections, in discussions with colleagues and as a basis for decision making. The background is the need and wish for a richer language in the interaction design process – to be able to put words to, and communicate matters of interaction in a precise way.

The thesis presents an alternative approach to the recent trends within the field of interaction design that focus on user experience and aesthetic experience. The framework and concepts introduced are intended to be of use when talking about interaction before there is any, i.e., before any design exists that people can interact with. Therefore, the framework and the concepts do not refer to actual use or people's experiences. Instead they refer to the device itself, to how the device relates possible interaction to its functions, and how this relation can be expressed in certain context of use. Aesthetics is seen as the whole of how a design relates interaction and function to each other and how that relation is being expressed by and through the design.

Keywords: aesthetics of interaction, interaction design methods, interaction form, expression of interaction, interaction design

THIS THESIS...

This thesis summarises basic research work carried out between 2003 and 2008. The work has been presented in peer reviewed conference proceedings and journals, at workshops and at exhibitions. It has been carried out mostly through explorative design, literature research and workshops.

The thesis consists mainly of two parts: a theoretical and a practical part. The theoretical part covers design methods and approaches on how to focus on interaction in a design process, before there is any actual interaction. The concepts of *interaction form*, *interaction form properties* and *expressions of interactions* are defined and two exercises on these concepts are presented. A design critique method called *digital myths* is also presented.

The practical part consists of design explorations. Some of the work has been carried out in collaboration with other researchers. In such projects the interaction aspect has been the domain of Hanna Landin, responsible for the software and, to a varying extent, hardware.

The practical and theoretical work are part of the same research process, they have been carried out side by side throughout the years, influencing each other and affecting each others results and should therefore not be regarded as two separate activities.

Both the theoretical and practical work focus on aesthetics of interaction, from a designing perspective. A framework is presented and examples are given on how that framework can be used early in a design process.

Photographs and illustrations by Hanna Landin unless stated otherwise.

…IS BASED ON THE WORK CONTAINED IN THE FOLLOWING PAPERS…

Landin, H. 2008. Digital myths and delusions: an approach to investigate interaction aesthetics. *Digital Creativity*, vol. 19, no. 4, December 2008, pp. 217-232, Routledge.

Landin, H., Persson, A. and Worbin, L. 2008. Electrical burn-outs: a technique to design knitted dynamic textile patterns. *Proceedings of Ambience 08*, Borås, Sweden, pp. 139-145.

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Landin, H. 2005. Relating theory and practice in the design research discourse. *Proceedings of In the Making, Nordic Design Research Conference* NORDES ‘05, Design research strategies tutorial, Copenhagen. [online] http://www.tii.se/reform/inthemaking/files/p48.pdf.

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The Bag | EXHIBITED AT *Stockholm Furniture Fair*, Stockholm, 8-12 February 2006 and *Salone Satellite, Milan Design Week*, Milan, 5-10 April 2006 as part of the exhibition case 'Body and Space' of the School of Textiles Borås. *Röhsska Museet* (The Röhsska Museum of Fashion, Design and Decorative Arts), Göteborg, 8 June - 8 August 2006 as part of the licentiate exhibition of Hanna Landin and Linda Worbin. *Dutch Design Week*, Eindhoven, 21-29 October 2006 as part of 'Brainport-Material Laboratory'. PROJECT TEAM Hanna Landin and Linda Worbin.

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INTRODUCTION

The first times, I have to pay close attention to which buttons to press in which order in combination with which gestures and when. I hold the rectangular piece in my right hand, it is shiny white, angular and gives a compact expression. I'm glad that I bought it before the transparent blob swallowed it, now the only things that are round are the buttons. In my left hand I control some of my movements with my thumb on a smaller piece that fits nicely into my palm. Soon I cannot explain what I do, it is in my hands. I am no longer aware of which gestures I perform in combination with which buttons and joystick movements. I just try to stay alive. I like the way the interaction is designed. Someone would perhaps say that it is intuitive and natural. I would say appealing. I find that the way to access what I need and to perform what I want to perform to be designed in a rather pleasing way, even though some solutions are a bit rigid and awkward.

Above words like rectangular, shiny, white, angular, compact, a transparent blob, round, and so on, are used to describe the form of something. Think, for instance, of a heavy table, a substantial one with sharp edges. Then, imagine another one standing next to it that is gentle, light and neat. Then imagine lifting them up and the latter turns out to be heavier to carry than the former. Heavy, substantial, light and neat, might not be the actual physical properties of the tables, they might just describe how the different units of the tables have been put together. Tables, and other artefacts, can be described as light and neat even though they might have a lot of weight. Rather than physical qualities, the notion of form

tells us in which shape a product has been constructed. The form of a product can suggest heaviness even though the product itself is not heavy. Form has more to do with how it has been built, how parts are put together to form a whole and how these have been arranged in three dimensions.

When we want to describe the form of interactive computational devices there is an additional aspect; we can describe these products not only by the physical form but also in terms of their interaction form. Computational devices do not only manifest themselves spatially but also temporally and the temporal structure is related to interaction and use. Redström (2001 p. 39) talks about two main form elements:

> "*i) the temporal structures that are generated by the execution of programs; and ii) the spatial structures that manifest these temporal structures*".

Löwgren and Stolterman (2004 p. 137) describe the dualistic nature of the medium of computational technology as spatial and temporal:

> "*Digital artifacts are every bit as temporal as they are spatial. In order to perceive the whole, or the dynamic gestalt, of a digital artifact, we need to experience it as a process, which is to say that we need to try it. The gestalt of a digital artifact emerges in the interaction with the user over time.*"

More than twenty years earlier, in 1980, Jones (1992 p. xxxii) wrote in his second preface to Design Methods about time:

> "*As the scale of designing is increased (from the designing of objects to the designing of systems, programs, flows, communications, communities, 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 form the 'time arts' (music, dance, theatre, film, novel, poetry, etc) how to compose-in-time with some sense of beauty.*"

We find temporal structures in film, dance and music, etc. However, in those contexts there is often a clear distinction between the spectator or listener and the artist. Within interaction design, spectators and listeners often become directors to some extent, as they, through their actions, can influence how the temporal structure will manifest itself spatially. Their

role as directors is limited, though, by the design, since the design sets the limits of what will be possible to influence.

In the opening paragraph the words intuitive, natural, appealing, rigid, and awkward are examples of describing not the form of the spatial design but the form of the interaction design. In this thesis *interaction form* is the basic issue. To talk not only about traditional spatial form but also about interaction form can open up for a fruitful distinction. Today words like intuitive, easy, difficult and clumsy are a bit slovenly used to describe user interfaces of computational devices. Sometimes these kinds of words are used to describe how people might perceive how it is to *use* a device. A design team can say that they are aiming at a device that people find easy to use, not clumsy to use, for instance. Sometimes the words are used in another way that describes the actual interaction form of the device. For example, when a user interface is said to be built in a clumsy way, resulting in mistakes when people interact with it. The distinction, that can be fruitful to make from a design perspective, is that in the latter example the interaction form can be clumsy even though someone interacting with the device does not perceive it as clumsy. You can, for example, believe that the system does something else than what it actually does, unaware of misunderstandings or faults being made. The purpose of the notion of interaction form is to be able to frame, discuss and reflect on different interaction designs. Just as one can describe the spatial design of, for example, a table one should be able to describe the interaction design of, for example, a mobile phone.

In addition to describing a form, it can be fruitful to also describe how a form is being expressed, i.e., how the form is manifested, conveyed, represented and communicated. You can, for instance, describe an open form as being expressed as welcoming, like an entrance on a building, or describe an object that has been swallowed by a transparent blob as playful. If a group of designers has a common vocabulary they can discuss and decide on what kind of expression to aim at. Not only spatial form can be expressed, an interaction form can also be manifested, conveyed, represented and communicated in different ways. Thus, in addition to the notion of interaction form the notion of *expressions of interaction* will be presented. These are expressions we can use to frame, discuss and reflect on how a design expresses interactions in different contexts.

The notions of interaction form and expressions of interaction can be used to explain, understand and compare different products, i.e., for analysis, but even more importantly they can be used within the design process, as methodological tools, i.e., for synthesis.

If interaction form and expressions of interaction shall be fruitful notions not only for analysis but also as working design concepts, it is important that they refer to the actual device, and not primarily to users' experiences. The focus is on expressions rather than experiences and the starting point is the design of the device, early in the design process before there is anything to actual use or interact with. The starting point is not people's experiences when interacting with already produced devices.

Forms and expressions are a design approach, a way to reflect on how computational artefacts present themselves with respect to how people interact with them, relate to them and live their lives surrounded by them. The idea of introducing the notions of interaction form and expressions of interaction is to strengthen the language of interaction design as a design discipline. Even though user experience and interaction aesthetics have gained more interest recently, the language used within the area of interaction design still deals mostly with usability. The aesthetical design perspective is still missing.

BASICS

This chapter describes the context of the thesis through a survey of basic concepts. The next chapter describes related work on frameworks and conceptual tools for interaction design. The purpose of these two chapters is to put the research work (practical and theoretical) in a context. They present a background to the view on interaction and aesthetics that will be put forward in subsequent chapters.

INTERACTION DESIGN

Interaction design defines the behaviour of a device or a system in response to a person. It is strongly related to the field of human-computer interaction, an interdisciplinary field with its roots in computer science and cognitive science. The field of human-computer interaction grew big when computers mainly were used for work. When they started to be used more and more for leisure and became more ubiquitous, it was time for other design objectives and new methods. In a way interaction design emerged as a reaction to human-computer interaction, answering a wish for a more design oriented field. Efficiency, usability and usefulness were accompanied by the design objectives of satisfaction, enjoyment, motivation, aesthetics, etc. For some people interaction design is just one part of human-computer interaction, for others it stands for other aims and other kinds of methods.

Some people mean that interaction design only deals with the design of computer related products or systems (e.g. Thackara 2001, Löwgren and Stolterman 2004, Sharp, Rogers and Preece 2007). For others that

distinction is not as important as the bigger perspective on design, e.g. that what you design is not merely the object but the acts that define the object in use (Hallnäs and Redström 2006).

One common denominator in all views of interaction design is time. Time is fundamental; there cannot be any interaction if there is no time span. The time aspect implies that some design problems are shared with the fields of temporal changes, like music and movies.

Time and interaction have been discussed and explored in several fields, for instance, in art and architecture. For example, Wallenstein (1996) discusses minimalism in the sixties as a period of change where the piece no longer only had references within its own frames. He points at the increased interest in the space where the piece was exhibited, how the audience could approach the piece and perceive it over a period of time. Bourriaud (2002) presents a survey of art in the 1990's with focus on a new kind of interaction where the spectator takes part of finalizing the piece of art. He describes it as an encounter not so much with a space as with a time span (p. 59). One can also think about what it was Duchamp created when his Fountain was exhibited in 1917. Was it an object, an event, or perhaps a situation highlighting different ways to interact with a urinal?

Beside time, interaction design always implies a focus on the human perspective of interaction and use. It emerged as a field where not only technological possibilities should affect the construction of the future world. Interaction design as a field implies a certain complexity. If interaction design is to define the behaviour of a device (or a system) in response to a person, it can be very helpful to know who that person is, and what that person actual will do with the device. Unfortunately, these are things that we seldom can be sure of at the beginning of a design process. Even if there only will be one user, and we know who that is and can study him or her, we cannot be sure how the design will affect him or her when the design is put in a real context and actually might have made a change in the world. Sometimes we know some of the people we design for, and we can assume what someone will do with a device, and we can design for certain kinds of use, etc, but is it possible to define all the behaviours of a device in response to all possible people who might interact with it in all possible ways? Hallnäs and Redström (2006) point at a few central problems of interaction design. For instance: "*The empirical fallacy – the idea that use is an activity open for empirical investigations*

and not a concept we define." (p. 63). They also discuss what they call 'the hermeneutical gap' between analysis and synthesis, a gap between the actual user and the user we define within the design process, a gap "*between what in fact is given here and now and the change of meaning that the design will bring about*" (p. 71).

Several of the above aspects of interaction design are brought up in this thesis. The emphasis is on the complexity of designing a time span instead of a surface, and of designing something that might influence how people eventually choose to relate to the design and to the world. Furthermore, the scope is *interactive computational devices*, regardless of whether interaction design is considered to concern only computer-related objects or not. *Interactive* means that it must be something people can interact with somehow. *Computational* means that the thing should be able to store and execute a program, i.e., that it can contain a sequence of instruction in a memory and compute following them. *Device* is used since a device is more man-made than a 'thing', but for some people might have a less historical connotation than 'artefact'. In this thesis, the word 'device' can often be replaced by 'system'.

USERS?

The term 'user' has changed according to the development of computers. Kuutti (2001) describes the view as that the user was a rational cog in the organizational machine in the seventies, in the eighties a source of errors, in the nineties a partner in social interaction and at the beginning of the 21st century a consumer that is a cooperative constructor of her or his own life.

The problem with the term 'user' is that it implies that a person is defined by a thing that she or he uses. Dunne (1999), for example, chooses to speak of protagonists instead of users, as a way to focus on the main character that is surrounded by the objects that together with her- or himself writes the play of her or his life. The protagonist plays the main part and is not looked upon merely as a user of something. According to this view, the designers of all products, objects or thoughts that a person encounters can be regarded as co-authors. The notion of protagonist is for Dunne a way to take more poetic aspects into account, like how people's imagination is supported by a design, and a way to enter the role of the co-author.

Redström (2006) warns that user centred design might turn out to be user design. That user-tests and user-evaluations work as a way to see if the design creates the kind of user one is aiming for. He describes the shift of the subject of design from form to function to communication to experience. He is questioning whether the final experience is actually up to the designer to design, arguing that since use and users do not exist until the object is manufactured, that kind of design would be based on predictions, not on knowledge. Furthermore, Redström (2008) suggests leaving out the user in user-centred design, instead focusing on how people do things. He points out that use can be looked upon from two different perspectives, as defined by the design and as defined by use itself: "*'Defining use through design' is, for instance, what one does when expressing a specific notion of what it is to sit through how a chair is designed. 'Defining use through use' is what one does when using the chair to sit – i.e., when someone defines what a given thing is by using it in a certain way*" (Redström 2008 p. 413). According to that way of thinking one could say that the user can be defined both by the design and by the user her- or himself (through her or his choice of use), ending up with the same conclusion: it is not a question of who but of how.

In this thesis the word users is not used frequently, instead you will find 'people'. The reason is the aim of not defining people out of an object or an act. It is a reminder that we should not think that we can fully control either the user or the use of a device.

FORM

In this thesis *form* is seen as an arrangement of different elements that creates a whole. It is in line with how Bourriaud (2002 p. 111) uses the notion when talking about artistic practices: "*Artistic practice involves creating a form capable of 'lasting', bringing heterogeneous units together on a coherent level, in order to create a relationship to the world.*" Form is not something that only spatial objects can have. A performance, a relation, software, etc, can also be said to have different forms.

AESTHETICS WITHIN INTERACTION DESIGN

There is no common agreed definition of aesthetics within interaction design, even though the notion has been debated more intensely in recent years. The wish and need for a notion of aesthetics originate in an

increased assessment and acknowledgement of other values and perspectives than the ones that have been common within human-computer interaction, others than, for example, effectiveness, efficiency and satisfaction (c.f. ISO 9241-11 1998). Some qualities and perspectives that have been suggested when it comes to aesthetics of interaction are beauty (Cramton, Smith and Tabor 1996; Djajadiningrat, Overbeeke and Wensveen 2000), emotions (Norman 2004; Wensveen, Overbeeke and Djajadiningrat 2000), making people (critically) reflect upon particular matters (Bertelsen and Pold, 2004; Dunne 1999) and things in the design that can spur imagination with the aim of not limiting interaction (Djajadiningrat, Gaver and Frens 2000; Gaver, Beavor and Benford 2003; Gaver and Martin 2000). These perspectives overlap in some cases.

Even if there are many examples of authors differentiating between aesthetics and usability, some claim that the two are inextricably linked, seeing aesthetics as an extension of usability. Examples are Jordan (2000) and Norman (2004 p. 10) that says: "*we now have evidence that aesthetically pleasing objects enable you to work better*". This approach is what Udsen and Jørgensen (2005 p. 209) call the functionalist approach and they comment: "*However, even if the aesthetic turn can be seen as a positive development, the theory formation and practical applications are problematic. When functionalist theorists search beyond usability, they often maintain their original agendas and methods of quantifying the user experience*".

Aesthetics is often referred to as people's aesthetic experience of an object or an event, no matter if the author focuses on beauty, emotions, feelings or something that triggers critical reflection. For example Fiore, Wright and Edwards (2005), Löwgren (2006), McCarthy and Wright (2004), Petersen et al. (2004) all build on the pragmatic aesthetic view of Dewey (1934). According to Dewey, the aesthetic experience is an experience beyond ordinary experiences, it is more intense. It is pervasive and related to intelligence. Furthermore, it is something positive; it is described in words of appreciative, enjoying and fulfilling. One of his main points is that the aesthetic experience is not necessarily an experience of art in museums or other institutions, it can be of artefacts or events of everyday life.

The question is how fruitful the pragmatic aesthetic view is, when it comes to interaction design. Some of the conclusions are that one should reflect on one's own experience of the user's experiences to develop

empathy (Fiore, Wright and Edwards 2005), or that it is about doing interactive things that promote curiosity, engagement and imagination (Petersen et al. 2004). Even if it is argued that the pragmatic aesthetic view opens up for a more artistically-oriented idea about design, more able to account for the roles of emotions (Fiore, Wright and Edwards 2005 p. 129) it is hard to see how this can be done without assuming that we know the experiential result of certain design decisions. The difficult part is to go from a focus on experiences to actual design. Löwgren's (2007) answer is that designers should develop their assessment skills of aesthetic experiences by analysing already existing products and thereafter reflect on one's own practice.

Hallnäs and Redström (2002b) have another view of aesthetics that more focuses on the actual design of an object than on the experience of it. Their perspective on interaction design, which they claim to be an aesthetic perspective, is that it is about designing *meaningful presence* of everyday computational things. Aesthetics is then a matter of logic of expressions, a way of saying that the expressions of an object should have a sound – logical – coupling to the functions of the object. For example, if the expression of a chair suggests stability and the function of the chair is to offer a place to sit for humans, it should be sitable. If it instead breaks into pieces when someone sits on it, the expression logic is weak. They suggest a way of focusing on aesthetics by thinking that form follows functions as well as function follows form, or as they put it "*function resides in the expression of things*" (Hallnäs and Redström 2002a p. 107). In order to be aware of the tight couplings and interdependencies between form, expressions and function they advocate thinking exercises with the aim of finding expressions that have a logical connection to certain functions and to find functions that have a logical connection to certain expressions. This view implies that some things have a deeper aesthetics than others, i.e., they have a more profound expression logic. However, a logic of expression is always present in a design: "*The basic aesthetical choices regarding the concrete appearance of a thing can never be avoided, only neglected.*" (Hallnäs and Redström 2002a p. 106). They mean that aesthetics will be there anyway, since the thing will have some expressions anyhow, though how well thought out may differ. The question is what is meant by logic? Is it another word for what people interpret as natural? We will come back to both this and Löwgren's perspectives in the next chapter of related work.

In Bourriaud's, already mentioned, definition of form there is a focus on creating a relationship to the world. Consequently, he defines relational aesthetics as: "*Aesthetic theory consisting in judging artwork on the basis of the inter-human relations which they present, produce or prompt*." (Bourriaud 2002 p. 112). The background to this definition is art work where the spectators are not only spectators, but are persons that complete the work through their participation. He refers not to experiences or merely visual presentations, instead he is describing 'aesthetic objects' such as meetings, encounters and events, of which the time span is of importance. Translated into the field of interaction design, a perspective of aesthetics could be a perspective of the relationships presented, produced or prompted between humans and devices (and the world), manifested in the time span of interaction.

In the next chapter, related work, some concrete examples are presented of how the term aesthetics is used within the field of interaction design. Foremost, however, it is a chapter on frameworks and concepts that have the aim of contributing to the development of a richer and more precise interaction design language.

RELATED WORK

Frameworks and concepts can help us to reflect and communicate in a design process. They can help us to be precise and to sort out and structure a design problem, for ourselves as well as in communication with others. Some, and in some cases debated, examples of concepts, frameworks and qualities related to interaction design that have been used to define, categorize, discuss, assess and criticize proposals and products are, among others, affordances (Gaver 1991; Gibson 1979; Norman 1998), idiom, excise, flow, pliancy, goal-directed design, personas (Cooper and Reimann 2003), ubiquity and invisibility (Weiser 1999), seamful and seamlessness (Chalmers and MacColl 2004), metaphors (Blackwell 2006, Sharp, Rogers and Preece 2007), graphic objects such as windows, menus, icons, dialog boxes, etc (Apple Computer 1992, Cooper and Reimann 2003), tangible objects such as lens, phicons and phandles, etc (Ishii and Ullmer 1997). Even though these kinds of concepts and frameworks, that have been more or less popular over different periods of time, might support the interaction design process in different ways, and to different extent, they do not help much when it comes to matters of aesthetics of interaction.

In recent years, interaction aesthetics has been discussed much more in depth and lately a couple of different suggestions of concepts and frameworks have been suggested. In this chapter work related to this thesis will be discussed that presents concepts, qualities or frameworks to use in the interaction design process. It is work that also relates to aesthetics of interaction in one way or the other, which is stressed to a

greater or lesser extent by the different authors. Four examples will be presented: *experiential qualities* (Löwgren 2006, 2007) that refer to the experiences and feelings when interacting with something, *interaction gestalt attributes* (Lim et al. 2007) that are more related to the object than to people's experiences, *characters* of computer artefacts (Janlert and Stolterman 1997) that take into account that people tend to ascribe certain characteristics to also non living things such as computers, and *expressions* of computational things (Hallnäs and Redström 2002b) that are highlighting that a design can present itself to people in different ways. The concepts and frameworks are suggested to be complementary to usability, i.e., concepts and frameworks with a focus on things beyond efficiency and other more easily measurable user aspects of a design. However, note that what is meant by the word aesthetics differs.

EXPERIENTIAL (or USE) QUALITIES

As mentioned, a common reason to use the concept of aesthetics also within interaction design is that computers no longer are something we just encounter at work. They have expanded to every day situations, they are more ubiquitous and used for entertainment, reflection and many other purposes. The common reason why aesthetics is something different within interaction design than within other design fields is that interaction design is not only about spatial form, but also temporal form, which is said to imply another kind of complexity. Löwgren (2006 p. 56), for example, describes it as:

> "*With a slight simplification, we might say that graphic-design and industrial-design products carry much of their meaning on the surface whereas interaction design products hide much of their meaning in virtual 'contents' to emerge only in sustained interaction.*"

Even though a slight simplification it points to the core of the temporal aspect of interaction design. Mazé and Redström (2005 p. 10) point out (after referring to Maeda (2000 p. 25) on compensating for physical space with the dimension of time):

> "*As discussed above, the expressiveness of the spatial surface of objects is insufficient for dealing with the underlying complexity and so our focus needs to shift towards how to use temporal form to express this. This also explains why any attempt at*

> *reducing this complexity to what can easily be presented on a spatial surface is likely to fail, or at least generate a range of inconsistencies in terms of representation. Another consequence is that, to some extent, it is not possible to separate form from interaction, since termporal form is manifested through spatial form elements in use.*"

Löwgren and Stolterman (2004), among others, stress that the design of artefacts with the characteristics of both spatial and temporal form need a new 'design knowledge construction', adjusted specifically to computational artefacts. They propose the conceptual tool of *use quality*, also referred to as *experiential quality* (Löwgren 2006; 2007). The qualities in question are said to be part of "*a language for articulating the use-oriented qualities of digital artifacts*" (Löwgren and Stolterman 2004 p. 14), and the knowledge of them are said to help designers to "*eventually contributing to more rewarding experiences of using digital artifacts*" (Löwgren 2006 p. 65). Examples are divided into five categories: a) qualities of users' motivations like playability, seductivity and usefulness, b) qualities dealing with people's immediate experience like pliability, fluency and immersion, c) qualities concerning a social aspect like social action space and personal connectedness, d) qualities concerning the meaning of use like surprise and parafunctionality, e) structural qualities like elegance, transparency and efficiency (Löwgren and Stolterman 2004). These qualities are said to emerge in use of artefacts, they exist only in the moment of interaction between humans and artefacts.

The idea is that knowledge of this kind of use qualities could lead to better design, i.e., the intention is that designers shall adopt the qualities and develop their design judgement to be able to better discuss what they aim for in their design, and to become better at choosing among different design alternatives during the design process (Löwgren 2007). Löwgren (2007 p. 8) propose that this kind of language can be a tool for thought even though the qualities first appear when the product is in use:

> "*… it is a matter of capturing and articulating elements of an experienced designer's or critic's assessment ability in order to enable them to enter the languaging of design where the knowledge of the field is maintained and developed in discourse with other researchers, designers, and critics.*"

In this context aesthetics refers to the aesthetic experience following the pragmatics view of Dewey (1934). Aesthetics is said to be important since it can be the reason why a user wants to use something: "*To put it simply, chances are better that people will choose a product if it appeals to them.*" (Löwgren 2007 p. 1). Löwgren (2006) argues that, for example, pliability is worth aiming at, that it will make a product a better product. Aesthetics is used in the terms of 'aesthetically superior experience' and 'aesthetically pleasing' and pliability and other qualities are said to be part of the 'experiential-aesthetic dimension' of an artefact.

From a designer's perspective, a potential problem with this concept of experiential quality is that it is experiential and exemplified through already designed products. For instance, pliability is exemplified through less and more pliable applications like yellow-pages maps vs. Google Earth, where Google Earth is said to be a highly pliable interface (Löwgren 2006 p. 59) and:

> "*As such, it is relational – pliability is not a property of the artifact itself, nor is it a psychological or physiological property of the user. Pliability appears in use. Strictly speaking, this means that an interaction designer cannot design a pliable product. What he/she can do, however, is to design conditions for pliability to appear in the subsequent use of the product.*" (Löwgren 2006 p. 64)

Accordingly, as a designer one cannot design a product with the quality of pliability but one can design a product with the right conditions for pliability. This takes the ability to identify pliability in already made things, to have developed an assessment skill of pliability. In other words, the potential problem is that we base a design knowledge on a generalization of the feelings people have when using something, without knowing how general these feelings are, and without a plain connection between an experiential quality and the conditions of a design that actually leads to it. Such a connection is probably very hard to find since there must be many different kinds of conditions that can lead to a certain experiential quality. However, the concept of experiential qualities stresses the need of being able to discuss design decisions that can affect how people will relate to and interact with a product yet to be produced, even though we cannot be certain about it. It stresses the fact that there is a definite value in being able to discuss and reflect on things even though it might be in a somewhat imprecise manner.

To summarize this perspective, aesthetics is something fruitful. One cannot design products with certain experiential qualities – one can only design the conditions that can lead to them, and the answer to the question of how to do this is to base design decisions on examples of already existing products that have the use/experiential qualities in question.

INTERACTION GESTALT ATTRIBUTES

Lim et al. (2007) propose the concepts of *interaction gestalt* and *interaction gestalt attributes*. Compared to experiential qualities the interaction gestalt and its attributes are less related to the user's experience and more related to the properties of the artefact:

> "*In any interaction, the interaction gestalt is experienced by a user and evokes the user's subjective experience of the quality of the interaction /.../ However, only thinking about the user experience cannot fully guide designers to explore a design space of possible aesthetic interactions in a concrete way. This means that designers should have knowledge of how to shape aesthetic interactions in a more visible, explicit, and designerly way. This is a kind of knowledge we are currently missing in HCI. /.../ In this regard, the challenge here is to create a language that helps a designer understand which attributes are to be considered in order to create a certain gestalt that in turn will result in desired user experiences.*" (Lim et al. 2007 p. 240)

Lim et al. mean that interaction gestalt attributes are different from both user experience qualities and properties of the artefact. However, it is important that "*shaping the gestalt involves both imaging how the gestalt should be manifested in an interactive artifact as well as anticipating how users will experience the gestalt.*" (Lim et al. 2007 p. 241). Interaction gestalt and its attributes are positioned in between the user experience and the interactive artefact and said to be tightly related to and interdependent of the two.

Just like experiential quality, the interaction attribute is a tool meant to inspire designers, a tool to define the shape of a particular interaction. The examples of attributes are connectivity, continuity, directness, movement, orderliness, pace, proximity, resolution, speed, state, and time-depth (Lim et al. 2007).

Even though Lim et al. (2007 p. 250) claim that these interaction gestalt attributes are not attributes of the artefact itself, "*it is not about how interfaces look like or what features need to be implemented*", the examples they refer to make the difference slightly unclear. For instance, the attribute state: "*The case of state, it has only two variables: fixed vs. changing. When elements stayed in a same state, it is in a fixed state. When elements change to different states, it is in a changing state.*" (Lim et al. 2007 p. 249). The example on changing state is http://www.samsung.com/au and the example on fixed state is http://www.usa.philips.com.[1] On Samsung's site there are moving pictures and transitions, images slides in and out when you move the cursor. Philips' site, on the other hand, is more static in the sense that nothing changes unless you click on a link and then a new page loads. The attribute of state seems to refer to how the site is presented graphically when you interact with it. Despite the visual differences between the two sites, the way you interact, by moving your cursor and clicking links, is very similar. Therefore, the attribute seems to refer more to how the content of the site is presented to you than to ways of interacting. Another example is the attribute of connectivity, which goes from independent to networked. It is the "*level of connectivity among various information elements accessible through interactive artifacts or those artifacts themselves*" (Lim et al. 2007 p. 248). It is being exemplified by online thesauri. Since Löwgren (2006) uses the same example when exemplifying the experiential quality of pliability, it is a good example of the difference between the two concepts. When Löwgren says that the visual thesaurus, www.visualthesaurus.com, is more pliable than thesaurus.reference.com he clearly refers to a potential experience of interacting with them: one might get a smoother and more flexible feeling when using the former since one browses words through the connections to synonyms rather than reads a list of them. When Lim et al. (2007) exemplify connectivity and say that the visual thesaurus is networked and www.askoxford.com is independent (where there are no links to any synonyms) it is clear that they do not refer to people's potential experiences. However, it is not clear that they do not refer to a description of properties of the actual interface or the underlying structure. The visual thesaurus is obviously constructed in a linked way

[1] The websites were accessed 25 February 2007, I accessed them on 26 February 2008.

where each word has relations to other entries in the database. The entries are not independent, which at the end affect how people can interact with the thesaurus. The design of the visual thesaurus, for example, can affect how many and which words the user clicks on and reads about since they are made accessible in an easier way. Still, the way of interacting, and consequently the interaction gestalt, is that really more networked? Is clicking on words, presented to me, a more networked way to interact than typing in words?

The reason why Lim et al. choose to separate the attributes from the properties of the artefact might be explained by the following quote:

> "*if a designer considers movement as one attribute of an interaction gestalt he or she tries to design, he or she will explore a design space for the interaction gestalt from static to dynamic movements that can be shaped as an interaction both by a user's input behaviors toward the artifact as well as by the artifact's output behaviors shown to the user.*" (Lim et al. 2007 p. 250).

The answer might be found in the argument that one can explore the design space both from the perspective of a person's behaviour as well as the artefact's behaviour. The idea might be that it will make it easier for designers to focus on the potential effects of the interaction design if the attributes are regarded to be positioned in between the properties of the artefact and the experiences of using the artefact. If you put to much focus on the properties of a device, the potential effects on people's behaviour might be overlooked.

The reason why the presented examples of the attributes are hard to separate from the actual properties of the artefact might be due to the research goal of Lim et al. (2007 p. 244):

> "*Our goal is to provide the new design knowledge that can support design decision-making and creativity to form concrete and graspable aesthetic interactions rather than to form abstract and high-level design ideas.*"

If the goal is a language that is helpful in a concrete way when it comes to design we might not be able to *not* talk about matters that actually concern the artefact itself.

When it comes to the notion of aesthetics Lim et al. also draw upon the aesthetic experience view of Dewey (1934). Aesthetics is referred to as the holistic experience of using an artefact (Lim et al. 2007 p. 239). Therefore, one question is why the authors separate the interaction gestalt, but not the concept of aesthetics, from people's experiences.

CHARACTERS OF COMPUTER ARTEFACTS

We have in the two examples of framework above moved from people's experiences towards the device since the first example was about the qualities of the experience of use and the second example was about attributes of the interaction – defined as something in between the experience of a person and the properties of a device. Accordingly, the next example is a framework that focuses on the device, but only in the sense that people *ascribe* certain characters to devices.

In the late nineties Janlert and Stolterman (1997) discussed the *character* of 'computer artefacts', following work done by, for example, Nass, Steuer and Tauber (1994). Janlert and Stolterman stress that people find a meaning in ascribing not only persons and objects, but also computer artefacts characters, and that characteristics such as clever, reliable, friendly, capricious, etc, help people to understand how to deal with the artefacts:

> "*...we believe that characters are important conceptual devices that reduce the mental effort involved in dealing with artifacts. In ascribing a certain character to an artifact we make a very simple, but powerful description that frequently will be accurate enough to help us to manage the task of handling the artifact and to appreciate the consequences of our interaction with it.*" (Janlert and Stolterman 1997 p. 300).

Worth considering is the fact that from a design perspective it does not matter whether people actually consider an artefact to be smart or if they just find it convenient to ascribe cleverness to it. Because if they ascribe cleverness to an artefact they will deal with the thing as a 'smart' thing:

> "*People's propensity to ascribe character to artifacts is not a proof that they generally believe that artifacts literally have character. For some people and some artifacts, there may be genuine belief (and let us not judge whether they are right or wrong – it is beside the point), but more often they will think of*

it as a convenient fiction, when they think about it at all." (Janlert and Stolterman 1997 p. 298).

Consequently, from a design perspective, it does not matter whether an artefact actually has a certain character or not, i.e., if it actually *is* being capricious, aggressive, gentle, cautious, or not. The point is, if people interact with an artefact as if it has a certain character, it does not matter whether the artefact actually has it, or whether people actually believe it has it, as long as they act the same.

Janlert and Stolterman say that characteristics may link properties of an artefact's appearance with properties of its functions and potential behaviours. They mean that the concept of characters is useful since if a person can ascribe a character to an artefact, the character can help to generate expectations, explanations, give a context for interpretations and a schema for normal, and abnormal, functionality. Hence, if a computational device is designed in such a way that we can ascribe it a character, that character can guide us in how to behave in our interactions with it. An example Janlert and Stolterman (1997 p. 309) give of generating expectations is that a 'persistent' artefact can explain to you "*that you must be sure to press a button for at least a few seconds, or apply sustained pressure on a lever, or repeat a command again and again*". An example given of how a character can be used as a context for interpretation is: "*Since this thing is fast, that it took so long implies that the task was big*" (Janlert and Stolterman 1997 p. 309).

An ascribed character might also be something unwanted. In dialogue systems, for example, where people interact with the system through speech, people might think that the system is smarter than it is, because it talks to them, expecting more of the system than what it can deliver.

Janlert and Stolterman stress the fact that the framework of characters can be used for design in two ways. The first is that the designer should pay more attention to characters and in the design strive for a consistency of character across different functions and qualities of the artefact, rather than a consistency that just becomes a rule of uniformity. The second is that designers should develop adequate signs and symbols for the character of a computer artefact, and strive to display the character of the artefact as clearly as possible. It is presented as a conceptual tool for thinking, to use during the design process. However, they do not offer any actual design examples.

Janlert and Stolterman (1997 p. 313) also stress the fact that to develop the design of characteristic features to display a coherent character, is more important than to strive for a transparency, since the complexity of computational things continues to increase:

> "*We suspect that these design objectives – transparency of function and operation – may, paradoxically, become a secondary concern when the functional complexity of the artifacts reaches a certain threshold.*" This is due to the fact that: "*High-level, non-functional expectations and high-level, non-functional constraints on our action, can couple function to context and situation in a cognitively more efficient way.*" (Janlert and Stolterman 1997 p. 314)

What is suggested is to focus on something in people's interaction with objects (the ascribing of a character) from a perspective that this something is being a character/property of the object itself – irrespectively whether it actually is. That might be useful as a way to discuss and reflect on how the design of a device might affect how people will interact with and relate to the device.

EXPRESSIONS OF COMPUTATIONAL THINGS

As mentioned Hallnäs and Redström (2002b) propose a slightly different perspective, that one should not only design for the use of products but also for the 'presence' of them. They refer to Weiser (1996 p. 3) and say that we, when designing, should not only think about how to interact with computers, we should also consider how to 'dwell' with them. In other words, to focus on presence is a way to focus on how products play different roles in our lives and how we accept them and give them a place in our lives. They stress that there is an important difference between designing for use and designing for a meaningful presence, where the latter should be evaluated differently:

> "*When thinking about the presence of things, we seem to face a situation where we cannot relate general design and general evaluation to the existential definition of a specific thing. An existential definition is based on an act of acceptance, that is, we turn to a thing and give it a place in our lives. Behind the various manners in which things present themselves to us there is something that remains invariant with respect to all the*

> *different possible existential definitions. When we design for presence, we have to relate design and evaluation to some picture of this invariant 'thing' that in some sense builds the things we define as we accept them to be present in our lives.*" (Hallnäs and Redström 2002b p. 112)

Hallnäs and Redström mean that there is some invariant thing that we can focus on in the design process and that we can do this by focusing on the expressions of the device. They propose the notion of *expressional* as a help, i.e., as a way of not only thinking about functions of an object and the use of the functions. Instead the expressions are in focus since the expressions will define how the product will present itself to us in our life. An expressional is something that is designed to be the bearer of certain expressions: "*the expressions that are invariant across the many different existential definitions, that is, an expression-identity*" (Hallnäs and Redström 2002b p. 113). The notion of expressional is compared to the one of appliance, the former is a thing designed to be the bearer of certain expressions whereas the latter is a thing designed to perform certain functions. Note that the concepts of expressionals and appliances can be used as two different approaches when designing the same device.

Hallnäs and Redström have a different perspective on the concept of aesthetics than Löwgren (2006) and Lim et al. (2007), even though their aim of the expressionals is somewhat similar to the aim of experiential qualities and interaction attributes. They also aim to open up the design space and to have a more precise discussion about interaction design, not only regarding efficiency, simplicity and ease of learning. However, in contrast to the above mentioned authors, Hallnäs and Redström do not define aesthetics to be about the experience, instead aesthetics concerns the expressions of products. They regard aesthetics as a way of discussing and comparing different designs with respect to the logic of expressions: "*Aesthetics, as we understand it, is concerned with how material builds expressive things, that is, it is a logic of expressionals.*" (Hallnäs and Redström 2002b p. 115).

> "*... think of a phone not in terms of an interaction model based on the notion of phoning, but instead in terms of an artifact with certain expressions, made from a certain kind of (technical) material, that people use to build their everyday lives. If we think about a phone in this way, we disregard, or 'bracket,' the*

> *user and instead turn to the expressions as a foundation for existential definitions.*" (Hallnäs and Redström 2002b p. 113)

When considering the mobile phone as an expressional they suggest that it is a talking-loudly-to-yourself-device, or a flirting-device that is used to initiate and ground a conversation, or a check-that-nothing-has-happened-device that is brought along just to see that no one has called (Hallnäs and Redström 2002b p. 119). This perspective is rather different from the experiential qualities, suggested by Löwgren (2006, 2007), that more concentrate on how the interaction feels. It is also different from the interaction attributes, suggested by Lim et al. (2007), that more concentrate on the qualities of the artefact that affect interaction. Hallnäs and Redström are interested in the expressional of an object as you live with it. They present examples of exercises to train the ability to see how functions and expressions can be related to each other in a logical way, i.e., to train the ability to see the aesthetical design choices (Hallnäs and Redström 2002a). They also present design methods for shifting focus from the design of things to the design of the acts that define the intended use of things (Hallnäs and Redström 2006).

Examples of expressions of a mobile phone that can affect its presence in your life can be things like the volume of the ringtone, the required volume of your voice, vibrations of the alarm, LEDs communicating if something has happened or not, gestures for interacting with it, etc. It can also be such thing as different ringtones for different persons, some more discreet than others since you might not really mind if you miss to answer the calls. What is shown is that it can be hard to completely separate expressions from functions. Hallnäs and Redström also point out that they do not mean that functions and expressions can be treated separately, but that they correspond to two different perspectives "*addressing two quite different questions: the existential versus the functionality of an artifact.*" (Hallnäs and Redström 2002b p. 115).

What is also shown in this mobile phone example is that all the examples above can also be seen as the aspects that can affect the character of the phone, or the interaction gestalt, or the experiential quality. The different frameworks can be different perspectives on the same design choices, they just present different focuses. Consequently, they can be used in parallel or in sequence in the design process, they are not substitutes for each others per se.

FORM AND EXPRESSION

In the work presented in this thesis *aesthetics of interaction* is seen as *the whole of forms and expressions.* In other words, *the whole of how a design relates interaction and function to each other and how that relation is being expressed by the design.* With interaction is meant everything you can do with a device, as opposed to function, which is what the device can do for you. Furthermore, how a design relates these two things to each other is presented by the device through different expressions.

As pointed out, we no longer design computational devices just for efficiency and work. People nowadays live with computational devices in their everyday life and accordingly the notion of 'user experience design' has emerged. The point of that notion is that the object of design is not the device itself but people's experiences when interacting/living/dwelling with it. However, it is of course much, much harder to design an experience than a device, since we do not design people. If we designed people, it would be much easier to determine what they would experience and perceive, we would just program them. However, since we do not program people, we have a gap between the device and people's experiences of their interaction with the device.

One can approach the gap between the design and people's experiences of the design in many different ways. For example, one approach can be to say that we cannot know or understand what someone actually experiences in a given situation and instead focus on things that can be

verified. For example, make a list of user requirements (for instance, a person of the target group should be able to send a text message within one minute the first time she picks up the mobile phone) and then perform an iterative design process until the requirements are achieved. In this approach experiences are regarded as something too complex to be treated in the process and therefore left out. Another approach can be to look for ways of tying specific design decisions to specific experiences, which might imply relying on people's descriptions of their experiences and believing in somewhat general results:

> "*Building a knowledge base of theory and design knowledge that explains and informs how emotion, mood, arousal and action can be influenced by design qualities is necessary, not only to improve design but also to manage the design process*." (Sutcliffe et al. 2006 p. 119)

However, as McCarthy and Wright (2004 p. 10) point out:

> "*Employing the phrase 'user-experience design' as a reminder or motivator to designers to pay attention to people's experience of technology is one thing. Employing the phrase to indicate that a particular user experience can be designed is another thing altogether. The latter suggest a return to the simplicity of a technologically determinist position on what experience is.*"

Accordingly, a third approach can be to reflect on people's possible experiences of interacting with devices, but not believing in guidelines on how to design for specific ones. The designer can acknowledge the gap, thinking that he or she cannot determine experiences, but reflect on possible experiences of interacting. One can, for instance, focus on the things in the design that will affect possible ways to interact, and examine what these design elements might express. Thereafter question and speculate on how these expressions might affect people's relation to the design and experience of it. This last approach is the focus of this thesis.

Aesthetics is in this thesis defined as something we can focus on in the interaction design process, when making design decisions. Aesthetics of interaction is seen as something for which the conditions are set at the same time as a device or system is designed. This is not to say that a designer is aware of the aesthetics that is being shaped, since a designer

might not foresee every possible interaction, but the conditions will anyway be there, in the device.

This perspective on aesthetics makes a distinction between the aesthetic experience during *actual* interaction and the aesthetics of interaction of a device with respect to *possible* interaction. Instead of the aesthetic experience, we can focus on the aesthetics of interaction that is designed into a device. The advantage is that this notion of aesthetics of interaction is something we can relate to more easily in the design process since it concerns the actual design of the device, something less abstract than the aesthetic experience. Another point is that it reminds us that there are no rules or truths about how the design of something will eventually be experienced by someone, that such things have to be reflected upon and explored for every design, situation and person.

To clarify, an interactive device cannot be more or less aesthetical than another one since all devices will relate interaction and function to each other in one way or the other. A device cannot relate more or less. Important is instead that the aesthetics can be more or less considered by the designers. Aesthetics of interaction is defined with the aim to open up for discussions and decisions on what *kind* of aesthetics to aim at, not just say that we want to arrive as something that is aesthetical. It is to discuss how interaction and function should be related to each other, and how this relation should be express through the design.

This view of aesthetics can help being more conscious about what kind of device one is designing and to be open for different kinds of use and interaction. It might not help a process aimed at forming people's experiences, but, it might help to produce well conceived design with respect to how a device might affect how people interact with it, relate to it and to other people and the world.

In the second preface of Design methods, the one written for the 1980 edition, Jones (1992) explains what kind of design he has in mind for the methods of the book. He says that his earlier answer that it is the design of 'things' is misleading, that it is more true to say that the methods are intended for the design of 'all-things-together', the 'total situation', meaning that the methods focus on "*the functions and uses of things, the 'systems' into which they are organised, or the 'environments' in which they operate. These larger entities /…/ are, more so than the objects and*

products within them, the operating wholes of which modern life is being formed and made" (Jones 1992 pp. xxxi-xxxii).

It is the design of a device that makes different kind of use and interaction possible, wanted and well defined, as well as unwanted and undefined. Things can be used and misused in many different ways and it can be impossible to predict them all. Regardless of how people finally will interact with a device, the designer is more or less responsible for how the interaction turns out, but is this something that can be dealt with in the design process?

When a thing is designed, the possible interaction is defined, as well as a possible relation between that thing and people. As a designer you have to ask what it is that you design. If you design a table, for example, is the answer as simple as 'a table'? Or are you defining what a table is? In other words, something that in turn also affects what working, eating, socialising or any other table related activity might be about? Hallnäs and Redström (2006 p. 22) stress: "*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*"[2]. What happens if the object is not a table but a computer? Are you then designing how people can communicate? How money transactions can be carried out? Are you designing parts of people's lives through the devices you design? The society? The humanity? The "*operating wholes of which modern life is being formed and made*" (Jones 1992 pp. xxxi-xxxii)?

In 1970 Jones (1992 p. 6) pointed out the designer's responsibility, defining design as to initiate change in man-made things, saying that this change "*ends with the evolutionary effects upon society-at-large or the system of which the new product forms a part*". His suggestion of how to deal with the dilemma of designing 'future behaviour' is:

> "*The ultimate answer to the dilemma is not for designers to become as gods but for the design process to become more public so that everyone who is affected by design decisions can foresee what can be done and can influence the choices that are made*" (Jones 1992 p. 9).

Even if methods have evolved in this direction, such as participatory design and focus groups, etc, it is rare that everyone who is affected by a

[2] Hallnäs and Redström do not limit interaction design to computational objects.

design is informed about it in such a way that they can predict the consequences. The problem of predicting consequences is also a problem for all parties, designers, producers, customers as well as users, and it is a problem that increases with the increased complexity of computational technology.

Bourriaud (2002 p. 42) speaks of art in the following quote but you can replace 'artist' with 'designer': "*The artist's practice, and his behaviour as producer, determines the relationship that will be struck up with his work. In other words, what he produces, first and foremost, is relations between people and the world, by way of aesthetic objects*." If not focusing on such things as the artist own relation to the world through the work, or the act of expressing him- or herself, Bourriaud's definition of art can as well be for design: "*Art is an activity consisting in producing relationships with the world with the help of signs, forms, actions and objects*." (Bourriaud 2002 p. 107)

If the answer to the question what we are doing is not as simple as just another table or just another computer, the answer to how to handle the very task of designing is not simple either. For example, the answer that you as a designer have a tacit knowledge (in this case about tables or computers) that will give you the answers to all design problems will not be sufficient. As little as the answer that all design decisions can be based on prior user studies (about people and tables or computers). So the question is how we can focus on use, in a design process, when there might be use we will not be able to predict, if, as already asked, 'use' is the right word for the relation between an object and a human being.

When the object or a prototype already exists and we have a real person interacting with it, we can study their relationship and the interaction, and we can come to some conclusions about the design. That is, when the design already is defined and is put in a certain context and in the hands of a real person. Then we can analyse why certain things in the design, the context, the person's background, etc, might trigger different behaviours and ways of interacting, and the result might be generic or not. However, it is much harder to come to any conclusions when the object does not exist yet, when there is no mock-up or prototype and when there is no context, no user, etc. In the research presented in this thesis, the central question is of how we can discuss interaction aspects in these early stages of the design process. The aim is to be able to reflect, discuss and deal

with the aspects of interaction before we make the first important design decisions that often strongly influence a design.

The aesthetics of interaction of a device is something that can be perceived and experienced in different ways when people interact with the device. The way of interacting might differ from one time to the other, which might lead to different responses. Furthermore, the context and person and that person's experience, mood, expectations, etc, can be different from one time to the other. Nonetheless, it is the device itself that makes the different aesthetic expressions possible. What are perceived and experienced by people are simply different sides of the inherent aesthetics of interaction. To design an interactive device means that you define the interaction aesthetics even though it will not be experienced until the device is interacted with. In other words, the interaction aesthetics is being designed as the device is being designed – but how it will come through, will be given in every actual interaction.

To summarize, the purpose of this thesis is to open up for more options when it comes to interaction design. The idea is to reflect on how people might experience and perceive an object, just as how people's relations to the object might look like and evolve. However, there is no guarantee for a certain experience. People might interact in a non-intended way. Therefore, this thesis suggests that instead of only focusing on *intended* interaction and fulfilling requirements, we should also consider *possible* interaction. We should think of the design and people's experiences of the design as two distinct things.

What is suggested is to develop an awareness of more subtle distinctions of expressions of a design with respect to interaction. What is searched for is a better awareness of what kind of device you are actually making and a way to be able to consider potential consequences.

Below the concepts of *interaction form* and *expressions of interaction* are presented. These are concepts aimed to support the early design process, providing inspiration and guidance. However, to be useful as such a tool a designer have to work with the concepts and find other ones, that better suit a specific design process. This kind of design knowledge has to be developed in practice.

INTERACTION FORM

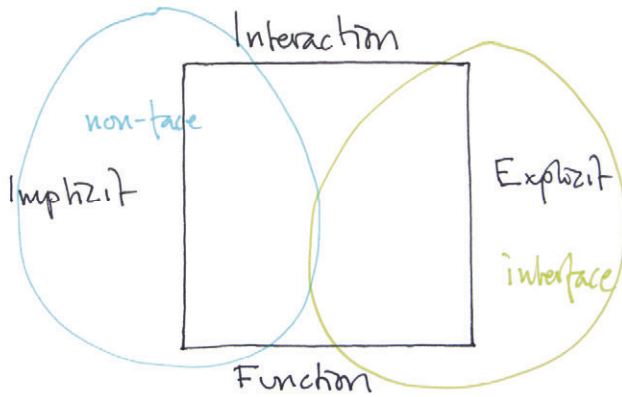
Interaction form is the way in which a design relates interaction (what you can do with a device) and function (what the device can do for you) to each other.

The form of a device is the arrangement of the different elements that creates a whole. We can talk about the spatial form, such as the form of a table, chair, etc, and the temporal form, such as the form of a story, movie, etc. The arrangement of the elements that creates an *interaction form*, however, is manifested both spatially and temporally.

One definition of interaction form is given by Hallnäs (2004 p. 15): "*Interaction design form can in this context be understood as the way in which a design relates function and interaction to each other, more specifically it concerns the logic of acts defining intended use of things and systems.*" In this definition function is what things do as we use them, and interaction what we do when we use them. This thesis builds upon the same definition but proposes that the concept should not only cover intended interaction but all *possible* interaction. Interaction form is then the way in which a design relates interaction – what you can do with a device – and function – what a device can do for you – to each other regardless of design intentions. The important thing is that interaction in this context is what a person *can do* with something and not how a person actually *uses* something.

Interaction with an ATM, for instance, can include standing with other people in front of it, in a queue, putting a card into the machine, pressing different buttons depending on what is being displayed, etc. It can also include attaching a card reader and a video camera onto the machine to skim other people's cards and codes. The function of an ATM might be described as presenting text on a display, comparing the balance and the

amount to withdraw, subtract the amount from an account and handing over the amount in notes, etc. It can also be what makes skimming possible. There is no point in trying to separate interaction and function or see them as opposite poles. They should instead be seen as a relation to each other.



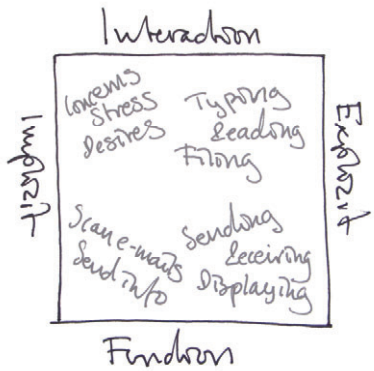
The area of interaction form.

Interaction form concerns more than the design of the visible or tangible user interface. Interaction form includes also things that are not apparent in the interface and all possible ways a person can interact with the device. The point is that if we accept that the design can also support unpredictable interactions, use, misuse, etc, we might examine and reflect on this more than what is typically done today, perhaps not only focusing on trying to prevent unwanted user behaviour. Interaction form covers, in other words, more than the explicit contact surface between human and product.[3]

The right part of the 'area of interaction form', see figure, contains what we might refer to as the user interface. It can be things like the graphic design, buttons, sliders, images, and all actions and functions related to these, for example, clicking, scrolling, reading, presenting data, be an input device, etc. This is what is explicit, i.e., the clearly and distinctly

[3] Compare with exploring combinations of 'definition of use through design' and 'definition of use through use' within the design process, as proposed by Redström (2008).

stated part of the interaction form. Examples of what is explicitly defined in the design of an e-mail program with respect to function (lower right) are sending and receiving e-mails and displaying them in different views, etc. Whereas explicitly defined interaction (upper right) concerns reading, typing, filing, etc.



Examples of implicit and explicit interactions and functions of an e-mail program.

The left part of the area of interaction form is the implicit part. That is, the not plainly expressed and not apparent part. Examples of what is implicitly defined in the design of an e-mail program with respect to function (lower left) are, for example, to scan sent e-mails for certain words related to terrorism, or send information about the use of the program to the developers. Implicitly defined interactions (upper left) can be unpredictable ways of use as well as people's thoughts and concerns about a device that are not explicitly defined in the design. Examples of what is implicitly defined in the design of an e-mail program with respect to interaction are having undesired contact with other people, being stressed about answering e-mails, having concerns about viruses, etc.

Sometimes something that is implicitly defined in the design of one product becomes explicitly defined in a new product. An example can be the hand saw. The hand saw has a handle that is suitable for a hand to hold, one side has sharp teeth and there is a clearly defined direction of movement, etc. To saw with a hand saw can, in other words, be said to be explicitly defined in the design. To play on it with a violin-bow might be implicitly defined since it is possible but not supported by the interface.

However, when musical saws started to be manufactured, without saw teeth, the former implicit interaction to play, and the former implicit function to be an instrument, became explicitly defined in the new design. Another example are record players used for listening to music, that people started to use for scratching. With some hardware modification they evolved to become instruments instead, for scratching, mixing, blending, etc. The former implicit interactions were supported by new design, and became explicit. The same thing can happen when people create a new interface to a device, like when they hack or modify a device.

FORM PROPERTIES

Interaction form as defined in terms of how a design relates interaction and function to each other can have different properties. An interaction form property is a property of such a relation that may relate more or less to interaction or to function. Say that we have a car with an advanced driver assistance system (ADAS) with an adaptive cruise control, so that the car slows down if the vehicle in front of it slows down, and a system that warns, and in some cases also steers up the car, if it is leaving the lane, etc. If compared with a car without such a system, this car can be described as having an interaction form property of automation. That is, interaction, driving the vehicle, and function, transporting people without accidents, are related to each other in a more automatic way. In this case this property of automation is more related to function than to interaction, i.e., more related to what the car can do for you (in the car or in the car in front, etc) than to what you can do with the car as driver or passenger. However, studies suggest that when drivers attribute their own activities as responsible for the behaviour of the car, they are less likely to be involved in accidents than if they consider the behaviour to be due to the automated system (Stanton and Young 2005). Therefore it might be a good thing, in this case, if people would experience that the interaction form of automation is more related to their interaction, even though it is more related to function.

Another example of the interaction form property of automation can be a text input interface that as you type suggests words you have written before. This example is also more related to function than to interaction

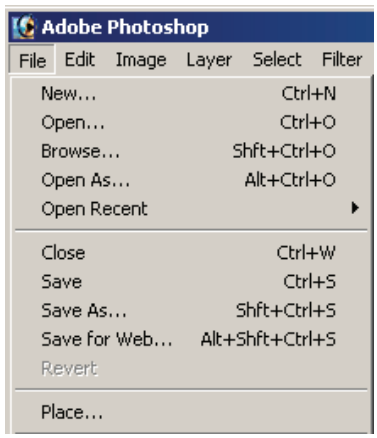
but if compared to the car example slightly more related to interaction, since it depends on which words you have typed in earlier. If the advance driver assistance system also would be adaptive to the driver these two examples could be identical from the interaction-function perspective.

An interaction form property should not be seen as something binary. Instead, it should be regarded as something gradient that there could be more or less of. For example, the interaction form of an advanced driver assistance system can be designed so that there is more of the form property of automation, or less. Automation is just one example of an interaction form property, further examples are presented below.

FRAGILE FORM

The interaction form is fragile if interaction and function are related to each other in a fragile way, i.e., if the relation between interaction and function easily breaks.

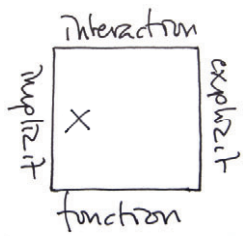
An interaction form can be understood as fragile if the relation between interaction and function easily breaks. There seems to be something inherently fragile about computational things, for example when a pc, mobile phone, coffee machine, etc, freezes. We have learned to recognize this kind of fragility when we switched our record-players to CD-players, old phones to VoIP-phones and television to digital television. In a report on software dependable systems made by US National Academy of Sciences one conclusion is "*The committee thus subscribes to the view that software is 'guilty until proven innocent,' and that the burden of proof falls on the developer to convince the certifier or regulator that the software is dependable.*" (Jackson, Thomas and Millett 2007, p. 2) In the report there is a list of aviation accidents where the software has not been directly blamed but implicated.



In Adobe Photoshop your original file can quite easily be destroyed by mistake if you slip on the Shift-key using the keyboard shortcuts when 'saving as'. The similar keyboard shortcuts for to 'save' and to 'save as' can be said to increase the fragile interaction form. However, the fact that in all newer versions of this software it is possible to go back quite far in 'history' reduces some of that fragility.

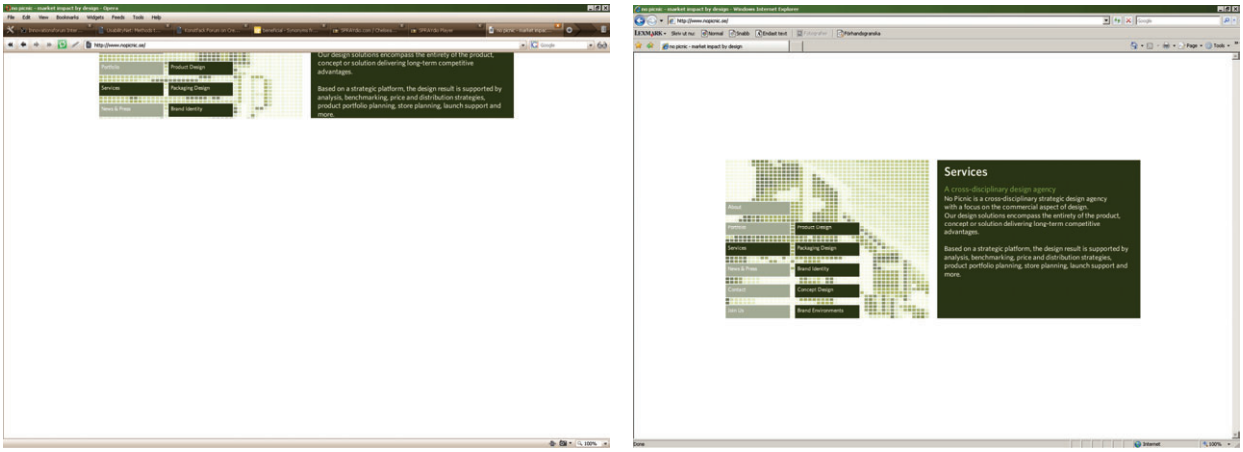
A fragile alarm clock.

An interaction form property might be useful when discussing the overall form of a computational device, but more often it is useful when discussing parts of a design. A mobile phone of mine is an example of when just one part of a device has a fragile form. The alarm goes off no matter if the phone is on or not. However, if the phone is off and you switch it on, set the alarm and then switch the phone off again, the alarm might not go off. This is something you might do if you realize that you have forgotten to set the alarm when you have already switched the phone off for the night, with oversleeping as a potential result. What you have to do to make the alarm setting work, but probably are unaware of, is to give the phone some time, a minute or two, before switching it off. This is an example of where one part of a design relates interaction (set the time of an alarm) and function (make sounds on a set time) to each other in a fragile way.



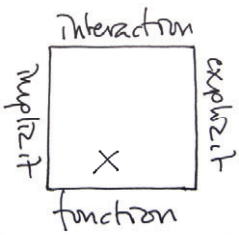
The fragile form of the alarm in a mobile phone (Sony Ericsson T610).

If positioning this example in the area of interaction form, it should be placed in the middle between interaction and function, since it is both a certain way of interacting that contributes to the form (as described above) as well as how the software of the phone actually works (the phone needs some time to start up but allows settings to be made that might not be processed). Furthermore, it is positioned in the implicit area of the design, since there is nothing that indicates that this is how the phone works. You have to figure it out yourself, finding a pattern of the times you oversleep.



The same page of the website www.nopicnic.se in Opera to the left, and in Internet Explorer to the right.

Web browsers offer another example of the fragile form property. Sometimes people have to try different web browsers, in order to check if they interpret the same website differently. It is a way to find out whether it is the website that is not working the way one expects it to, or if it is the web browser that does not read the pages as the producers of the website expected it to.

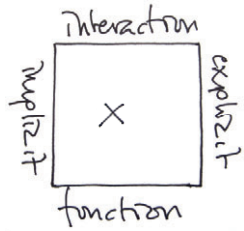


The fragile form of web browsers.

Even though there are standards for the World Wide Web it is common that people have to have more than one browser installed to be able to browse the web properly. Compared to the alarm example above, this fragile form of web browsers is more due to function. In the alarm example, you could affect the fragile form with your own actions (give the mobile phone some time to start up, for example) whereas there often is no way to affect how a web browser will render a web page. Furthermore, this fragile form property is positioned near the middle of implicit and explicit. Usually there is not much in the design that tells you whether a website is shown as intended or not, but at the same time this fragility is more explicitly defined in the design than in the alarm example. A blank page for example, or drop down menus that do not appear, have more to do with the actual interface than an alarm that sometimes goes off and sometimes does not.

The video game console Xbox is yet another example of a thing with a fragile interaction form. In contrast to the already mentioned examples the fragility is intended. The form can be said to be fragile for two reasons.

Firstly, people were able to modify their boxes, to add a bigger hard disk and be able to play pirate copied games, due to security flaws (Steil 2005). Secondly, Microsoft, the manufacturer, did not want people to modify their Xbox and set the terms, for their network service 'Xbox Live', thereafter. If they were able to detect that an Xbox was modified, they shut it out from the network. The fragility is therefore a deliberate strategy from Microsoft as well as a potential choice for the owner of an Xbox. Accordingly, this example is positioned in between interaction and function since it is due both to the fact that you can modify your Xbox and that Microsoft created a system searching for modded Xboxes. This fragility is slightly more implicitly than explicitly defined in the design. Implicit since the fragility has little to do with the main interface of the Xbox. The fragility considered here has to do with alternative interfaces. However, Microsoft made it clear that they would not allow modified Xboxes on the network. Therefore, this fragility is not completely implicit either.



The fragile form of the Xbox that is due to modding.

MAGICAL FORM

An interaction form of a device can be described as magical (have a magical form property) if there is something magical in the way interaction and function are related to each other in the design. Products that people often let themselves be dependent on, or deceived by, might have a magical form. The same thing goes for devices that make people think that there is something more or something else to them than there actually is. The magical form can be something intended by the designer, but it can also be a consequence of complex products that users cannot fully understand and therefore tend to ascribe various behaviours or characteristics to, cf. (Janlert and Stolterman 1997), (Reeves and Nass 1996).

The interaction form is magical if interaction and function are related to each other in a magical way. For instance, if something more or something else, than there is, seems to be there, or if it is done in an enchanting way.

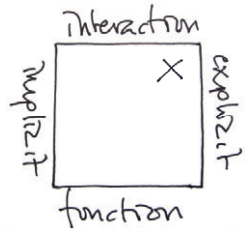
The point of the magical interaction form property is not to discuss products that can be described as hocus-pocus. As a matter of fact, the majority of computational devices can be said to possess this property since there are few devices that we are able to fully understand and control. (Interestingly, we often trust them anyhow, and choose our own way of understanding them.) Telephony, mobile, video, as well as through wire, is a good example. The way one can communicate in real time over a distance and hear (and see) the other person is in a way magical. We can get very used to it but can we fully understand it?

Another more specific example of something with a magical form is the placebo furniture, by Dunne and Raby (2001). The eight pieces of furniture are designed to address questions about people's relationship to and prejudices about technology. The furniture was 'adopted' by people for a few weeks to trigger reflections and thoughts on electromagnetic fields. They are called placebo objects since they do not shield off any electromagnetic fields but are designed to look as if they could. The interaction form property of these objects is magical since the construction of them helps people to see something else than a table, a chair or a lamp, etc. The GPS table that uses GPS to position itself in the world is an illustrative example, mainly because it shows the word 'lost' when it has lost the contact with the satellites. After some weeks one of the 'adoptive parents' said:

> "*It's silly really, but because the light flash, because it moves between its three satellites and there are four things you can read, three satellite positions and 'lost', it gives it a sense of being alive. There's no other word for it. I know it's not, obviously, it's an object and it's electronic, but it's interesting that it's a table that's doing that… You get the sense that you have to go 'Is it all right?'. It's silly to talk about treating it as a sort of person, but it is – 'I'd better go and check the table's there.'* " (Dunne and Raby 2001)

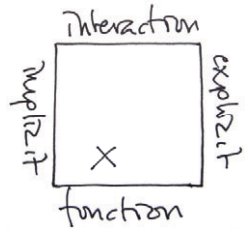
The Electro-draught Excluder and the GPS Table by Dunne & Raby. Photograph: Jason Evans.

To describe the interaction form of the placebo furniture as magical is however not a way to describe people's experiences of having them in their homes. It is a way to label the design with respect to interaction. That is, how the function of triggering people's thoughts about electromagnetic fields has been related to two kinds of interaction. To the arranging of the furniture in a home – using it as a lamp, table or chair, etc, and to thinking of the furniture in terms of something that indicates electromagnetic fields. The magical form is more due to interaction than to function since people's thoughts matter so much. The magical form is, in other words, more due to what a person does with the furniture than to what that the furniture can do for a person. Furthermore, this magical form of the furniture is explicitly defined in the design, since the furniture's visual and tactile interface is designed to trigger thoughts, i.e., they look like they shield off electromagnetic fields, and they express that they are alive, etc.



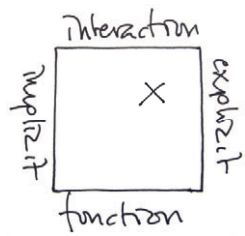
The magical form of the placebo furniture.

This is not the case with telephony, an example where the magical interaction form is more implicitly defined. That is, the magical part of the interaction form is not made explicit in the interface of phones. The magical form of telephony is also, in contrast to the placebo furniture, due to the function, i.e., there is not much you can do with telephony that affects its magical form, it has more to do with the capability to transfer sound (and images).



The magical form of telephony.

Other examples of products that have a magical interaction form are Tamagotchis (1996), Furbys (1998), Aibos (1999) and similar electronic toys that imitate, in one way or the other, living beings. When interacting with these kinds of toys people ascribe them other qualities than the ones they actually have. People do not look at them as pure software and hardware things, they can think of their toy as a creature. What is suggested is that this anthropomorphizing can be described as something being built into the device. This kind of magical form is more dependent on interaction than on function, but not as much as the furniture in the Placebo project. The toys will in some sense react as pets whereas the furniture perhaps will not even work in the way people might think they do.

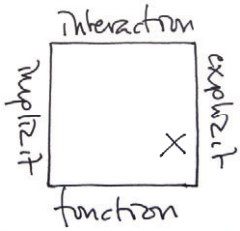


The magical form of electronic toys like Tamagotchi, Furby and Aibo.

CHANGEABLE FORM

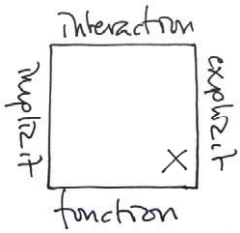
The interaction form is changeable if the way interaction and function are related to each other can change.

Computational devices can change over time and there are two reasons for this that is due to software. One is that data can be saved and accessed which implies that the device's content and behaviour can change over time. Examples can be Wikipedia (2009) which is constantly being revised and growing with new articles, mobile phones recording the words you enter to suggest them in future and search engines adjusting search results to the kind of links you usually click on, etc. The second reason is that software is relatively cheap and easy to replace. Examples can be updates for operating systems, software upgrades of mobile phones and software that can be downloaded to one's car when driving, to temporarily increase the horsepower.



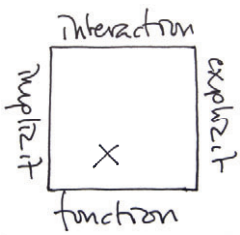
The changeable form of Wikipedia.

A changeable interaction form means that the way a design relates interaction and function to each other changes. The relation between what you can do with something – a mobile phone, a search engine, Wikipedia, a car, etc – and what that something can do for you is not fixed. The search engine, for instance, might initially present search results about the city of Dallas in Texas when you have typed in 'Dallas'. After some searches, it might present more and more search results about the TV soap opera Dallas, since you have shown more interest in such links. Another example can be that your e-mail program might after some time suggest the right names of your acquaintances instead of indicating that you have typed in misspelt words.



The changeable form of the car.

Often this changeable form is more related to function than to interaction, which is another way to say that often you cannot affect the computational device's ability to change, since that ability is built into the function of the device. So, even though you can affect *how* the change will turn out, the changeable form is often more dependent on what the device can do for you.



The changeable form of the search engine.

In most of the examples above the interaction form is (or would be) explicitly defined in the design. The interface of Wikipedia, for example, is explicitly designed so that people can edit, add and contribute. In the car example the customers should know that they are able to change the horsepower if they need it and are willing to pay for it. Search engines, however, present their changeable form less explicitly. That a search engine will adapt to your behaviour might be something you have to read in a press release or something you find out yourself eventually, therefore more positioned to the left in the area of interaction form.

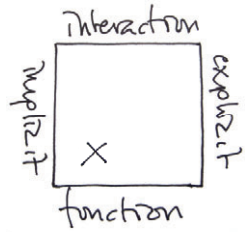
ILLUSIONARY FORM

The interaction form is illusionary if interaction and function are related to each other in an illusionary way.

Illusions are easily created with computational technology. Appearances are deceptive. When interacting with a device it can be hard to distinguish between what actually is, and what just appears to be.

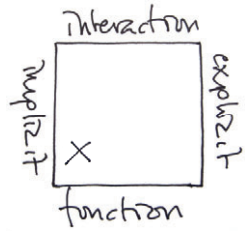
An illusionary interaction form is designed if the design relates interaction and function to each other in an illusionary way. We can, for example, think that we are doing something else than what we are actually doing, being deluded by the interface. Since a picture on a screen is only a bunch of pixels, it can be hard to know what it *actually* is. Is it just an image, or a button, or a link?

The ability to create illusions can be regarded as a problem, something that, for example, makes frauds easy to carry out, such as websites looking exactly like your Internet bank, to delude you to give away your code. Compare with a fake bank office in terms of time and cost. On the other hand, it can be regarded as an advantage that makes it possible to create good prototypes. It makes it quite easy, time effective and cheap, to sketch and present design solutions of graphical interfaces that look just as they were fully implemented. If one succeeds in designing an illusionary interaction form, one can create prototypes that people regard as the real system. This might be desired sometimes, especially in the latter stages of a design process. However, it can also be a problem, in early stages, since it for example can result in comments on colours when one just would like to try out the information structure, etc.



The illusionary interaction form of a GUI prototype that appears to be real.

The illusionary form is more related to function than to interaction in both examples above, i.e., both when seen as a problem and when seen as an advantage. The form in these examples is not something a person can affect by his or her own actions. A person can, for example, not do much to change the illusionary look and behave of a prototype or a fake Internet bank. It will, for instance, not look and behave less real even if a person knows that it is a fake.



The illusionary interaction form of a fake Internet bank.

How the illusionary form is positioned in the interaction form square is illustrated for the above examples. The positions are just examples since they are dependent on how the fake Internet bank and the GUI in question are designed in every detail.

INDISTINCT FORM

The interaction form is indistinct if interaction and function are related to each other in an indistinct way.

The interaction form can be described as indistinct when a design relates interaction and function to each other in a way that is not clear and obvious. An indistinct form is different from the illusionary or magical form since it is when the relation between what you can do with a device and what that device can do for you is merely obscure. That is, obscure and not misleading or enchanting or suggesting that there is something more or else than there is. It could, for example, be the form of a device where it is unclear how to act to achieve what you want.

'Party' is just one of eighteen different 'scene modes' to use when taking pictures with a Panasonic DMC-LX2.

To authorize invoices for payment correctly with an electronic invoicing system can be an example of something with an indistinct interaction form. If the design does not communicate which actions that are crucial or suggests the order in which to do things, the design makes it unclear how to act.

Another example is a system where it is unclear what kind of function that actually is being performed when you do a certain thing, for example, different programmes on a digital camera. What is actually happening when choosing the programme called 'soft skin', 'food' or 'beach'? More examples of things with an indistinct form will be given below.

COMMENTS

Different interaction form properties have been suggested and exemplified above. However, the point is not to categorize existing products. Instead interaction form properties should be used to specify what kind of product one aims for, or does not aim for, out of an interaction perspective. The point is to reflect on which design decisions that might lead there. To discuss whether an interaction form is more related to interaction or function, and whether it is more explicitly or implicitly defined, is a way of specifying what part of the design that affects the form the most. What part, in other words, that is important to focus on and could be a good idea to change if one wants to change the form.

One should not forget that a computational device can have several different form properties. A mobile phone, for instance, might not only possess the magical interaction form discussed above, but also several different fragile ones, etc.

The examples presented of the different ways a design can relate interaction and function to each other, should not be regarded as the only ones, or as the most fruitful ones. They are only a few examples, typical of interactive computational devices. The next chapter will exemplify how these kinds of relations can be expressed.

EXPRESSIONS OF INTERACTION

Expressions of interaction is a designerly way of discussing and reflecting on how a design expresses interaction form in certain contexts of use.

It is expressions of how people might relate to the interaction with a device, in certain contexts of use.

The concept of interaction form gives us a conceptual tool to discuss different ways of relating interaction and function to each other in a design. However, that relation is also being expressed in one way or the other by the design. One can look at it as if an interaction form and all properties of it are defined in a design process together with how that form and its properties will be expressed in every different context, planned or not. *Expressions of interaction* is then a designerly way of discussing and reflecting on how a design expresses interaction form in certain contexts of use. The point is that even though it is somewhat abstract and intangible, interaction is expressed in a design, and we should be able to discuss how.

We might not be used to discussing and reflecting on expressions of interaction, especially not of computational devices. We are, for instance, more used to thinking about and interpreting the expressions of a book, how the graphic design of the cover expresses whether it is a book of fiction, science-fiction, or an encyclopedia, etc, and how the material, paper, colour and size express whether it is an expensive book, of a limited or cheap edition, etc. To some degree we are also able to talk about the expressions connected to interactions with the book, i.e., how to read, hold, carry or place it in a bookshelf is being expressed by the design. Example are the expressions of the typography when it comes to reading, the weight of the paper and sharpness of the edges of the paper when it comes to turning pages, the size of the book compared to people's

hands, the weight of the book in the context of laying down in bed or sitting at a desk, etc.

If we think of a computational device instead, like a mobile phone, we can discuss the expressions of the physical shape and colour of the phone, as well as the graphic design being presented on the screen, in the same way we discussed the expressions of the book. If the phone, for example, expresses being robust or fun, expensive or cheap, whether it shares expressions with an old Volvo 240, a turquoise iMac or a brown wallet, etc. Furthermore, just like the book, we can also discuss some expressions that have to do with interactions, like the resolution of the display when it comes to reading, the size of the phone compared to a pocket, etc. It seems, however, more troublesome to discuss expressions that have to do with the interaction with the software. Words seem to be lacking to describe and discuss, for instance, the expressions of browsing the World Wide Web with the phone, or the expression of an earplug handsfree, that when switching from listening to music to answering a phone call, starts to play back the sound of the surroundings. The more obvious difference between the physical form of an iPhone and a Motorola RAZR is, for example, easier to articulate than how the expressions of the interaction with the software differ, even if that difference is bigger.

It is easier to discuss and compare the physical forms of an iPhone and a Motorola RAZR than the forms and expressions of the interaction design.

The aim of the research of this thesis is to be able to describe such kind of differences in other words than just more or less appealing, intuitive or fun. What is aimed for is a richer design vocabulary on interaction that does not cover only physical shape or graphical user interface, but also interaction that evolves over time in a relation between a person and a device.

Within product and industrial design, there is a semiotic perspective on what products represent. It is an approach of focusing on the interaction between products and people, and a way of not regarding the product as a separate construction (Vihma 1995). There are examples of how a physical form is described in words not actually related to physical form, and not in the literal sense of the word. A telephone booth, for example, is described as ‘unconnected from its surroundings’ and ‘technically cool’ (Vihma 1995 p. 133). A Ferrarri Testarossa is described like this: “*This model from 1984 is charged with a strong expression of high speed which is consistently emphasized in every detail*” (Monö 1997 p. 100). Even though you might not know how a Ferrari Testarossa looks like, you probably get an idea if it is described as having the expression of ‘high

speed', and if you know that is was made in 1984. However, can 'high speed' look like something? In this context, 'high speed' as an expression relates to people's experiences and knowledge of aerodynamics. Actual high speed is not something that is in the car, however, there is an expression of that car – an expression of a form that is defined and built into it. 'High speed' is just part of a vocabulary, used to be able to articulate and narrow down the form and it might be helpful as a concept, especially at the beginning of a design process.

Within interaction design we can look upon expressions of interaction in a similar way. Just as the physical form of a car expresses something, the interaction form of a car expresses something. Just as it is irrelevant whether 'high speed' is something inherent in the product itself – it is just a way to describe the expression of the physical form, it is not relevant whether an expression of interaction is something inherent in the device itself – it is just a way to describe the expression of the interaction form. Different expressions of interaction can be used to frame and discuss how a design expresses interaction in different contexts of use, expressions that in the same way as high speed are not meant to be understood in a literal sense.

Expressions of interaction can be described as expressions of how people might relate to the interaction with the design, in certain contexts. An example can be accomplishment. Accomplishment can, in other words, be a concept to use in the design process to reflect on how the design expresses how someone might relate to interacting with the design, in certain situations. It can be the expression of a distinct form of software that is outstanding for a specific task, or it can be the expression of an indistinct form of a video game that is challenging and rewarding to play.

Expressions of interaction are not something we prove by empirical user studies, but a conceptual framework we use to discuss and frame basic issues of aesthetics of interaction. A vocabulary of the expressions of interaction is not about tracing the experiences people have when they are using a device back to the design of the device. Instead it is developed within the design process. The starting point is ideas about interaction at the beginning of a design process, not people's experiences of something already existing. It is an attempt to develop an understanding among designers and design researchers of how interaction can be expressed, to be able to communicate and discuss goals and aims and alternatives, in the very beginning of the design process. It can be seen as a design

approach to achieve a better understanding of interaction design. The aim is a vocabulary that can be used as a conceptual guiding tool.

Below some characteristics of expressions of interaction are listed, that will be exemplified further on.

- Interaction form will be expressed in one or the other way. If you design something that people can interact with, there will be expressions of interaction, no matter whether you considered them or not.
- Expressions of interaction may vary in degree. An expression of interaction is something that there can be more or less of, it does not just either exist or not. One can, accordingly, discuss whether different design solutions support or counteract, strengthen or reduce, an expression. A design can also support several expressions of interaction, not just one.
- Expressions of interaction can be expressions of a more or less explicitly or implicitly defined interaction form, and of a form more or less interaction or function dependent. Since interaction form properties can be more or less explicitly or implicitly defined, and more or less interaction and function dependent, expressions of interaction are expressions of such states. An expression of a more explicitly defined relation between interaction and function, for instance, is an expression of a relation that is part of the main interface. Whereas an expression of a more implicitly defined interaction form, is an expression of something that is not part of the apparent interface.

  The interaction form square, on page 32, can be used to reflect on different aspects of a design. Expressions of forms of the upper right corner, explicit interaction, can imply questions of how a design should take into account that people might hold it in their hands in a certain way, or look at it from a certain angle, etc. Whereas expressions of forms of the upper left corner, implicit interaction, are expressions, for instance, of how the design relates people's thoughts, prior experiences, etc, to function. Even though this is somewhat abstract it can be used to reflect on how the design should take into account that people might think of a device in a certain way, or are used to certain things from similar objects, etc.

- What a device expresses does not have to reflect its actual properties or qualities. Within the car industry expressions such as sporty, sturdy, and sleek (Volvo XC60 2009), aggressive, muscular and dominance (Alfa Romeo 147 2009), or high speed, as already mentioned, can be used to describe the physical form of a car. Interestingly, these expressions do not describe the actual performance or properties of the cars, but what the physical form suggests. The physical expression of a car might be sporty and muscular even though the car has not got much horsepower. The same goes for expressions of interaction, they do not have to reflect actual properties or qualities of the device.

- Expressions of interaction. Not experiences of interaction. There is an important difference between an expression and an experience of interaction. To say that we when designing a computational artefact define certain expressions of interaction is neither to say that people will experience something that corresponds or answers to those expressions (feeling accomplished, for example). Nor that people will identify the expressions (describe the device as having an expression of accomplishment). People's feelings and experiences are individual and today, we know too little to specify them in terms of design requirements. Expressions of interaction are instead a way to reflect on what the design can imply in a certain context of use, in a potential situation. It is a way to question and reflect on what the effects of the interaction can be in a certain situation, in terms of people's ways of interacting and relating to the design. In other words, expressions of interaction do not refer to people's experience. The expressions are regarded as something that is defined in the design process whereas people's experiences are not being defined in the design process. People's experiences are not regarded as anything that is designed at all, just as little as people's actual interaction with and actual relation to computational devices. However, a design can *express* how it *relates* to people's possible interaction with it, irrespectively of how people eventually will experience the use of the device, or how they actually will interact with it.

Accomplishment, for example, as an expression of interaction, is just a way to describe a design. It might be noticed by a person eventually, i.e., a person using the device might describe it as having an expression of

accomplishment. A person might also experience accomplishment, not only perceive the expression but also feel accomplished. However, it might also be the case that a person notices it as an expression but experiences something else, or that a person neither notices it nor experiences it. What people notice and experience when they interact with a product differs between persons and between situations. A device can have many different expressions of interactions, even contradictory ones, as expressions of very different ways of interacting in different contexts of use.

Affordances, a concept defined by the psychologist Gibson (1979), was introduced into the field of HCI by Norman (1988) and Gaver (1991), among others. It can, just like expressions of interaction, be framed as a way of discussing a design from an interaction perspective. Gibson's focus was on affordances in our environment in relation to animals and humans. The ground affords support, air affords respiration, a large object needs a handle to afford grasping, etc. Whereas, within HCI, also pixel based graphical elements have been analysed to consider whether they afford pushing, moving or editing, etc. The idea of affordances is that the shape of something constitutes what that thing affords – the possibilities of actions. Similar to expression of interaction, affordances are presented to be independent of perception. Hence, if something affords sitting on, i.e., being rigid, knee-high and having a flat, horizontal surface, that does not imply that it looks suitable to sit on, or that people perceive it to be suitable to sit on (Gibson 1979 p. 128). However, the goal within design has often been to make 'perceptible affordances', avoiding hidden and false ones, as Gaver (1991) puts it. Another similarity is that an affordance is not a property of people's experiences. Gibson (1979 p. 137, 141) says that affordances are "*properties of things taken with reference to an observer but not properties of the experiences of the observer* /…/ *An affordance, as I said, points two ways, to the environment and to the observer*". Gaver (1991 p. 83) points out: "*Perhaps most important, it allows us to focus not on technologies or users alone, but on the fundamental interactions between the two*". A mobile phone might, for example, have the affordance of touching the screen. If it also has an expression of interaction of accomplishment, it means that accomplishment is an expression of how the design relates the touch gestures to the functions of the phone. Accomplishment is then an expression of how people might relate to the use of the touch gestures for navigating the phone in certain contexts.

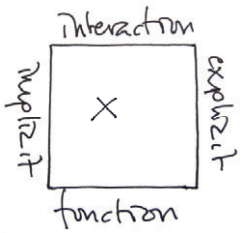
Below, nine different examples of expressions of interaction will be presented: anxiety, alienation, indifference, confusion, imagination, dependence, suspiciousness, thrill and trust. These are only a few examples, just like the examples of interaction form properties. Some of them are chosen since they are rather typical of interactive devices, others to encourage reflection on aspects that might be overlooked.

An interaction form can be expressed in different ways. If a device has got a fragile interaction form, for instance, that fragility can be expressed as something else than fragility. For instance, if the fragility is function dependent it can be expressed as *anxiety*, e.g. due to a design that suggests that the device might break. If the fragility is more interaction dependent it can be expressed as *thrill*, e.g. due to a design that suggests that the device might break but that it depends on you, you could be able to prevent it. If the form is more implicitly than explicitly defined in the design, it can be expressed as *alienation*, e.g. a device that will not reveal itself to full extent so there is a risk for misunderstandings. If the form is completely implicitly defined and invisible to people, it can be expressed as *indifference*, which is a device that will not express its fragile form at all.

ANXIETY

Anxiety is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

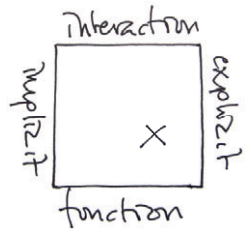
To say that anxiety is an expression of interaction is to say that the way the design relates interaction and function to each other, is being expressed as anxiety, in certain contexts of use. Anxiety can, for example, be an expression of the Xbox described previously. To the left is the same illustration as on page 39 of the fragile form property of the Xbox that is due to modding. What is suggested is that this fragile form can be expressed as anxiety in certain contexts, for example, in the context of having a modified Xbox and connecting to Xbox Live. The device is, in other words, designed in such a way that anxiety is an expression of how people might relate to the device, an expression Microsoft might want to have in their system.



The cross marks out the fragile form of the Xbox, a form that may be expressed as anxiety.

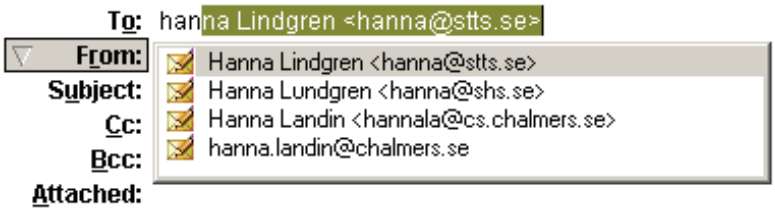
Some fax machines, where the feedback of what is being sent where is poor or non-existent, can also be described to have an expression of anxiety, but of a rather explicitly defined indistinct form. The form is indistinct if the design relates interaction and function to each other in an unclear way. It might be unclear, for example, how the way you feed the machine with paper and press buttons are related to what is actually

printed somewhere. Such kind of indistinctness is rather explicitly defined in the design of some fax machines. It is pretty much part of the interface to give no clear directions of how to place the paper, or where the paper is being sent to, if it was received, etc. Anxiety is a way to discuss the lack of feedback in relation to possible wants and wishes of sending a fax, in that kind of urgent situations, when sending that kind of important documents, etc. We can think about which design decisions that would reduce or strengthen such an expression of interaction, in such situations.



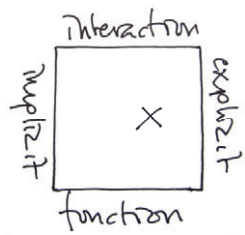
The indistinct form of a fax machine that may be expressed as anxiety.

Certain e-mail programs are another example of devices that can express anxiety. For example, e-mail programs that automatically suggest e-mail addresses matching the letters you have typed in to the To-field. To automatically fill in addresses is something that simplifies the writing of e-mails, since you do not have to know addresses by heart; you just have to be able to remember the first letters of the name of the addressee (if you have used the address before).



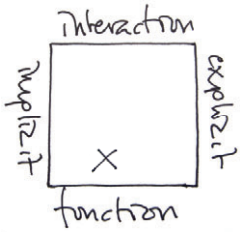
E-mail program Eudora auto-completes e-mail addresses based on initial letters.

In some software you just press enter to choose the first alternative, in other you have to click on the correct alternative. If you just have to press enter, the design makes it easier to send an e-mail to the wrong person: you just type in a few letters in the To-field, press enter and send. Then you realize that you sent it to someone with a similar name or adress. This design decision, i.e., to automatically fill in the first address of a generated list of contacts, strengthens the expression of anxiety. It is an expression of a fragile form that is as much related to interaction as to function. This means that the fragile form depends both on what you do (read or do not read the address, press enter, etc) and what the e-mail program does for you (suggesting an e-mail address in such a way that you do not have to choose and click). This fragile form property is to some extent, but not completely, explicitly defined in the design.



The fragile form of auto-completed e-mail addresses, a form that may be expressed as anxiety.

The interaction form property of fragility can often be expressed as anxiety. As mentioned, many computational devices can be said to have a fragile interaction form. Debugging computer software can, for example, be described as a way of trying to eliminate fragility and anxiety. If the fragile form is explicitly defined in the design the expression of anxiety is strengthened, and if implicitly defined reduced. A very general example is computers of all kinds that might freeze or crash, a fragile form that can be more or less implicitly defined. If we have a series of laptops, for example, with the same hardware fault that makes them crash in a similar way, the fragile form is rather explicitly defined and so will the anxiety be. Whereas if we have a device with higher reliability that very seldom freezes, but when it freezes it does it for no obvious reason, the fragile form and the anxiety are more implicitly defined in the design.



The fragile form of an encrypted RAW-format that may be expressed as anxiety.

Different file formats for storing data, such as digital photos, are another example of something that can be said to have a fragile form. Since different camera producers have their own RAW format, there is a fragile form that can be expressed as anxiety. There is not one open standard for storing digital images. This might lead to that in the future, using another computer, or a newer operating system, or if the camera producer no longer exists, we will have problems reading or converting our files. This expression of anxiety became apparent when Nikon released a camera (D2X) with a RAW file format that had an encrypted white balance. Concerns where being expressed on different forums on the Internet:

> "*Just over 36 hours have passed since we posted this advisory, since then there has been an explosion of commentary and discussion on our forums. It's very clear that genuine Nikon buyers are concerned that Nikon are gradually closing their RAW format (NEF) and that some third party converters will struggle to convert NEF's either now or in the future*" /…/ "*Looking at it from Nikon's point of view you can see why they may be a little upset that other companies are making money from conversion of their proprietary file format, however it seems that photographers believe that the image (in JPEG or RAW format) is theirs alone and they shouldn't be restricted to its development*" (Digital photography review 2005)

This is an example of where an expression of anxiety is reflected in people's actions (making their concerns heard). To use the concept of anxiety in cases like this opens up for reflections on how to add or reduce

design elements that eventually might affect how people relate to their camera. To reduce the expression of anxiety, one might open up the format and provide a good specification or well documented code so that it will be easy for people to create new converters. That would be to work on the explicit function of the interaction design. Another alternative is to work on the implicit interaction. If a lot of people are using the same file formats, people will be interested in the same converters. If that is the case the awareness of a critical mass of users might reduce the expression of anxiety. In other words, one might consider to let the design express that there is a critical mass of users. There might of course be many reasons for not doing any of the above. To reflect on ways of increasing or decreasing an expression, however, can make it easier to weight and discuss the pros and cons of a design, from an interaction design perspective.

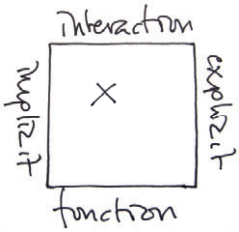
ALIENATION

Alienation is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

According to Borgmann (1999), technology alienates people from reality. This is criticized by Verbeek (2002) who means that technology is something that helps people shape their relationship with reality, which is also the perspective of this thesis. Nevertheless, alienation is in the current work suggested as an expression of interaction of technology, and of computational technology in particular. That is, alienation as an expression of how a device relates interaction and function to each other. It is not alienation as an expression of how a device alienates people from reality, it is how design decisions express a distance between people and the device.

Alienation can be the expression if there is an unclear connection between interaction and function. Accordingly, an indistinct interaction form can be expressed as alienation, but also an illusionary form or a fragile form. The ticket machines on the railway stations in Sweden[4] offer an example of alienation as an expression of an indistinct form. They suggested by default (if you did not change the date or time) the next train connection counted from next full hour. For example, if you were buying a ticket at 07.08 it suggested the first train with a departure after 08.00, even if there were earlier departures. The design of this system was indistinct since the system sometimes suggested the next train connection, sometimes the second or third next, etc, depending on the number of departures per hour

[4] of the state-owned railway SJ, replaced in October 2008



The indistinct form of a ticket machine, which by default does not suggest departures the current hour. A form that may be expressed as alienation.

and the time (for example, if it was 07.00 or 07.59) and this without making it obvious or explaining why. This indistinct form depended slightly more on interaction than on function and was more implicitly than explicitly defined in the design. This since the form depended on that people interacting with the system might expect trains leaving for a certain time (now), and since the actual time and the default time for the trains were displayed, however easily missed if you did not read everything carefully. The form was, in other words, dependent slightly more on what people did than what the system did. Alienation as an expression of interaction means that this way of relating the interactions (the way you could buy a ticket with this machine on the station) and the functions (making a reservation on a certain train, etc) to each other expressed a distance between you and the system.

Products designed in such a way that we, even if we use them often, never really see the link between cause and effect, are other examples of things that can be described to have the expression of alienation. If a design does not let you see the consequences of your actions, it might express a distance between you and the device, i.e., an expression of alienation. Examples can be digital cameras, washing machines, circotherm ovens, dishwashers, cars, etc. These products seldom communicate the consequences or actual significance of different options. Alienation might be the expression when the lights on the dishwasher start to twinkle in a certain rhythm, when a message appear on the dashboard of the new car, or when you want to adjust the temperature in the fridge, etc.

Two controls in a refrigerator.

INDIFFERENCE

Indifference is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

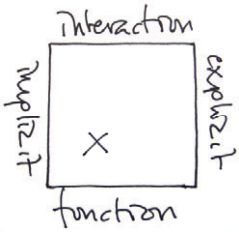
Implicitly defined interaction forms can be expressed as indifference. To say that an implicitly defined fragile or illusionary form, for instance, is being expressed as indifference is to say that even though interaction and function are related to each other in a fragile or illusionary way, that is not the expression. The fragile form is not expressed as fragility but as indifference, etc.

Debit and credit card systems offer an example. Such systems can be said to have a fragile form since you rather easily can use someone else's money, all you need are the numbers printed on the card, and in some cases the four digit code. The design relates interaction (to access money in stores, in ATMs, over the Internet, etc) and function (give access to someone's money) to each other in a way that can break rather easily. The system makes frauds possible, and almost likely. A consequence can be that the bank has blocked your card for security reasons, or that someone has emptied your bank account. (The form is fragile no matter who you are, i.e., no matter if you are a credit card customer, the bank or a criminal. It is just that some people are affected by the fragility, others take advantage of it.)

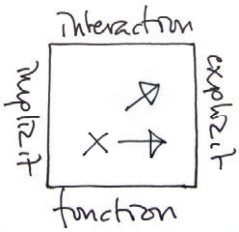
A fragile interaction form. With the numbers that are printed on the card you pay with someone else's money on the Internet.

This fragile form is expressed as indifference in certain contexts of use, which is a way of saying that the fragile form will not be expressed in any particular way. From the banks' perspective an expression of indifference can be preferable, since if the fragile form is not expressed as fragility, but as indifference, people probably will use their cards more, which generate money for the bank. Looking at it from the criminal skimming point of view, an expression of indifference is something good since it does not give people reasons to be careful and it decreases the chances that they will realize when they are giving away crucial data to a third party.

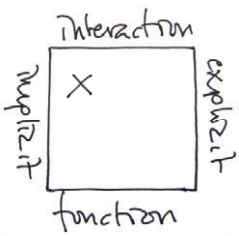
Indifference as an expression has to do with design decisions that do not express anything clearly, it can be something with no expressions as well as something being expressed as unimportant. Again, it is important to separate indifference as an expression and as an experience. If people do not notice an expression of, for instance, fragility, that might just mean that the experience is that of indifference, not that the expression is indifference.



The fragile form of credit card systems that may be expressed as indifference.



Examples of ways of changing the fragile form of a credit card system and how it is being expressed.



The fragile form of a credit card system that may be expressed as anxiety.

The fragile interaction form of credit cards is more related to function than to interaction, i.e., it has more to do with the functions of the system than with what someone can do with it. The reason why the form can be expressed as indifference has to do with that the form is implicitly defined, i.e., to the left in the area of interaction form.

If one would like to reduce this expression of indifference, one might, for example, try to move the fragile form towards explicit function instead. It could be a design of credit cards that expresses the fragile form in such a way that people might be more aware of the risks, even if the design does not make frauds such as skimming impossible. Such a design would have an expression of fragility rather than of indifference. Another approach could be to move the fragile form towards explicit interaction. It could be a design that implies that the card holder must be more involved in a credit card fraud, not only trying to pay or do a withdrawal as usual, but also do something else, a more careless action. It could be a safer system where the expression of indifference would be reduced.

One might also be able to transform the expression of indifference to anxiety by just changing the information about the system. If people are informed that they can be skimmed without notice, the expression of the fragile form could change into one of anxiety. This is related to implicit interaction, i.e., people's attitudes, ideas and thoughts regarding interaction.

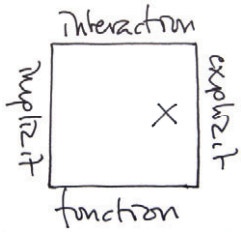
The idea of using graphs of interaction form, is to visualize consequences of basic design decisions to open up for discussions about pros and cons. If the design affects people's safety in some way, anxiety might, for example, be preferable to indifference as a step towards making it less likely that people will take risks. However, in the example of credit cards, anxiety might at the end make people use the cards less, which might be negative from the banks' perspective. The idea is that when different scenarios and design alternatives have been identified and discussed, the design team hopefully has created a foundation for decisions on what to try out and examine further.

It can also be fruitful to think about the consequences of moving expressions like alienation, anxiety and others deeper into implicitness. If a fragile form, for example, being expressed as alienation becomes more implicitly defined, it means that the expression of interaction of indifference might be strengthened, at the expense of alienation.

CONFUSION

If you want to design something that expresses that it is 'easy to use', confusion might not be the expression you are looking for. Confusion is often an expression of an indistinct form. Ticket machines are a typical example, for instance, the ones of bus stations in Stockholm (see next page). The machines were installed in 2007 but are based on much older parking meters. This fact may explain why the different steps of buying a ticket are in random order rather than in sequence, and why there are instructions to read at four different places. The interface relates interaction and function to each other in an indistinct way which is explicitly defined in the design. What is suggested is that this indistinct form can be expressed as confusion in certain contexts. Confusion is a way of describing the fact that the interface does not express the functions of the machine in a clear and plain way, and that it is not clearly expressed how to carry out a certain action.

Confusion is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.



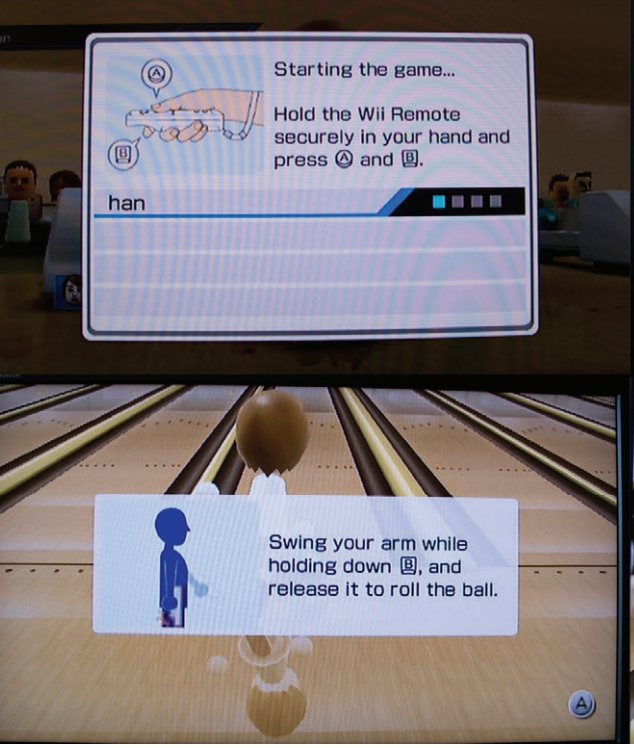
The indistinct form of the ticket machines in Stockholm and Gothenburg that may be expressed as confusion.

Even though we choose to use the word confusion, we do not mean that people necessary are confused. For instance, people buying tickets might know how to handle the design so that they get the right ticket anyway, or people might be buying the wrong ticket without knowing, not being confused at all, thinking they are buying the right one.

The machine on the trams of Västtrafik in Gothenburg is another example. The numbers to the left have nothing to do with the number of people you want to pay for, or which tram you ride, even though each tram line has a colour of its own (line 1 is white, 2 yellow, 3 blue and 4 green, etc). The numbers are only indirectly related to the price. You are supposed to press the button for how many 'coupons' you want, 2 or 3 for an adult (depending on where you go) and 1 for a child, provided that you are only travelling within the city. If you are travelling further away, changing to bus or train, you can pay for those coupons as well. This information cannot be found directly on the machine or on your card. Accordingly, this design also relates interaction (inserting a card and pressing buttons) and function (charging) to each other in an indistinct way. It is a form that may be expressed as confusion in certain contexts, for example, when using the machine for the first time when catching the light blue tram 9. (After you have inserted your card, should you press 1 since you are only one person? Or 9 as in tram 9? Or should you press something else?)

Ticket machines on the trams and busses in Gothenburg.


16:52
1. Välj biljettyp
Biljetter Tickets
Här kan du köpa 1-timmes zonbiljetter till helt eller reducerat pris.
Here you can purchase a 1 hour zone ticket at full or reduced price.
Betala med kort eller mynt. (Ingen växel)
Pay by card or with coins. (No change)
3 Betala med kort/mynt
Pay with card or coins
1 | 5 | 10 kr
OBS! Ingen växel / Note: No change
4 Tryck för biljett
Press for ticket
Välj biljettyp och zoner
Choose type of ticket and zones
H = Vuxen Adult
R = Ungdom/pensionär Youth/pensioner
1 Tryck en gång för helt pris (H)
Tryck två gånger för reducerat pris (R)
Press once for full price
Press twice for reduced price
2 Tryck för de zoner du ska resa i
A / AB / ABC
Press to choose zones
A / AB / ABC
Avbryt köp
Cancel purchase
Biljettyp Type of ticket A
1-timmes zonbiljett 1-hour zone ticket
Mer information finns på informationstavlan.



In WII Sports the brief bowling instructions do not tell you that the bowling ball will spin depending on the angle of the remote.

Confusion can also be the expression of a changeable interaction form. If the way a design relates interaction and function to each other changes from time to time, the risk, or chance, that there will be an expression of confusion increases. The fact that there are rather few adaptive user interfaces might be explained by the probability of confusion as an expression of changeable forms.

However, confusion as an expression does not have to be something negative. Usually, videogame interaction is based on pressing buttons on the game controller. However, the Nintendo Wii game console uses a set of two remote controls for each player. The controllers have two accelerometers and an optical sensor that makes it possible to interact in several ways. Consequently, your movements when holding the controller also matter, and since movements in the air are less specific than to press a button, the relation between your actions and what happens in the game becomes more indistinct. That is, the design relates interaction and function to each other in a way that is not clear and obvious. To fully understand the effects of your movements, for instance, you have to know how the remote controls work and how the game has been designed. To play a game, though, this understanding is not important. You can learn how to play by trying out different ways of moving the controllers.

Wii nunchuck and remote.

Photograph previous page: Hanna Lindgren

Photograph: Nikolaj Lindberg

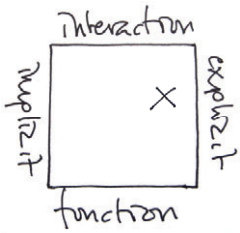
Two persons trying out and using different techniques when boxing with the Wii.

The expression of confusion of the Wii is in certain situations a fun and entertaining part of playing a game. In the game WarioWare, for example, the expression of confusion adds to the amusement, since the whole idea is that you in a few seconds have to find out what to do with the game controller, whether to swing it, point it, twist it, drop it, etc.

IMAGINATION

Imagination is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

There are several digital toys that borrow expressions from living beings, as already mentioned. This magical form is in certain situations expressed as *imagination*, i.e., the form is expressed as to open up for imagination. One rather early example is the Tamagotchi (1996). It was an egg shaped digital pet with a display and a few buttons by which you could feed the pet, clean up its waste and play simple games with it to make it happy.[5] Animal expressions have also been added to everyday objects, such as a pillow as in the case of PillO'Mate (McGee and Harup 2003), or a bicycle as in the case of the Iron horse (Landin, Lundgren and Prison 2002). The PillO'Mate pillow is heavier than other pillows, it is warm and purrs like a cat. The Iron horse is a bicycle that sounds like a horse. It got some horse behaviour, like occasionally greeting the owner, snorting and neighing in different situations, etc, see page 139.



The magical form of some digital toys, the PillO'Mate and the Iron Horse. A form that may be expressed as imagination.

All the above are examples of things with a magical form. That is, the way the design relates interaction and function to each other, adds

[5] As a substitute teacher in 1997, I had to console a crying eight years old pupil that had forgot her Tamagotchi at home, deeply concerned about it lying there alone, starving to death.

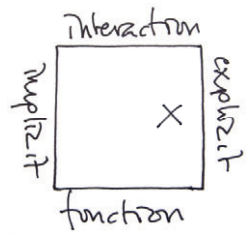
something that does not really exist in the material itself. Even though people know that these objects are not alive, they can choose to relate to them as some kind of living beings anyway. Imagination is, in these examples, an expression of a rather explicitly defined magical form, a form related slightly more to interaction than to function since the form is dependent on people's choice of interaction.

DEPENDENCE

Dependence is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

The expression of dependence can often be seen in computational devices that people tend to let themselves be dependent upon. A magical or a distinct interaction form can, for instance, be expressed as dependence. A mobile phone is a typical example. People tend to develop a somewhat nervous and dependent relationship to their phone and one part of the reason can be found in the design of mobile phones. There is something in the audio and tactile appearance of mobile phones, when putting through phone calls and messages, that interrupts people, making it hard for people to ignore them. It is the design decisions regarding the ringtones and the vibrator settings that can affect whether the form of the mobile phone is being expressed as dependence or not.

Dependence is here positioned to the right, more related to what is explicitly defined in the design, and as much to interaction as to function. The form is due as much to the way the phone is designed to notify us of incoming calls and messages – ringtones, vibrations, etc – as to how we let it notify us, for example, by where we put the phone, how we set the sound volume, our choice of vibrator settings, etc. All these functions and interactions are rather explicitly defined in the design. They are part of the explicit interface.



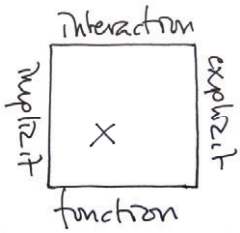
The distinct form of mobile phones that may be expressed as dependence.

Mobile phones are just one example, other computational things where a magical or a distinct form is being expressed as dependence are games, internet communities, digital pets, e-mail programs (that play a sound or show an icon in the tool bar when you have new e-mails), etc.

SUSPICIOUSNESS

Suspiciousness is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

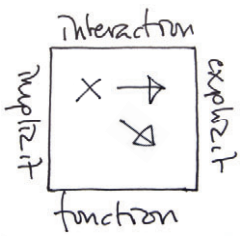
An e-mail spam-filter is an example of something that can have an implicitly defined fragile interaction form, if e-mails that are not spam can falsely be classified as such. The fragility of such a spam-filter is more related to function than to interaction, since the fragility will not be affected by people's actions to any greater extent. The fragility is also



The fragile form of a spam-filter for e-mails that m may be expressed as suspiciousness.

more implicitly than explicitly defined if people seldom see the e-mails that are sorted out. This fragile form can in certain situations be expressed as suspiciousness. That is another way of saying that the design allows interaction to be expressed in a way that suggests suspiciousness, for instance, if the design expresses that the filter occasionally cannot distinguish ordinary e-mails from spam and at the same time does not present an easy way for people to check this for themselves. An e-mail program can suggests, for instance, that people cannot be sure whether someone received their e-mail or whether the answer got stuck in a filter, or whether they received it but simply did not answer.

A way to reduce suspiciousness can be to move the expression upwards, towards interaction. It can be a design that gives people an easy way of searching the e-mails sorted as spam. Another way can be to move it further towards explicit function. It can be a system that can give you feedback if an e-mail you sent where classified as spam together with the reason: if it was because of the content of your e-mail, or how it had been sent, or your address, etc.



The indistinct and changeable form of Facebook that may be expressed as suspiciousness, and suggestions of how to reduce that expression.

Facebook (2008a) is another example of the expression of suspiciousness. It is a social networking website that grew massively during the year 2007. Two important design decisions are that people can add their own applications to it, and that people disclaim their rights to everything they upload or type in, e.g., their images, videos and texts. There are many things in the design of Facebook that support the expression of suspiciousness, for example, the lack of information about the implications of adding a new application, unclear conditions that one has to accept like: "*Know who I am and access my information*", the continuous change of Facebook from the developers' side, the unclear privacy settings, that you cannot know if you actually delete things or just hide them, etc. Most of these things are related to an indistinct form but some to a changeable form. The design of Facebook, with these interaction form properties, provides a ground for questions as who can access all information, who is the buyer of statistics and user data, what can happen in the future, etc. In other words, Facebook is design in such a way that there is an expression of suspiciousness in certain contexts.

Suspiciousness is in the case of Facebook more or less related to implicit interaction, since it is thoughts, expectations, wishes, etc, that affect the expression. This means that one way of decreasing the expression might be to try to affect how people think and approach the system. Make it

more explicit and clear, for instance, what the licence of agreement actually implies from the beginning and continuously inform about such matters. Another way could be to be more consistent so that people can try out things themselves and see the actual consequences.

THRILL

Thrill is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

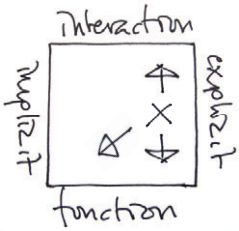
Thrill can describe how someone might relate to buying a train ticket on auction. In October 2007 SJ, the state-owned railway traffic company in Sweden, started to put up remaining train tickets for auction 48 hours before departure. They already had about hundred different fares for the same departure so to also sell by auction could be seen as the next logical step. The closing time for the auction is 6 hours before departure, so if the train leaves at 8 am you will know whether you got a ticket at 2 am (i.e., whether you were the highest bidder). The auction is not taking place on the website of SJ but on one of the biggest Swedish auction sites, Tradera.

Train tickets between Stockholm and Malmö that cost between 16 and 108 SEK 13 hours and 34 minutes before departure.

Compared to the usual way of selling train tickets with a fixed price, one can describe this way of selling tickets, strictly speaking this way of relating interaction and function to each other, as indistinct. Indistinct since the consequences of your actions are not clear. You do not just buy a ticket. You might have to bid several times and it might take hours before you can see the result. This indistinct form property might be expressed as thrill in certain situations of use. Thrill since the design implies that there could be an opportunity to buy a much cheaper ticket than if you buy one in advance, and since the design makes it hard for you to be sure that your bid will be the final price.

To say that thrill is an expression is, once again, not to say that people will be thrilled, though they might. People might be irritated, frustrated, amused, happy or having whatever experience one can have bidding, winning or losing an auction. To say that thrill is an expression of the design is just to say that the system is designed in such a way that thrill can be a description of how someone in certain situations might relate to this way of buying tickets. A scenario can be a nearly broke fan living in Stockholm with a strong urge to see a concert in Gothenburg.

Irritation, frustration, and amusement can, just like thrill, be discussed as expressions of the design. One can, for example, discuss how different design decisions would strengthen or reduce different kinds of expressions, in different situations.



The indistinct form of auctioning off train tickets a few hours before departure that may be expressed as thrill, and suggestions of how to change that expression.

The indistinct form of selling tickets by auction depends as much on explicit interaction as on explicit function. The form is built into the user interface of the auction site and supported by the time limits that are set. At the same time matters what people can do with the system, e.g., that people can lay as many bids they want and that they can raise with any amount of their choice. If this indistinct form would depend more on explicit interaction (the top arrow in the figure to the left) the expression of thrill might be strengthened. It would mean that you would be able to affect the indistinctness more with your actions. A design allowing people to withdraw bids, allow blind bids, etc, offers an example. If the indistinct form instead would depend more on function (the lower two arrows in figure to the left) expressions such as frustration and irritation might be strengthened instead. Such a change would imply that people would be less able to affect or control the indistinctness through their actions. It could, for instance, be an auction with a delay of presenting the current bid, or a system that did not send out information to you if you had won, instead requiring that you logged in on the site and checked yourself, etc.

TRUST

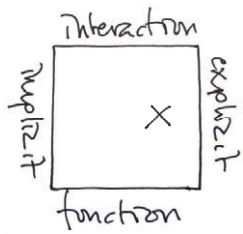
Trust is a way of discussing and reflecting on how a design expresses an interaction form in certain contexts of use.

In our everyday life we have trust in a lot of different computational devices. We trust Internet banks, servers, voting system, electronic locks, cars, etc, even if we do not know, and often are not able to fully understand, how they work. From this perspective it can be fruitful to think of how a design can support the expression of interaction of trust and reliance.

Airline flights can be an example of the expression of trust. The airlines want people to feel secure and one way to achieve that might be through a design that expresses the interaction form as trust. Trust can, for example, be the expression of a distinct and non-fragile way of relating interaction to function. For example, having the same kind of security controls on all airports, having the same kind of safety demonstrations on all aircrafts, keeping the same regulations for bringing liquids on board for a longer period of time (which learn people *the* way of packing and decreases the room for arguments), and using the same kind of safety equipment on all flights. These are examples of design decisions of a flight that supports a distinct form. It is a distinct form that can be expressed as trust in certain situations, giving the expression that the airlines know what they are doing. They will ask you every flight to pay attention to the safety demonstrations since they are important, they will provide you with a life jacket since it might help you, they will not allow more liquid than 100 ml since that will save you from terrorists, etc. If they all keep the same routines they might express that the routines work and are good, even if they are not.

To strengthen the expression of trust one can aim at making a product as reliable and distinct as possible, and try to avoid indistinct or fragile interaction forms.

Trust can be a way of discussing how the design of an Internet bank expresses the interaction form, in certain situations of accessing money. Trust can, in such an example, be an expression that is due to a distinct interaction form, positioned in between explicit function and explicit interaction. The form can depend both on the way of handling money and how the security is being designed, through security tokens, (explicit function) and on the interactions of writing in different codes and to download and use certain certificates (explicit interaction). The expression of trust would probably be reduced if the distinct form were more dependent on interaction, for example, which web browser you chose to use, if you used an encrypted wireless connection or not, etc. However, that does not mean that the expression of trust automatically would be strengthened if the distinct form were more dependent on function. Perhaps there is a need for a balance between interaction and function so that people become aware of that they are doing something different than browsing an ordinary site, e.g., that they are actively contributing to the security by their actions.



The distinct interaction form of an Internet bank that may be expressed as trust.

Three different security tokens of Internet banks.

It might also be relevant to look into how different ways of relating interaction to function support or counteract the expression of trust. Some decisions might support the expression of trust and others the expression of suspiciousness.

COMMENTS

In a design process one can go through different design alternatives and discuss them out of different scenarios and raise questions about the form and the expressions. What kind of interaction form are we looking for? What kind of interaction forms are these alternatives representing? How can we move the form closer to implicit function? What would happen with the expressions of interaction if we change the interaction form to be more dependent on interaction? What would happen if it was more dependent on function? What happens if we make it more, or less, explicit? Since it seems like we might have the expression of x in these kind of situations, how can we reduce that expression, or should we try to avoid those situations instead?

TRAINING AND CRITIQUE

In this chapter one design exercise on form and one on expressions are presented, followed by a methodology of investigating digital myths. Together they present three methods of how we can focus on aesthetics of interaction in the design process. They address a designerly way to focus on the relation between devices and humans, where the aim is to reflect on how the way devices present themselves to people can affect how people interact and relate to them.

The first exercise deals with interaction form. You reflect and base design decisions on how the design can relate interaction and function to each other. The second exercise deals with expressions of interaction. You reflect and base design decisions on how the design can express interaction forms in different contexts of use. Finally, the critical design method of digital myths is presented. You identify digital myths that restrict interaction in one way or the other, myths that you review, demystify and finally transform.

EXERCISE IN INTERACTION FORM

AIM

To put focus on how a design can relate interaction and function to each other and base design decisions upon such reflections. To pay attention to interaction aspects early in a design process, before there is any actual interaction or any object to test on users.

PREREQUISITES

Acquaintance with the concept of interaction form.

OUTLINE

1. Develop your own understanding of the interaction form in question, by yourself or within a group.

2. Identify design elements that will affect the interaction form and think of possible consequences for people's interactions.

3. Focus on how to strengthen and how to reduce the interaction form in a design and reflect on possible consequences.

VARIATIONS

Focus on different interaction forms. In the example below the interaction form is fragile, but it can be replaced with another form. One should reflect on two interaction forms for each design, at least.

LEARNING OUTCOME

A better sensibility to interaction forms, and an improved ability to deliberately transform a form.

IMPORTANT

There are two traps one might easily fall into. The first one is of focusing only on the design of the spatial shape or on the material qualities of the artefact, and not on how the design actually relates interaction and function to each other. One might think, for instance, of the fragile construction of the handle of a washing machine instead of how the different washing programs are presented and what they imply for the interaction with the machine. The other trap one might fall into is to not make a clear distinction between people's potential experiences and actual properties of the interaction design. The distinction is important; the interaction form of a device can be fragile with consequences for the interaction even though people do not experience it as fragile, and the other way around.

EXAMPLE

Below is an example of how to carry out this exercise.

1. Examples of fragile interaction forms

    a. Identify some devices or systems containing computational technology that have a fragile interaction form. Reflect on what it is that makes the interaction form fragile. Is the form due to the explicit interaction, explicit function, implicit interaction and/or implicit function?

    b. Think about how it might be to experience the use of the devices or systems. What kind of experiences do you think the interaction form might lead to? Reflect on several different possible experiences for each product. Might the experience differ whether a person is aware of that the device/system has a fragile interaction form or not? In that case how? What might happen if a person, for instance, thinks of the device as something robust?

2. Fragile interaction form design

    a. Choose one of the below alternatives to do the interaction design for.

- a booking system for train tickets
- a car
- a payment system for a public transport company
- a music player
- a mobile phone
- an elevator

b. Try to identify design decisions that will affect whether the design will get a fragile interaction form or not.

c. Consider the consequences of a fragile interaction form. How might people's interaction with the device/system be affected if the fragility breaks through and is noticed, for instance? (Might a person get nervous or might it become more exciting to use the device, etc?) Do you think a person will change the way he or she interacts?

d. Based on the reflections you have made, make up your mind and sketch how you will design your device or system. State your reasons.

3. Strengthen and reduce the form

a. Choose one computational device you are familiar with. Redesign it so that you increase the fragile interaction form. Which design decisions lead to an increased fragile form?

b. Come up with some different use scenarios where different persons relate to the device in different ways, some in a negative way and some in a positive way. Can you make the device's interaction form fragile in such a way that you can take advantage of it? Reflect on how the different ways of relating to the device, different attitudes, might affect people's possible experiences of the interaction.

c. Now redesign the device so that the fragile interaction form is reduced. Which design choices will reduce the fragile interaction form? Analyse how this change might affect potential interaction and experiences.

EXAMPLES OF IDEAS AND REFLECTIONS

Below are a few examples of ideas and reflections that have emerged when people have tried out this exercise.

When considering the design of a car from a fragile form perspective, some thoughts concerned different ways of giving feedback. The importance of proper sound feedback when closing the boot was considered, as well as the sound and the flashing of car lights when locking the car with a remote. The latter feedback can be designed in an ambiguous way by using a time delay or using the same feedback for both locking and unlocking. A result can be people double checking whether the doors are locked or not. Automatic braking assistance systems (with the aim to reduce the braking distance) and automatic distance control systems were also considered. The conclusion was that these might make people feel unsafe instead of safe, depending on how these are implemented and presented.

One observation of the participants from the design exercise was that one can build things in a certain way to give a solid expression, but, on the other hand, one can choose to create a fragile interaction form to direct users' behaviour. One conclusion was that a device's fragile interaction form can make people be more careful about how they interact. A related thought was about how people like to master things. That a device might be designed with a fragile interaction form in such a way that it is regarded as a professional device; 'foolproof systems are used only by fools'. The idea was that one can design a kind of well thought-out fragile interaction form that supports the feeling of being a professional.

EXERCISE IN EXPRESSIONS OF INTERACTION

AIM

To put focus on how a design might express an interaction form in certain contexts of use, and to give some experience of how such expressions can be considered in one's own design process.

PREREQUISITES

Acquaintance with the concepts of expressions of interaction and interaction form.

OUTLINE

1. Analyse a device or system by focusing on an expression of interaction. What strengthens and what counteracts the expression in question? Is the expression related to explicit interaction, explicit function, implicit interaction and/or implicit function?

2. Identify different ways of strengthening and reducing the expression of interaction by a redesign of the device/system.

3. Reflect on possible corresponding experiences of people when interacting with the device/system, i.e., experiences that correspond to the expression of interaction in question. Reflect on possible non-corresponding experiences.

4. Based on the previous reflections, propose improvements on the device/system and state your reasons.

LEARNING OUTCOME

A better sensibility to expressions of interaction. An improved ability to deliberately change an expression of interaction. Be able to see the difference between expressions and experiences, from a design perspective.

(The exercise is not meant to teach one way of thinking, or *the* expressions. It is meant as an initial exercise in thinking of how a design can express interaction forms.)

EXAMPLE

Below is an example of how to carry out this exercise. The design that has been chosen to analyse and redesign is the social community website Facebook (2008a). The example is based on the design of Facebook of 2008.

1. Discuss and list things in the design of Facebook that can express alienation in certain contexts of use, i.e., alienation as an expression of how Facebook relates interaction and function to each other. Identify design elements, for instance, that express a distance between a person and Facebook (irrespectively of whether a person might experience any alienation or whether the design actually creates alienation). Also list design decisions of Facebook that do not shape the expression of alienation, i.e., design elements that counteract the expression. Focus on the interplay of people and interface and functions. The design elements that shape the expression of alienation can be due to different things. In your examples the alienation might, for instance, be due more to the functions of Facebook, or it might be a matter of the chosen graphical interface, or it might be due more to a person and that person's prior experience, thoughts, prejudice, etc. Give it some thought and try to identify the most important factors.

2. Go through your list of examples systematically and change something in the design to increase the expression of alienation. Then, redesign to decrease the expression.

3. Reflect on which design decisions that might increase the chances of a corresponding experience or perception, i.e., which design decisions you think will lead to that people will feel alienated by Facebook (even though it is hypothetical). Discuss and compare with design decisions that might

not support the corresponding experience. Finally, discuss experiences and perceptions that people might have irrespectively of the design.

4. Suggest improvements on Facebook, or suggest (parts of) a new social networking website, and do it out of the perspective of alienation. Be very specific in your design decisions and state your reasons.

To exemplify, below are a few examples of things in the design that can be considered. Some of them have been investigated when people have tried out this exercise.

- As an administrator of a group, try to delete posted items or the group itself. If possible look at how this has been expressed differently during the last years. There might be both expressions that suggest that things are not deleted, just not shown, and expressions that suggest that things actually are deleted. An example of a context of use is you trying to delete something from a database, finding out that it was not deleted, merely hidden. Such an expression of alienation depends heavily both on the function of the system (in this case not deleting things in the database) and on the way of presenting this function to you.
- Consider how the way of inviting friends to add applications is expressed. Has it been automatically suggested? The expression of alienation that can be found here has less to do with interaction and is more related to function, i.e., you cannot affect this expression much with your actions.
- Consider the way the privacy settings are presented to you. The expressions of alienation that can be found here is due to the chosen graphical interface and wording, and to the functions of the settings.

VARIATIONS

In the example above the design of Facebook has been chosen to analyse and redesign. Facebook can easily be replaced with something else, for instance with Geocaching (2008), surveillance systems, or an electronic invoicing system. In any case, it should be something you are acquainted with.

A design can also be analysed and redesigned from the perspective of different expressions of interactions. Different examples are given below.

EXAMPLES OF VARIATIONS

Below are examples how to focus on the expressions of indifference, suspiciousness and trust instead of alienation. Replace step 1 with following:

1. Discuss and list things in the design of Facebook that support the expression of indifference. Identify design elements that give a neutral expression or design elements that are not expressed at all. It can be things that increase the chance that people will be indifferent to parts of Facebook, perhaps neutral or just not aware of something. It can also be things that people have strong feelings about, where the design still supports the expression of indifference. People might, for instance, think that something really matters even though the design expresses that it does not. Also list things that do not support the expression of indifference, such as things in the design that is designed to notify or inform you in an expressive way. Once again, it could be design elements that increase the chances that people will be less indifferent, more aware, have an opinion, as well as design elements that people feel indifferent about even though the design has strong expressions of something. Focus on the interplay of people and interface and functions. The design elements that shape the expression of indifference can be due more or less to interaction or function. For example, in your examples the indifference might be due more to what Facebook can do for someone, or it might be a matter of the chosen graphical interface, or it might be due to a person and that person's prior experience, thoughts, etc. Give it some thought and if possible, try to identify the most important factors.

A design element that can be considered is the fact that you cannot see who is allowed to see a photo of you, if you did not upload it yourself. You cannot see, in other words, if it is only the friends of the person who uploaded an image, or everyone, that can see the image. To not present information about other people's privacy settings can be seen as a way to increase the expression of indifference. The opposite – to reduce the expression of indifference – would be to list the names of the persons who have viewed a photo. This example is related to the chosen graphical interface and to what is decided to be displayed, not so much to what you are allowed to do, or what the system can do for you.

To focus on the expression of suspiciousness, replace step 1 with what follows:

1. Discuss and list things in the design of Facebook that support the expression of suspiciousness. In other words, identify design elements of Facebook that shape suspiciousness as an expression of how interaction and function are related to each other. It can be things that give an air of not providing important information, or a design that seems to insinuate certain things. Also list things in the design that do not support the expression of suspiciousness. It can be things that give the expression of being clear and explicit and easy to understand. Focus on the interplay of people and interface and functions. The design elements that support the expression of suspiciousness can be due more or less to interaction or function. In your examples the suspiciousness, for instance, might be due more to what you are allowed and not allowed to do, or it might be a matter of the chosen interface (like how the terms of use are presented) or it might be due more to a person and that person's prior experience, thoughts, what she has read in media, etc. Give it some thought and if possible, try to identify the most important factors for each example.

The terms of use can be a design element to consider: how they are presented graphically, the language, their contents, and the way you have to accept them. You can also try out what happens if you say that you were born 1999 when you apply for an account. Take a look at the terms you have to accept every time you add an application, presented as "*Know who I am and access my information*". That is not an example of expressing how interaction and function are related to each other in a clear way. If you check that box and accept, are you later on given any hint on what it actually implied? Another already mentioned part of the design of Facebook that can be considered is the way of deleting things. The expression of suspiciousness might be more related to people's experiences and thoughts, and to things people have read in media or rumours, etc, than to explicit function.

To focus on the expression of trust, replace step 1 with what follows:

1. Discuss and list things in the design of Facebook that support the expression of trust. Identify design elements that can express that you can trust Facebook in certain situations. Also, list things in the design of Facebook that do not support the expression of trust, such as things that express that you, when interacting, cannot rely on the things you see. Focus on the interplay of people and interface and functions. The design elements that shape the expression of trust can be due more or less to interaction or function and be more or less explicit. In your examples the

trust might, for instance, be due more to what Facebook can do for you or someone else, or it might be a matter of the chosen graphical interface, or it might be due more to you, what you can do with Facebook and your prior experience, thoughts, etc. Give it some thought and if possible, try to identify the most important factors.

When it comes to the expression of trust it can be interesting to compare the language used in the terms of use, and how the terms are displayed and presented, with the terms of Flickr (2008). One can also consider how, and how often, Facebook changes the way people's activities are presented to others. The expression of trust might, for example, be reduced if changes are made often, or if it is suggested that people cannot foresee what kind of information about them that will be presented to others in the future. One can also discuss how an awareness of the fact that there are plenty of users might affect how people interpret an interface. If it, for instance, would strengthen the expression of trust if one showed how many active users Facebook got and in what ways the users have influenced the company.

The expression in step 2, 3 and 4 changes accordingly to the one of step 1. For instance, if the expression is the one of trust:

2. Go through your list of examples systematically and change something in the design to strengthen the expression of *trust*. Then redesign to reduce the expression.

3. Reflect on which design decisions that might increase the chances of a corresponding experience or perception, i.e., which design decisions you think will lead people to trust Facebook (even though it is hypothetical). Discuss and compare with design decisions that might not support a corresponding experience. Finally, discuss experiences and perceptions that people might have irrespectively of the design.

4. Suggest improvements on Facebook or suggest (parts of) a new social networking website, and do it out of the perspective of *trust*. Be very specific in your design decisions and state your reasons.

COMMENTS

Indifference seems to be an intriguing expression since it can mean two things, that the form is being expressed in a neutral way, and that the form is not being expressed at all. If translated into conditions, it is the difference between being aware but not care, and not even being aware.

Indifference as an expression opens up for two different discussions. One is a discussion about design elements that reduce or neutralize the appearance of something. It can be design elements of Facebook that try to make it neutral to upload a photo to your profile, for instance, not expressing the terms clearly[6]. The other discussion concerns the design elements that are not expressed at all. In the case of Facebook it can be data about you being sold to others.

If comparing with other expressions, indifference seems to make it easier to see the difference between something as an expression and something as an experience. Perhaps because of the fact that people can be indifferent to many things even if the things are expressed in a non-indifferent way, and the other way around, people can feel a lot of different things even if the design does not express anything in particular. It seems to be a little bit harder to see this difference when it comes to suspiciousness and trust. Indifference might therefore be a better expression to start with.

This exercise is meant to be an initial exercise, with the aim to acquaint people with the concept. In the following ones, one can define one's own expressions and design with respect to those. The examples of expressions of interaction being brought up here are suggestions. It might be good to emphasize that the concept of expressions should be developed continuously to be useful. The choice of expressions to reflect upon should of course vary depending on the aim and context of the project at hand.

[6] It is not made explicit that "*By posting User Content to any part of the Site, you automatically grant, and you represent and warrant that you have the right to grant, to the Company an irrevocable, perpetual, non-exclusive, transferable, fully paid, worldwide license (with the right to sublicense) to use, copy, publicly perform, publicly display, reformat, translate, excerpt (in whole or in part) and distribute such User Content for any purpose, commercial, advertising, or otherwise, on or in connection with the Site or the promotion thereof, to prepare derivative works of, or incorporate into other works, such User Content, and to grant and authorize sublicenses of the foregoing.*" (Facebook 2008b)

This part is based on a preprint of the article Digital myths and delusions: an approach to investigate interaction aesthetics. The final version was published in *Digital Creativity*, vol. 19, no. 4, December 2008.

DIGITAL MYTHS AND DELUSIONS

Digital myths and delusions are in this work suggested as a way of working with interaction aesthetics of computational devices. It is a critical design approach introducing alternative design proposals in three steps. In the first step you define *myths and delusions* of digital devices restricting interaction and awareness. In the second step you introduce *critical myth exposures* reading, exposing, reviewing and demystifying the myths. In the third step you design *transformers* to explore design alternatives, i.e., you transform the myths by changing the design and the way the device is being presented in use. The aim is to question what counts as normal and intuitive with respect to all those everyday computational devices we are getting more and more used to.

The starting point for this method is the question of how the way in which devices present themselves to us in use, affects acts of use and the way we live our lives.

> "*Myth hides nothing and flaunts nothing: it distorts; myth is neither a lie nor a confession: it is an inflexion.*" (Barthes 1972 p. 129)

Barthes refers to a myth as a communication system, as a meta-language on top of our ordinary language that is important to 'read' and 'demystify' since:

> "*For the very end of myths is to immobilize the world: they must suggest and mimic a universal order which has fixated once*

> *and for all the hierarchy of possessions. Thus, every day and everywhere, man is stopped by myths, referred by them to this motionless prototype which lives in his place, stifles him in the manner of a huge internal parasite and assigns to his activity the narrow limits within which he is allowed to suffer without upsetting the world"* (Barthes 1972 p. 155)

The method to be presented below focuses on digital myths. Inspired by Barthes' view on myths, we define, discuss and question mythologies within interaction design as a form of critical reflection and interaction design critique. We do this through conceptual design proposals that question what counts as normal and intuitive in interaction with computational devices. This is similar to how Gaver and Martin (2000) use conceptual design to increase a design space. The design proposals suggested below exemplify a method to critically examine interaction aesthetics.

The background for this method is that computational/information technology is a rather new 'design material' (Redström 2001; Löwgren and Stolterman 2004), i.e., new in relation to more traditional materials like wood or ceramics. Still we live in a period in which we are getting more and more used to the 'presence' of computers and computational behaviour in our everyday lives (Hallnäs and Redström 2002b). That is, the presence of not only desktop or laptop computers, but also of mobile phones, bike computers, computers built-in into every day objects like cars, jewellery, toys, etc. Even though the vision of 'ubiquitous computing' (Weiser 1991) has been around for more than a decade with its seamless integration of computers, more and more advanced and non-seamless human-computer interaction develops. It follows with the introduction of new devices and services, when merging different technologies and when introducing an existing product to new markets. Along with this technology and product development comes critical reflection, for example, work done by Dunne and Raby (2001, 2008), Toran (2008), Gaver, Beavor and Benford (2003) and Djajadiningrat et al. (2004).

Derrida (as cited in Benjamin 1988 p. 10) said in an interview about deconstruction:

> "*De-construction … analysis and compares conceptual pairs which are currently accepted as self-evident and natural, as if they had not been institutionalised at some precise moment, as if they had no history. Because of being taken for granted they restrict thinking.*"

Are we taking things for granted when we are designing user interfaces? Are we designers restricting ourselves?

The digital myth is in this work regarded as a fabrication, something that we can read and demystify. Since we are using the notion of a digital myth as a tool for critique, we keep in mind that the myth is: "*chosen by history; it cannot possibly evolve from the 'nature' of things*." (Barthes 1972 p. 110) That is, a digital myth should be seen as something defined by the context, and as a way of presenting digital devices. It should be seen as a presentation and a fabrication chosen by history and by the context, and not something that is given by the material. The myth will be defined by *how* we design computational devices, not by computational technology as a material. This is an important distinction since it implies that we can replace a myth without changing the ingredients. We can replace a myth by changing the arrangement of the elements, by changing how hardware and software are implemented and by how the device presents itself in use.

It is the appearance of computational devices in use that leads to myths and delusions. Depending on how we express functionality, people might think they really delete something on their computers when they empty their desktop trash can. Or, that they are writing a document when they are writing in Word. Or, that a music file is a music file even when not played. Or, that navigating the Internet is to click on objects, etc.

Digital myths and delusions do not have to be regarded as problems. On the contrary, some of them facilitate interaction with computers. However, there might be problems if these myths and misunderstandings too much affect how people engage in or understand everyday computational technology, if they, for example, 'immobilize' and 'stop' people, and among them designers. For critical interaction design, it is a challenge to suggest ways of exploring and transforming digital myths.

TO INVESTIGATE INTERACTION AESHTETICS

The method of digital myths and delusions consists of three steps. The first step is identifying/defining a *digital myth*. The second step is reviewing the myth through a *critical myth exposure*. A myth exposure is a conceptual design idea, a model, or a prototype, not so much meant to be implemented as meant to be a tool for thinking and reflecting. The myth exposure aims to emphasize and accentuate the myth, as a way of reading and demystifying it. The third step is a *transformer*, which can be a conceptual design proposal, a model, or a prototype. The purpose of a transformer is to present an alternative design, as a suggestion of how one can redesign the myth. These three steps is a way to systematically reflect on the expressions of interaction of devices. That is, expressions of possible interaction, not actual or intended (see the discussion above, in the section of expressions of interaction, page 46).

The idea of transformers as a tool for working with design aesthetics is inspired by the distinction between recognition and perception given by Csikszentmihalyi and Rochberg-Halton (1981). They write on the subject of aesthetic experience:

> "*What we are about to argue is that this aesthetic dimension is not a rare-fied frill but a vitally important aspect of how we relate to the world. The approach to aesthetic experience taken here was developed by Rochberg-Halton (1979a,b) and is based primarily on John Dewey's distinction between what he calls perception and recognition (see Dewey, 1934). For Dewey, recognition describes a falling back on some previously formed interpretative schema or stereotype when confronted with an object, whereas perception involves an active receptivity to the object so that its qualities may modify previously formed habits or schemes. Dewey does not limit aesthetic experience to art alone but considers it a potential element of all experience. Perception is essential to aesthetic experience and leads to psychological growth and learning. Recognition, or the interpretation of an object or experience solely on the basis of already existing habits, only serves to condition a person further to a life of convention.*" (Csikszentmihalyi & Rochberg-Halton 1981 p. 176)

Today a lot of user interfaces, graphical as well as tangible, are based on recognition rather than on perception. This is probably due to the search for intuitive and natural and sometimes even invisible interfaces. The question is what these interfaces would look like if interaction would be based on perception instead? Would they, for instance, have the same qualities as the alternative design examples made by Hallnäs and Redström (2001) or Djajadiningrat et al. (2004)?

A transformer is meant to transform the myth embedded in the interface so that the interaction will go from recognition to perception. The idea is to use it as a tool to rethink some of the more recognition based interaction designs. Consequently a transformer can only be a transformer if it is transforming a current myth; if the transformer becomes a myth itself (which might be likely) it is not a transformer anymore. Then the interaction is back to recognition and it might be time for a new transformer.

Note that Dewey and Csikszentmihalyi and Rochberg-Halton are focusing on the aesthetic experience while we focus on the aesthetic interaction design. We focus, in other words, on expressions of interaction as design expressions. As discussed in the chapter on form and expression, page 25, the basic assumption is that objects in use have properties, express things and have aesthetic qualities inherent in the design of the objects. When we design something we build certain expressions of interaction and a certain aesthetic into the design, deliberately or not. What we eventually will perceive or experience in use is left to discover. That will depend not only on the object but also on the context and on us. Expressions of interaction do not refer to someone's experience, they refer to the way in which the design expresses interaction form in certain contexts of use. Important to remember, is that we cannot be sure that a certain expression actually leads to a certain experience, but we can consider and speculate in which situations, for whom, etc, it might. Expressions of interaction may give us something to base the initial design decisions on when designing a first prototype.

Examining interaction forms and expressions through the critical reading of digital myths is one way of working with the interaction aesthetics in a design process. In what follows we will give some examples.

EXAMPLES OF DIGITAL MYTHS, CRITICAL MYTH EXPOSURES AND TRANSFORMERS

Below are four examples of how the method can be carried out. Four examples of firstly defining a myth, secondly reviewing it through a myth exposure, and finally suggesting a redesign through a transformer.

TO DELETE TRASH

Defining the myth

Do you have a trash folder in your e-mail program? Do you use an operating system with a trash can on the desktop? Where is the trash in your PC? In the bin or somewhere else?

The trash can in Mac OS X and in Windows XP, noteworthily called Recycle Bin.

To put a trash can on the computer desktop suggests to people that there is such a thing as digital trash, but is the digital trash really ever in the trash can? In Windows XP (2001) there is an attempt to clean up potential trash. It is an application that reminds you when you have icons on your desktop that have not been used for a while. The application suggests that you should tidy up your desktop and offers to put all rarely used shortcut icons into a new map, on the desktop, and name that map 'Unused Desktop Shortcuts'. Perhaps this is just one of the first examples of future cleaning applications for our computers, but why target desktop shortcuts? Why not the programs that we never use or the sound files we never listen to? Is it because the myth, that a tidy and clean desktop means that we are disciplined, efficient and therefore also good workers, is so strong?

For sure there are other things in your computer than desktop shortcuts that you have no use of. Things you have never used or never will use again, for instance, or things that you only needed once, like installation files. This kind of data can be hard to identify and even know about as we can store more and more on our computers and as we use more and more programs. Especially since there are no proper tools that help us deal with all bits and bytes that we do not recognize.

With this in mind we define the myth of deleting trash, a myth that concerns a couple of things:

1. It is hard to see what things are used for, consequently, on a computer it is hard to identify what is trash and what is not.

2. The vague trash can metaphor. Misunderstandings depending on how the trash presents itself to us.

    a. Unclear when things really are deleted.

        Not everyone knows the difference between pressing Delete and Shift+Delete in Windows.[7] (If you want to come closer to deleting something, you should not press Delete, you should press Shift+Delete.)

        Not everyone is even aware that things they throw away end up in the trash can. People sometimes try to free hard disk space by deleting files not understanding that the files will still occupy space as long as they are not also removed from the trash can. (As removing it from the trash can means to mark the space the file is occupying as available.)

        Another potential misunderstanding is thinking that a file is actually deleted when emptying the trash can. The trash can does not communicate that the content of the file will still be on the hard disk, readable and recoverable until something else is written over it. There is software that try to recover data, as well as software that shreds files to make data recovery unlikely by writing over the space on the hard disk several times.

    b. Things being moved to the trash can without notice.

        Depending on the settings, when deleting things on an external hard disk connected to your computer, the data might, without notice, be placed in the local trash can. This means moving data from the external disk to the local disk. Consequently, through the act of deleting, data that never were supposed to be put on your computer can end up there anyway.

A shredder software called File Shredder 2000 by Gregory Braun.

To summarize, the trash can metaphor withholds the actual functionality the digital material possesses. The desktop metaphor can be described as a

[7] If you mark a file and press Delete in Windows XP (2001) you get a pop-up window saying "*Are you sure you want send '[the file name]' to the Recycle Bin?*" If you instead press Shift+Delete you get the question "*Are you sure you want to delete '[file name]'?*" The latter choice deletes all references to the file. It does not write over the file on the hard disk but there will not be any reference to it in the Recycle Bin, in contrast to the first choice.

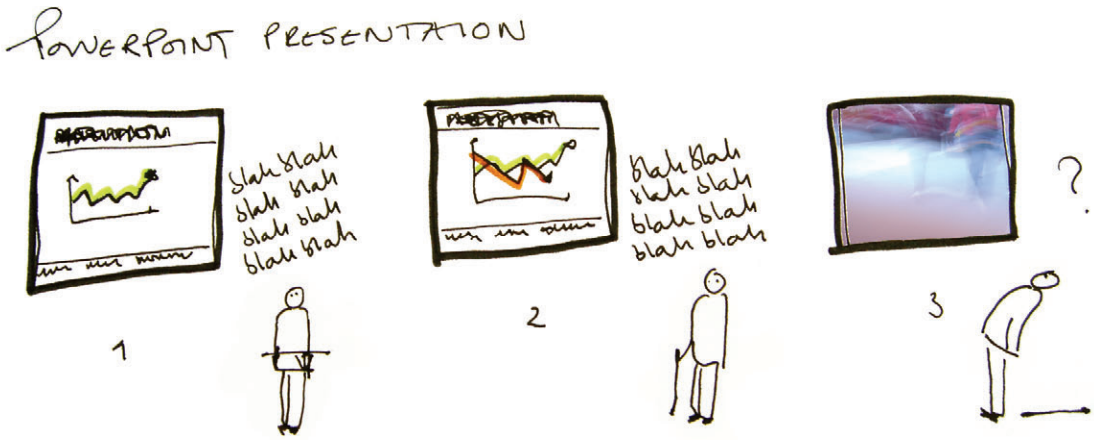
good breeding ground for delusions as it tells us that the computer is a familiar simple thing that we should know how to control and organize.

Critical myth exposure: digital trash with instincts

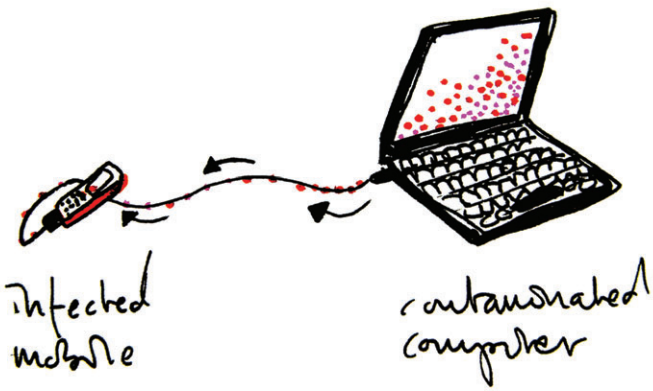
Things start to happen when we forget to take care of biological stuff, for instance, forgetting to empty the trash can in the kitchen. A bad smell can welcome us home from a holiday trip or small unwelcome guests may have moved in and populated our home. Things that we seldom touch and use can start to live. Fruit-flies, meal and carpet beetles may have found their right biotope, and if something starts to live, there is an instinct to stay alive and breed.

The critical myth exposure makes digital trash as unpleasant as real world trash, which means old files starting to get slippery and partly incomplete after some time in a yucky old file surrounding. The myth exposure is digital trash with an instinct for survival and a will to spread. If you, for example, have files in the trash can on your desktop that have been there for some time, or if there are data on your hard disk that you never access, these things will try to breed and spread as a way of securing their existence. (In a way similar to how the trash on external hard disks might behave, see case 2b above.) The files will populate your computer and will try to spread to other computers. To your digital camera or to your mobile phone, for example, if you connect these devices, or through the attachments of your e-mails. Old texts, images and sound fragments will emerge and pop up in the middle of other texts, images and sounds. Your e-mails will, just after you have pressed the send button, be mixed with the secret files you thought you had deleted. The images in your PowerPoint presentations will, while you are doing a presentation, be accompanied with all those dull, blurred and overexposed digital images, the ones that you have neglected to the degree that they have taken on a life of their own.

There is also a risk that your desktop will become sticky and more and more slippery if you do not look after it. If you have neglected your desktop, it will be harder to drag and drop objects on it, and it will, after a while, be harder to close applications and files, as they will be stuck to the desktop. It will also become easier to slip when clicking on icons, easier to, by mistake, put files into wrong folders, etc.



Disregarded pictures might appear everywhere.



A contaminated computer might infect other devices.

To prevent these kinds of things from happening you have to keep you computer tidy. Go through the files, keep them in good shape and up to date. Open files regularly, and write over the ones you have deleted, carefully. This would push you to be in better control of what is in your computer, since you will have to know your files by heart and examine why they exist.

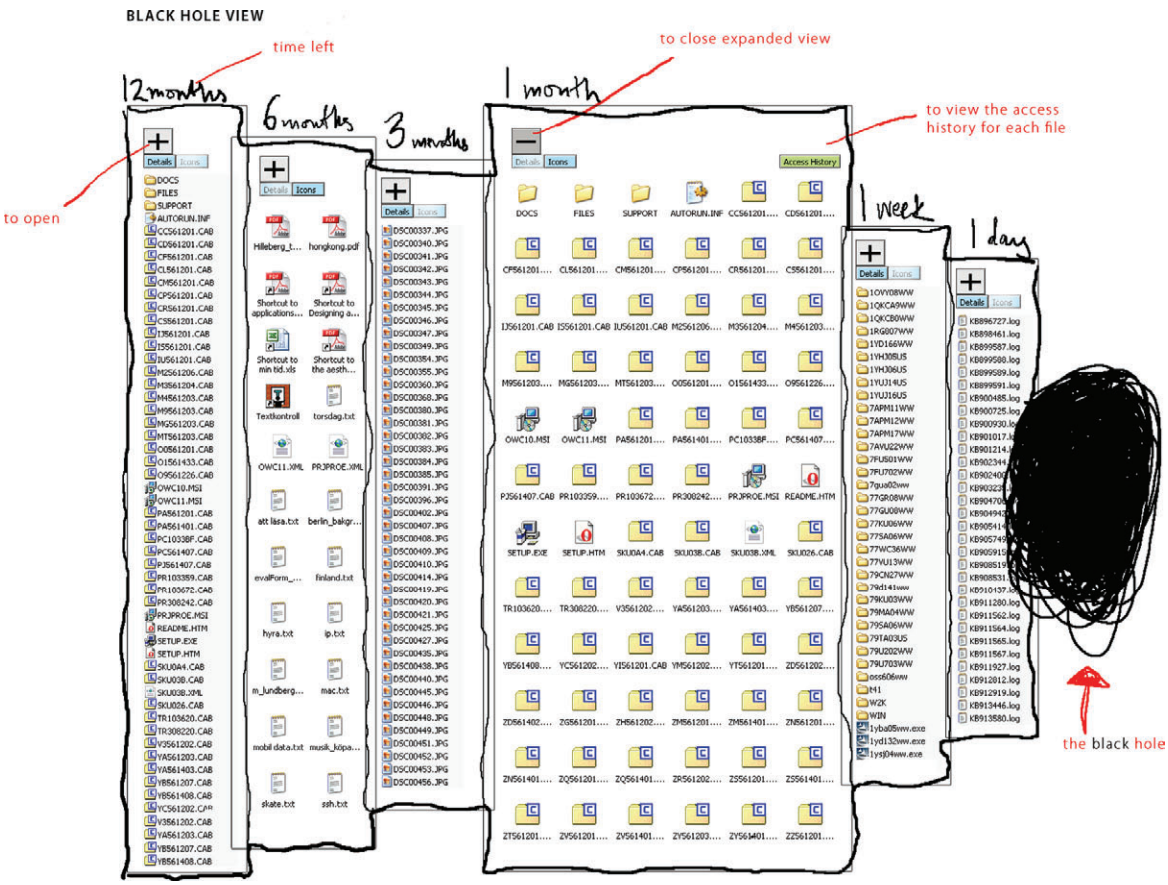
The expressions of interaction in this myth exposure are about control and lack of control. How much of control, or lack of control, depends on the implementation and specific design decisions. A design, that introduces the risk to lose control if not being careful, gives us the chance to make sure that we are in control. This could, for example, be the result of a user interface that hints that some unpleasant things are about to happen if nothing is done about the trash. We would then have time to take action. However, the interface could also be designed in such a way that people tend to be defeated rather than winning, for example, if the vermin shows up in one's computer without any warning, and it is more or less impossible to get rid of them. Timing, amount of vermin, how, when, how much they spread, how sticky the desktop will be, etc, are examples of crucial design decisions, that at the end will determine the expression.

These expressions of interaction could lead to two different interaction scenarios. One out of control and one in control. In the out of control scenario (where the expression of interaction is more of lack of control) the system is constructed in such a way that a person might start to avoid using the PC. When there is trash on one's computer, the increased difficulty of using it might lead to frustration and irritation. In this scenario there is not a fair chance to be able to look after all files and there is not any sufficient help given on how to clean up. It is too much of hard work and it is easier to just give up. In the other case (where the expression of interaction is more of control) you have a fair chance to keep up. The interaction might result not in irritation or frustration but in some sort of comfort. You might feel pleased with the order in your computer, knowing all the files and what they are there for. You might get that feeling, that some people have, when their homes are exceptional tidy and tiptop.

Transformer: the black hole

The next step after reviewing the myth through a myth exposure, is to break up the myth with the help of a transformer. The following

transformer is a file system without folders. Instead of folders, your files can be tagged and you have a well-developed search engine so that a file can be found in many different ways. A specific file might, for instance, be related to your last vacation, recent documents, March and to your friend Fred, etc. It can therefore appear in different contexts. You can choose between different ways of viewing and browsing your files, and among these views one is the view of the black hole.



A draft of the black hole view.

If you do not tag your files ‘guarded’ they will slowly, slowly be dragged into the black hole, but only if you or any program never access them and if they are not crucial for any programs that you use. Recently and often accessed files are located far from the black hole, unaffected by its gravitation, just as the guarded files. Files and programs used only a long time ago, on the other hand, are closer to the black hole and might after some time be dragged into it. The time determining how close a file is to the black hole is not a matter of calendar days, it is the time the computer has been used that matters. If a file gets dragged into the black hole the space occupied on the hard disk will be made available, which means that parts of the file will be lost if the space is needed for other data. As long as the space is not needed, the file will be recoverable. The file will appear as a shadow in your searches and views, but the fainter the shadow is, the less likely is it that it can be recovered. When a file is beyond recovery there will not be any representation of it anywhere.

A faint shadow means that the file still might be recoverable.

In the black hole view you are able to see a detailed access history for each file. By seeing how often and which dates a file has been run by which programs, you would be able to value its importance. You can decide to put files further away from, or closer to, the black hole, increasing or decreasing the time before potential destruction. You can also decide which files you would like to guard and make untouchable for the black hole’s gravitation.

The aim of this transformer is to change the expression of interaction from indifference to carefulness and awareness. With such a system people might be more in control and might also perceive that they are more in control, but this is not certain. It depends on how the black hole is implemented and presented. To go from indifference to awareness in the design means that it is very important that the system does not simplify things. If it is, for example, hard to really incinerate a file this should also be clearly communicated. The access history must be more reliable and much more informative than the ‘Frequency of Use’ is, in the ‘Add and Remove Program’ application in Windows XP (2001): “*Windows measures the number of times the program has been run in the past 30 days and labels it accordingly. Frequency is divided into three areas: ‘Rarely’ – the program is rarely or never run. ‘Occasionally’ – the program is run sometimes. ‘Frequently’ – the program is run often.*” It says, for instance, that the program I would say is most frequently used, my e-mail program, is rarely used.

An e-mail program is an application suitable for this kind of deleting system. All e-mails could be filtered and some guarded automatically depending on keywords you have chosen. All unguarded e-mails that you never care about, or never search for, would slowly but surely be dragged closer to, and eventually also dragged into the hole, with their attachments, and thus fade away and disappear.

DIGITAL EXISTENCE AND DURABILITY

Defining the myth

We have a conception of what a text file is, what a digital photo is, what a DVD is, etc, because we think of binary digits as something else than digits. We choose to think of the representations of the digits. We tend to think of and refer to e-mails as e-mails and text messages as text messages even when we are not given a representation of them on a screen. When the text message has been read, however, or the film has come to an end, or if there is a power failure, there is nothing left proving their actual existence. Afterwards there is no perceivable evidence that the text message, the e-mail, or the film, actually exist. We cannot touch or smell or hear that something has happened or has existed. When the mobile's battery is discharged, we can only look at the dead display or at the SIM-card and picture the text and picture messages and saved phone numbers. They are not there. Thus, digital information in the form of movies, texts and sounds, etc, does only exist when it is being presented by a computer as a movie, text or sound, etc. At other times it is simply stored in the format of bits. Encountering digital information is, in other words, an event, an event always dependent on time and electric power.

The myth of digital existence and durability is the myth about the magic of computational representations that hides run time[8] dependency.

The run time dependent existence can be compared to music or dance. Does music or dance exist even when not being performed? One difference between stored digital information and notes on a paper is that we can still, in a way, read the music by looking at the notes. However, we cannot read an e-mail without the representation. We cannot read program code without electric power. You can of course print out a text or a photo. However, that print will also be dependent on the run time of

[8] The duration of a computer program's execution.

printing. The print out is not the text or photo itself, it is only one version of it.

We are used to the fact that physical things get worn and grow old. Digital information does not grow older and cannot get worn. The qualities of digital information entail that we lose some sense of time, use and amount. There is, for example, nothing that can tell us if an e-mail was written three years or three minutes ago. It is hard to get a sense of when a memory device is almost full, compared to how easy it is to see when a water jug is. However, some user interfaces try to convey such information. The SonicFinder (Gaver 1989) is an example, a sound augmented computer desktop that takes the size of digital objects into account. In SonicFinder large files, and folders with many items, make lower sounds (in lower frequencies) when being selected, comparing to small files or nearly-empty folders.

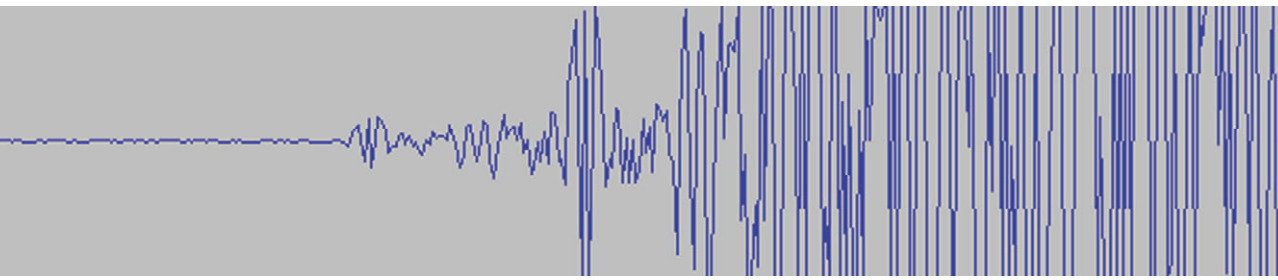
The reason why we tend to think of a bunch of digits as the Seventh Seal or as Swordfishtrombones might be due to the way these bits are being presented to us, by the computer. It might be due to how we view the material of computational technology. It is hard to get the hang of what bytes are, it is easier to think of them in terms of how they are being represented to us in run time. We might find it more convenient to think of a movie on a disc as a movie, and mp3-files as music, instead of data that need to be read in a certain way to be able to exist in their intended way.

Within electronic music there are examples of making music by decomposing data. It can be done by processing the data of images, for instance, with the help of software that is not intended for that purpose (Cascone 2000). One question is if such music is thought of in the same way by the maker and a listener. Might a listener think of it as a tune while the maker thinks of it as material, in the form of bytes? Have you ever listened to a picture, for instance?

Lots of work has been done to make digital information easier to grasp by giving it a physical representation. Early examples are the marble answering machine by Durrell Bishop[9] and work done by the Tangible Media Group, MIT Media Laboratory.

[9] Designed in 1992 at Royal College of Art, London. Messages left are manifested through marbles that can be put in different places to either listen to the message or dial the caller.

A picture as a picture.



The same picture as sound, as interpreted by the audio software Audacity.

The Tangible Media Group focused on giving physical form to digital information, making bits directly manipulable and perceptible (Ishii and Ulmer 1997). However, this way of making something difficult to grasp easier to grasp does only work in combination with electric power. Without the power supply these tangible objects do not know what kind of information to represent.

Critical myth exposures: time restricted files and the phone bag

The myth of digital existence and durability has been discussed above. The next step is a critical myth exposure that reviews this myth. As an example of such a myth exposure, consider the concept of information only accessible as information for a certain period. When the time expires the data can only be accessed as something else. A text document or an image can, for example, only be accessible as sound after the expiring date. This idea is an attempt to break up the preconceptions about the material of bits and bytes.

The working prototype the Bag (Landin and Worbin 2005) is another example of something that can work as a myth exposure. The Bag replaces the sound and vibration signals of a mobile phone with pattern changes on the outside of the bag, see the section of design explorations, page 151.

The Bag.

If you put your phone in the bag, incoming calls and messages are displayed as discreet colour changes. The bag is a tool to investigate what phone calls and messages are and signify by displaying them in another way. The changes of colour are rather subtle, designed not to attract people's attention too much. They are ambiguous enough to open up for interpretations. Is it an incoming call or not? The bag is designed to support people to choose for themselves. Do I want to interpret what I see as something to deal with or shall I instead just let messages and phone calls pass as an intriguing pattern? In that way the Bag works as a myth exposure. The interaction form of the Bag is more ambiguous and indistinct than the interaction form of a typical mobile phone. As a consequence, the Bag introduces freedom or independence as an expression of mobile phone interaction.

Transformer: time restricted data

Transformers of the myth can be objects and applications that allow you to control the digital existence. One example is a digital business card that contains information about you just as long as a non-chargeable and un-replaceable battery supplies it with power. With this kind of cards you can choose for how long your contact information and other data will be readable. If you, for instance, meet someone that you only wish to be in contact with during the next month, you give this person a card that only works for one month.

Another example is a curriculum vitae. The CV has a digital existence in different shapes; it can present the same data both in an informative and in a subtle way, but at different occasions and as you wish. The data may at first be presented as text but whenever you want to, you can send a signal to the CV, telling it, for instance, that from now on the only way to access the data is as a few seconds of sound.

The information on the business card and the CV is not completely controlled, someone can take a photo of it or take a pen and write down the information somewhere else. However, one day the information can disappear. When the receiver of your card finds it blank after, for instance, three months, it is not impossible to contact you, but he or she has to make more of an effort, looking for your phone number somewhere else. The disappearance of your contact information will not restrict people, but it will give them a hint of your wants and wishes. Accordingly, 'will' and 'wish' can be described as expressions of

interaction, and the card and the CV can be designed in different ways to increase or decrease that expression. The design will also affect the chances that the expression of 'will' and 'wish' will be perceived. If the receiver of a card does not know that the information disappears intentionally, for example, the expression might not be noticed.

TO SAVE

Defining a myth

In many pieces of software the option to save is presented in a menu in the same way as other options. Consequently, the function to save is not reflected in the interaction of saving. The interaction of saving, i.e., to click on the word 'Save' in a menu, etc, is presented in the same way as to choose 'Help' or 'Print', even if to save is a much more significant action. To save is to approve and accept everything you have done since the file was created, or was saved the last time. If you do not save, your changes will not matter. On the other hand, if you save, you might not be able to undo it. A user interface may present saving as something rather trivial but it is not a trivial function. As software users, the function of saving is something we all learn. However, it is not a function the software producers communicate clearly through their design, which gives a reason to define the myth of saving.

Some people, aware of the importance of saving, tend to develop a quite nervous relation to it. The shortcuts for saving (Ctrl+S in Windows and Command+S on Macintosh) are used so often that people use them without thinking. In some programs these nearly automatic movements of the fingers of our left hand tend to be fatal. Persons who have been using early versions of Adobe Photoshop probably know the feeling of by mistake saving changes to the original file. It is easy to slip or make a mistake, pressing Ctrl+S (save) instead of Ctrl+Shift+S (save as). That can be a fatal mistake since it cannot be undone. In recent versions of the software, the interaction form is not as fragile, since there is a 'history' function, helping you undo your actions, mentioned on page 36.

The way saving is designed in software can convey the expression of anxiety in certain circumstances. Below is an attempt to reduce anxiety as an expression by transforming the myth. First, however, the myth shall be exposed, to read it from another perspective.

Critical myth exposure: To save as a one-off action

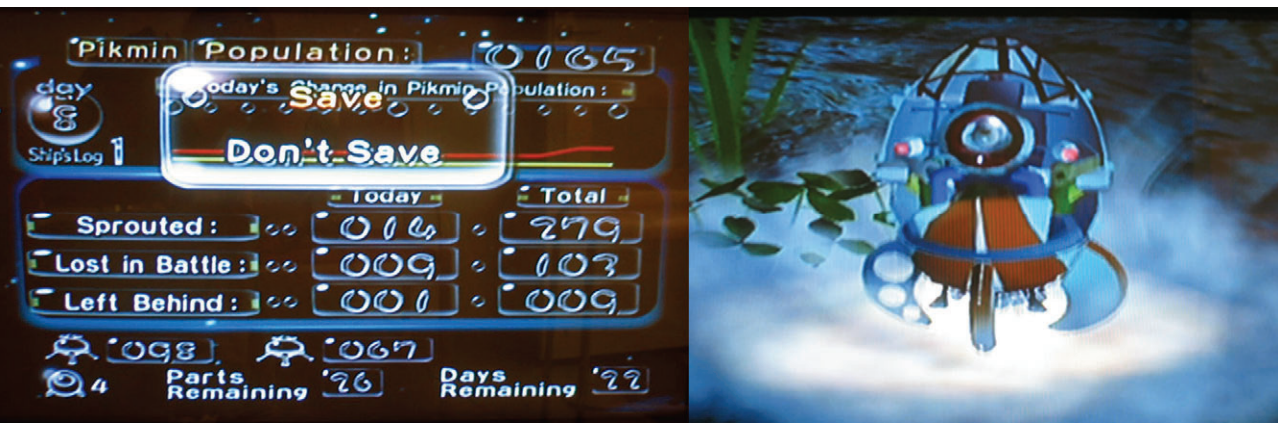
Imagine a computer where the option to save is presented just like today but where you are only able to save something once. To save something means to carve it in stone, or in other words, write it permanently to the hard disk. After you have made that decision, you are not able to save further changes, and you are not able to copy, cut or paste any of the content to other documents. The only way to save another version is to start out from scratch, redo your work. Furthermore, if a file is saved it cannot be deleted; the information written to the hard disk will not be overwritten.

How would this change your way of using computers? How would it change the way you relate to the interaction with computers? If the interaction form of such a computer is distinct and stable, and the computer is reliable and predictable, the result might be a situation where you have to plan better and be more focused in a positive way. You might have to accept that good is enough, since what you have done have to be good enough, unless you have the time and desire to do it all over again. Such a design might reduce the time you are shilly-shallying and the expression of interaction might be of less anxiety. However, if this computer is not a reliable one, if the interaction form is indistinct and fragile and the computer crashes now and then, unexpectedly, the expression of anxiety would probably be strengthened instead. Such an expression might also be experienced. If you, for example, have been working on something for several days, you might get nervous and anxious that all your work suddenly can be in vane. You might ponder over whether to save or not to save, back and forth, anxiously.

Transformers: save restricted IDE and >10 percent save

Inspired by the way saving is handled in computer and video games, the transformers deal with saving in a restrictive way. In video games, for example, loading and saving are not doable at the same time as playing. That limitation has forced game designers to come up with different ways of integrating the acts of loading and saving, so that they are part of the game. Three examples are The Getaway (2003), Grand Theft Auto III (2001) and Pikmin (2002). In The Getaway the way of saving affects for how long time you play. The game consists of missions that are split into different parts. You can only save the game when you have succeeded with a full mission. If you fail along the way, however, you can start over from the last completed part of the mission. If you switch off the console,

you have to start over from the last completed full mission, i.e., from the last time you were able to save. This implies that if you have succeeded with three (rather tricky) parts out of four, you might not want to quit playing or switch off the console. In Pikmin, you got 30 ‘days’ to complete a task and each day takes about half an hour to play, in real life. You can only save when a day has come to an end. When the sun has gone down you can choose between replaying the last day or saving it. If you choose to save, you will not be able to replay that day, unless you start over completely from day one. On comparison, Getaway is all about being able to save, whereas saving in Pikmin might not be the right choice, even if you can, because if you have not achieved enough during a day, you might not be able to succeed within the 30 days.



Screenshots from the video game Pikmin, Nintendo GameCube, 22 days remaining.

In Grand Theft Auto you can drive around in a city but you can only save in certain places, for instance, in a certain garage. Consequently, if you have succeeded with something really difficult after several attempts and want to save, you have to succeed in driving your way back to the garage as well. Persons that have failed with their mission, aware that they have to start over, might sometimes, instead of starting over immediately, explore the city. They can be less careful, for instance, trying out different ways of driving and be more violent than usual since what they do will not be saved. You might, in other words, get the feeling that what you do does not count, if it will not be saved.

With this in mind, one example of a transformer is a save restricted Integrated Development Environment (like BlueJ or Dev-C++), that only saves code that is faultlessly executable. If you have forgotten a semicolon somewhere in a Java file, for instance, you will not be able to save that file. If you are not able to find the fault, you might have to cut out several lines of code until the program allows you to save. This design might strengthen the expression of interaction of carefulness in certain situations. However, the expression of anxiety will probably not be reduced.

Another transformer could be a word processing program where you are able to save, or resave, a document only when at least ten percent of the characters are new. The more text a document would contain, the more words and sentences would have to be changed.

With these kinds of program, you would probably get the work done more often once and for all, since you would not be able to save smaller changes repeatedly. The way you would relate to writing text, processing images or coding, would probably change. If the programs were designed with a distinct, non fragile form, the expression of interaction of anxiety of certain situations might be reduced. However, depending on how implemented, if the form is fragile or indistinct, these programs could be designed in such way that the expression of anxiety would be strengthened instead, just as in the example of the exposure.

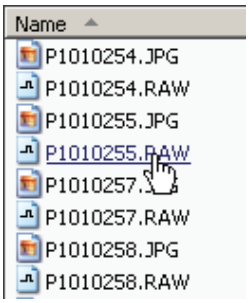
These transformers are examples of things that probably would lead to a new version of the myth of saving, a myth that can then be transform.

BROWSING

Defining a myth

Another example of a myth is that browsing and navigating is to click. On the websites of companies it is rather common that the first page is just a picture of the logotype. If we type in a web address and a single image appears, we know that to get further we have to click on that image. We are used to clicking on images, icons, text, or anything else we can guess to be a link. In the early days of the web, we were looking for underlined words in blue. Nowadays, to indicate a clickable zone, it is sufficient with a differing text colour or a certain position of an image.

In the file manager of Windows XP (2001) you single click on an item to open it. (It is a setting that you can change if you prefer to double click.)



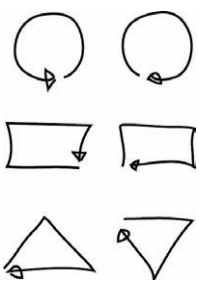
When a word gets underlined and the pointer turns into a glove, we know, from the web, that we should click only once.

If you point at a folder, the name will be underlined and the pointer will turn to a glove, as a way to communicate that you do not have to click twice. The design is, in other words, based on web design and depends on our experience from browsing the web. We have learned that we do not double click on underlined words.

To click on underlined words is not the only way of navigating, but it is the most common structure of websites and it has spread to Windows. To define the myth of browsing is a way of questioning this way of navigating.

Critical myth exposure: Gesture browsing the web

In the Internet browser Opera you can use different mouse gestures to navigate websites (Opera 2006). You can, for instance, open a link in a new tab in the foreground by moving the mouse pointer to the link, hold the right button, move down, and then release the button. You can go to the parent directory by holding the right button, then move up, then left, etc. However, these ways of interacting have yet not influenced the look or structures of websites. Most often when browsing the web, the position of the cursor only matters at the moment when you click, all motions between A and B are often just indefinite motions towards next possible action.



Gestures linking to different web pages.

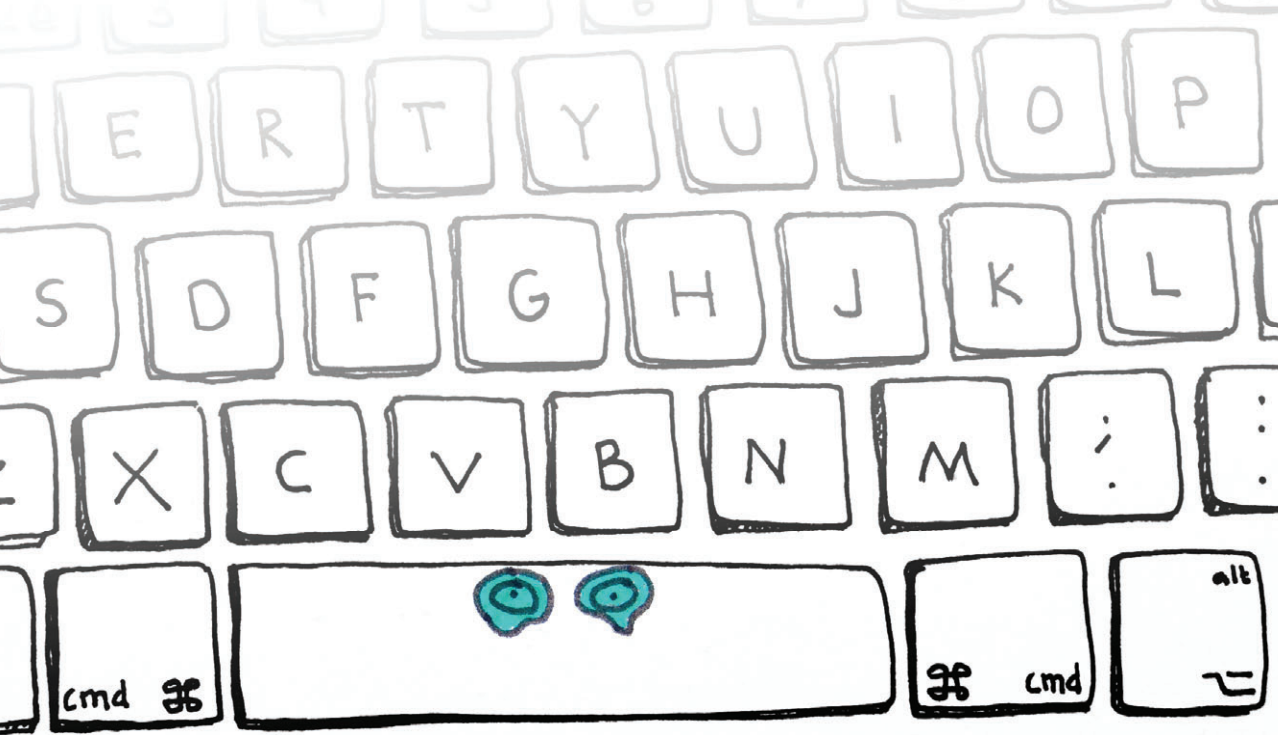
Browsing by mouse gestures was tried out as a way to review the myth (Landin 2003). To review the consequences the clickable objects have on the structure of the web, a website was made where the clicking on objects did not matter. Instead you navigate between different pages by the movements of the mouse. Different sizes of squares, triangles and circles were mapped to open different web pages. Movements to the right and left were mapped to go to next or previous page in history. In order to eliminate the eye's focus on the position of the cursor it was made invisible. Furthermore, eliminating the cursor increased the concentration on how it felt to do the movements with the hand. Since sound cannot come from a precise point on the screen but will surround the listener, it was used to amplify the geometrical figures. With the help of sound, the web visitor both gets information about the existence of other web pages, and is guided through the gestures. Sound guidance was experienced as easier than to look at the pointer movements on the screen. The hierarchy of the web pages was flattened and made more linear. By showing small

images of different pages and by using gestures, this website had another kind of structure, without clickable objects.

Through this experiment it was made clear for us how much clicking has affected not only the visual appearance of websites but also the whole structure of them. By removing clickable objects this myth exposure helped us see which impact they have.

Transformer: stick control

A conceptual example of a transformer is in this case the idea of a computer keyboard with two small control sticks, as part of the space key, one for each thumb. It is inspired by portable game consoles such as Nintendo DS and PlayStation Portable. The idea is that with these sticks one can perform a range of small but varying gesture combinations that are connected to different actions. For example, one can go backwards and forwards, zoom in and out, move to the next object in all directions and enter them, all this without changing the keyboard fingering. The control sticks can be used not only when browsing the web, but also for navigating the operating system. They are not supposed to replace the mouse, they are just a complement since they do not steer or move any pointer on the screen. It is only the gestures of the sticks that matter. In computer games people can develop a rather sensitive skill in the ways of combining movements of two hands. This keyboard should be built so that it has a challenging interaction form. You should be able to become better and better at navigating, being able to perform more and more actions with the help of the control sticks.



A keyboard with two control sticks.

It is not suggested that non clickable websites are better, more intriguing or useful. It is suggested that we can develop alternative ways of browsing to a greater extent than we have done today, and that such experiments are an important way of re-thinking interaction aesthetics carefully.

COMMENTS

The aim of the examples above is to present an alternative approach to designing computational devices, and these are just four examples. A fifth one concerns Internet: that the digital world is a different world and not the same as the 'real world', a myth that is being spread in media and in politics, for instance.

In the approach of digital myths and delusions there can be a clear connection between the definition of the myth, the choice of the myth exposure and the final transformer, but it does not have to be. Since the main point of the myth exposure is to read and review the myth and to become more aware of its nature and possible expressions of interaction, there are many different ways to go. One could use purely conceptual myth exposures or one could carry them out. One could strive for a consistency between the exposure and the transformer or one could allow a more open end. One could look for a design proposal to implement today or look for a scenario for the future. As a design method, the exploration of digital myths and delusions is a way of trying to think lateral, in new ways. It does not offer specific guidelines or a description of a few steps to do better design. It is a way to question and critically examine given a design ideology.

As mentioned in the introduction, the aim of this method is to critically explore interaction aesthetics, questioning whether given expressions of interaction are inherent in the materiality of computational technology or relate to the choice of user interface. There are two main reasons why to consider this:

a) When using a system there is a difference between being restricted physically and being restricted physically and mentally. An example is the desktop trash can that imposes certain rules on how to throw away things. The point is, if you are aware of how a desktop trash can and a hard disk, etc, actually work, you are only physically restricted, not mentally. If you are unaware of how these things actually work, you are

both, which can lead to misunderstandings and errors. You might be unaware of data still existing on your hard disk or unaware of that files have been moved to the 'Recycle Bin' from external hard disks, etc. To avoid mental restrictions you, as the designer, should in the design try to communicate that this particular way of doing things is just a matter of a design choice, not something that is inherent in the material or inherent in such a device.

b) It is the programmers, product designers, graphic designers, system developers, HCI-experts, interaction designers, technicians, etc, that lay the basis of the interaction aesthetics and the expressions of interactions. They are the ones that decide how people may live their lives with computers, it is not the material of computers that gives people a picture of how digital devices work or how they can use them and live with them. It is we, the designers and engineers, etc, who express the content of a digital device by imposing an interface. This is also why methods of critical design are important, to question the obvious and established reading of the design brief, early.

It is not surprising that some myths originate from metaphors. Since computational devices can be very complex it can be easier to present a caricature of a system instead of how the system actually works. The desktop metaphor is, for example, such a caricature. It takes advantage of things that people are already familiar with, or at least might be familiar with. In 1992 Apple stated:

> "*You can take advantage of people's knowledge of the world around them by using metaphors to convey concepts and features of your application. Use metaphors involving concrete, familiar ideas and make the metaphors plain, so that users have a set of expectations to apply to computer environments. For example, people often use file folders to store paper documents in their offices. Therefore, it makes sense to people to store computer documents in computer-generated folders that look like file folders. People can organize their hard disks in a way that's analogous to the way they organize their file cabinets.*" (Apple Computer 1992 p. 4)

However, the desktop metaphor would not lead to any myths unless we in our daily interaction with digital devices actually learned a new language, i.e., learned how to interpret desktop trash cans and desktop folders. By

using computers we do not learn how a real folder works, we learn how a folder in an operating system works. Often, after some iterations of different versions of some software, the metaphors develop and become more and more dissociated from the things they represents. The desktop metaphor probably still works well, not because people understand and think about real folders or real trash cans, but because it is actually a good caricature of the system. Nowadays lots of people that use computers have never had an office with a trash can that looks like a trash can, or a filing cabinet with folders.

As discussed within HCI for a long time, using metaphors entails a risk:

> "*Although the use of metaphor may ease learning for the computer novice, it can also cripple the interface with irrelevant limitations and blind the designer to new paradigms more appropriate for a computer-based application.*" (Gentner and Nielsen 1996 p. 72)

> "*By reflecting the physical world of mechanisms, most metaphors firmly nail our conceptual feet to the ground, forever limiting the power of our software.*" (Cooper and Reimann 2003 p. 249)

The risk of metaphors is that they might restrict people mentally too much, e.g., if people see the metaphor as the system itself and not as a picture of it, or if they think that the cause for something is due to the material even if it is not. For a historical survey and a profound discussion on user interface metaphors, see (Blackwell 2006).

However, the digital myths that can be found today might not be here tomorrow as they are not caused by the nature of computational technology. Most of the myths depend on the world we are living in right now. They depend on the way we *think* about computers and computational things, so to transform a myth means to change the way people think about digital devices.

The suggestion is not to avoid metaphors or user interfaces that hide actual functionality of a system. In the example of the myth of deleting trash, for example, the suggestion is to replace the trash can metaphor with a new one, the one of black holes, a metaphor that could spread a false idea both about what black holes are and how a computer works. The conditions for digital myths might be designed, since there is a point

in presenting digital devices in such ways that people do not have to understand how they actually work. There are ways of presenting digital devices that limit people, and probably there always will be since computational technology is such a powerful and complex material that is hard and certainly unnecessary to fully understand as a user. What is suggested, is that interaction design should vary more to prevent myths from getting too established and from considered natural. With a greater variation in presenting interaction, and if the design would change more, and more rapidly, people might look at user interfaces just as the user interfaces they are. The idea is that if you replace myths continuously, they will not have the same impact as if they would have been strengthened throughout the years. People will not believe in them as much. What we are looking for is a program for variety and continuous change, rather than the definitive stationary perfect interface.

To define myths and propose transformers is a way to try to break the spreading of design solutions that limits the design space, i.e., to counteract that we get stuck with the illusions of natural and intuitive interfaces. By twisting existing ways of relating to, and interacting with, computers we can open up for alternative future ways to dwell with them. It is not suggested that there is a better way of interacting and the examples given above do not have the purpose to demonstrate any such better ways. These design proposals are just examples of a first variation, a first step of several, in a continuous transforming process.

EXPLORATION

In the previous chapters the framework of interaction form and expressions of interaction has been presented, together with three design methods of training and critique. The framework and its methods have been developed side by side with interaction design work. Together they are an example of how design-based research can be carried out where the theory and the practice are each other's result. This chapter starts with a discussion about design-based research in general, a discussion that helps to put the following presentation of the design work of this thesis in context.

DESIGN-BASED RESEARCH

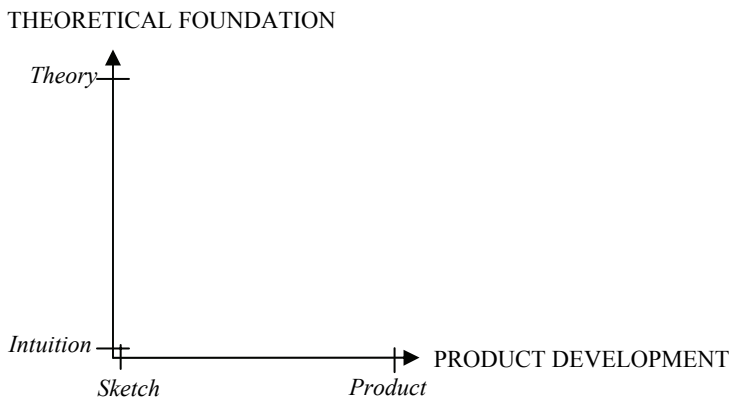
'Research through design', 'practice-based research', 'design-oriented research', 'practice-led research'. There are several concepts of doing research partly by means of practice. Sometimes the concepts are interchangeable, sometimes they are used to differentiate work. Different research groups use the concepts in different ways. What the concepts have in common is that they all exclude research that is only about practice, practice must be one way of doing the research, no matter what the advancement of knowledge is aimed for. In a report on practice-based doctorates, published by the UK Council for Graduate Education (1997), the research is said to not be about practice, or to advance knowledge within practice, it is research work done through creative work. In an evaluation of practice-led research, for the UK's Arts and Humanities Research Council, the authors accentuate that there are many different opinions of what practice-led research means. They choose to present a deliberately broad definition: "*research in which the professional and/or creative practices of art, design or architecture play an instrumental part on an inquiry*" (Rust, Mottram and Till 2007 p. 11).

What kind of role the actual design plays in this kind of research varies. The design can be a carrier of the knowledge and an important part of the research contribution, if the research findings are design alternatives, for instance. If the research findings instead are knowledge to be used in the design practice, the actual design outcome of the research project can play a minor role, and its design quality might not have to be that high.

In this chapter, research work that is done partly by (interaction) design will be referred to as design-based research. Below the relation between theoretical foundation and design outcome will be discussed, as part of a reflection on design-based research in general. It is a discussion that in the following section, see page 128, will serve as the basis for positioning the design work of this thesis.

DIAGRAM OF DESIGN-BASED RESEARCH

The following diagram, where design made as part of research is positioned in relation to theoretical foundation and product development, can be a tool for reflection and discussion on design-based research.



In the figure above 'theory' refers to models or conceptual frameworks for understanding and explanation. 'Product' does not only refer to mass-produced artefacts, it can also refer to designed activities, systems, software, services, etc. It does not necessary refer to a physical thing.

The idea with the diagram is to position the design outcome of design-based research. It can be design in every stage from sketches to products founded on anything from intuition to theory. Research carried out through design can be presented as different lines related to stages of theoretical foundation and to stages of product development.

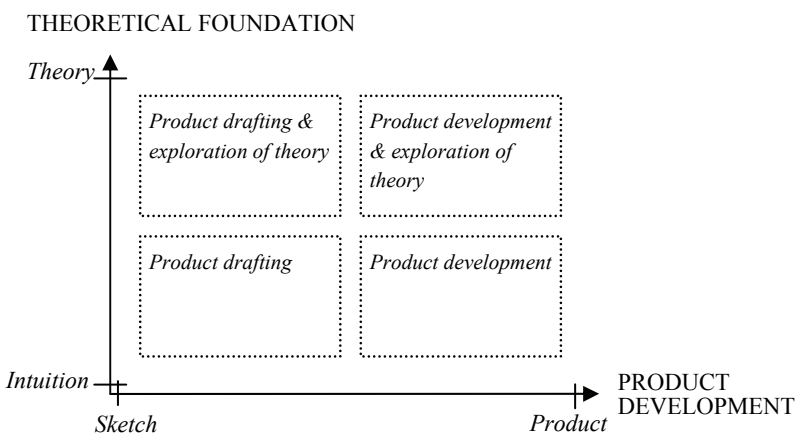
The x-axis of the diagram indicates how the design is being represented and the y-axis indicates how much the design is founded on theory. The scale of product development goes from simple sketches, such as pure

conceptual design proposals that do not have a strong representation and that exist only as sketches, to products ready for use. The former can, for instance, be text or drawings, and the latter a manufactured device on the market. In between, there are more developed sketches, mock-ups, working prototypes and design examples of different sorts. Within product development these stages are often seen as phases on a time axis where sketches and models are created before the final product is produced. However, in this diagram, the x-axis is not a time axis. Design-based research work can result in a mock-up or a prototype, just as well as a product, and the direction of a research process can go from making products to making sketches.

The scale of theoretical foundation starts with design work that has been carried out from pure intuition and ends in design work that is deeply rooted in theory. This means that in the upper part of the diagram, but not in the lower part, the design is derived from theory in some sense, or proven correct with respect to theory. Hence, the further up in the diagram, the more theoretically-founded design is to be found.

AREAS OF THE DIAGRAM

Four basic schematic areas can be isolated within this diagram:



The upper left area of *product drafting & exploration of theory* is an area that relates to product specifications and drafting of sketches and models with a foundation in theory. The design work can be seen as an exploration of theory. Within this area, research can end up if it is significant and original but too hard to carry out practically, or if the research contribution is more important as an idea, than as a product.

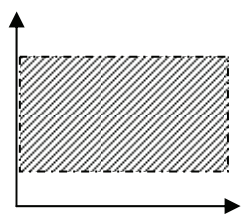
The upper right area of *product development & exploration of theory* is an area that also contains design work that is theoretically founded, but the design work here is to a greater extent developed and implemented.

Within these two upper areas, research starts off from theory. The aim might also be an expansion of that theory or to develop new theory, however that is not necessary. The aim can be to just instantiate theory through design.

Research carried out by design in the lower areas, work that is not greatly theoretically founded, may imply that the researcher relies on that something will emerge from the design process, or from an analysis of the design outcome afterwards. It can be a written analysis or a reflection, a method, a user evaluation with conclusions, or a manifest.

The lower left area of *product drafting* includes exploring by product specifications and drafting, more out of intuition than out of theory. Theory can be a result, though, and in such case the design is an example of a theory in becoming. (If the derived theory is later on instantiated through another design, that design is positioned further up in the diagram.)

Design work within *product development*, the lower right area, is carried out through product design. Work to be found within this area can be a basis for development of theory. It can also work as an example of a theory, and therefore be relevant as a reference.

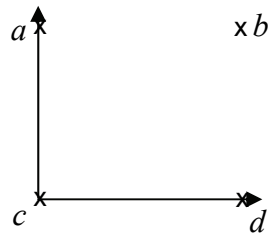


The ideal design-based research?

Design-based research is probably ideally neither at top, nor in the lower parts of the diagram, but in between. Neither right at top since the design work there is 'instantiated' theory, like a kind of strongly derived design on the edge of what we usually call design. Perhaps nor in the lower parts since the work there is carried out too much by pure intuition, work that can be hard to put words to and analyse.

BOUNDARIES

The outer limits for design work carried out in the context of research can in the diagram be interpreted as follows:



a. A conceptual construction strongly based on a theoretical foundation.
b. A product strongly based on a theoretical foundation, ready for use.
c. An intuitively designed conceptual construction.
d. An intuitively designed product ready for use.

a, b, c and d make up the boundaries of the diagram. However, whether design at these outer limits exists and can be done as part of research might be debateable.

EXPLORATIVE DESIGN

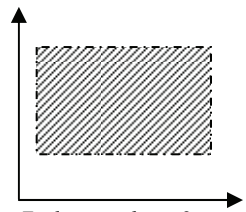
Explorative design can be a description of one way of doing design-based research. It is a way of describing a process of investigating and exploring an area by means of design examples. It is a continuing process where the designer's reflections during the design process affect the research outcome and the research outcome affects the next design object and so on. It is to learn of the process and of the design examples and to explore a design area through designing. In other words, theory and design are developed side by side, more or less at the same time and influencing each other.

The description in a report from the UK Council, of 'the more likely' procedure of PhD-research in the practice of subjects related to art, illustrates how explorative design can look like:

> "*This kind of research does not, typically, begin with a predetermined set of questions or assumptions but arises from particular situations or contexts, which can be described with sufficient precision for a project to emerge which can be*

> *scrutinised and approved by the institution on dialogue with the supervisor. 'Emergent' is the key element as, significantly, decisions and directions within the project are determined by the development of the project.*" (UK Council for Graduate Education 1997 p. 13)

In explorative design it can be hard to tell in advance where you actually will end up, and with what result, even if you might have a clue and a goal that actively guide the process. When you are experimenting, trying to find out how and where to go, you have to reflect upon what the design experiments imply. It is also mentioned in the report that this way of working demands a lot of the researcher. The researcher has to be able to be constantly self-reflective, to critically analyse the ongoing work, and to evaluate the process and reflect on the ways in which practice relates to theory. Knowledge, transferable and constructed, is easily missed otherwise. This can be compared with Schön's (1991) concept of *reflection-in-action*.


Explorative design?

In Redström's dissertation, the intention is, at large, to formulate a design programme, carry it out, instantiate it, reflect upon it and reformulate it (Redström 2001 p. 26). His appended papers can be an example of how this is done through explorative design. The earliest design work seems to have been carried out just to get a better understanding of a field, "*they represent our first endeavours into areas such as ubiquitous computing and tangible interfaces*" (Redström 2001 p. 28), while the latter ones seem to have been carried out with a clearer research purpose, following the formulated design programme. The process is described thus:

> "*the method employed here is not primarily designed to lead to increasingly more advanced or 'better' prototypes. Instead, it is the development of the questions asked and the hypotheses posed that are in focus: we move from the more general to the more specific as our understanding of the design space deepens and we are able to formulate new and more detailed hypotheses. Thus, the prototypes themselves are not necessarily more advanced in later steps of this process, which in turn is one reason for referring to them as design examples instead.*" (Redström 2001 p. 27)

Dunne's (1999) critical design work in his thesis Hertzian Tales is another example of explorative design, even though that process is much less

transparent. He briefly presents five conceptual design proposals with the aim to make people reflect on the role of technology, and to challenge preconceptions about how electronic objects shape people's lives. The design proposals present a critical approach and are not meant to be produced. They are questions instead of answers. The design proposals and the theory in the PhD thesis are separated without any clear method describing their relationship. Dunne simply mentions that his conceptual design proposals are "*by-products of an investigation into a synthesis between practice and theory, where neither practice nor theory leads*" (Dunne 1999 p. 14). The proposals are presented not as illustrations of the theory, they are said to have evolved simultaneously and to be part of the same design process (Dunne 1999 p. 15). The design proposals are positioned in the diagram of design-based research on page 124.

DIRECTED LINES

The diagram suggested above is, as said, a tool for discussing design-based research. The aim is not to simplify essential questions. The aim is to find ways to bring questions into the light and open up for a discussion where parallels between different work can be drawn and reflections on alternative directions made. One can, for example, relate one's own work to the work of other's, analyse it during the design process and afterwards, and reflect on alternatives of future work.

Why the lower areas of the diagram are of interest

Work done within the lower areas of the diagram can be a way of redefining and questioning a field. Kuhn (1970) describes a period of professional insecurity that precedes the emergence of new theories and discoveries, which eventually can lead to a shift of paradigm. Buchanan (2001 p. 8) refers to fields with open boundaries:

> "*Frankly, one of the great strengths of design is that we have not settled on a single definition. Fields in which definition is now a settled matter tend to be lethargic, dying, or dead fields, where inquiry no longer provides challenges to what is accepted as truth.*"

Within several fields of design the issue of basic definitions is not a settled matter. The boundaries are still to be found. To carry out design-based research in the lower areas, without starting out from a given theory, can be a way of not neglecting the possibility for new unforeseen

things to emerge from experiments that are more or less guided by intuition.

Exploration through explorative design can in some sense be an open form of design research. One can compare it with technology driven research where one try out things just because it is technically possible. For instance, if something new seems to be possible to do, one tries it out to get a better understanding of it. The difference is that in the case of explorative design it is the possibilities of the design area that are in focus, rather than the possibilities of a given technology.

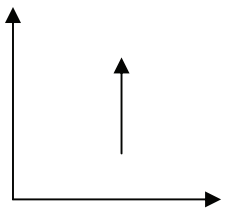
The two lower areas in the diagram can be compared with the phase of 'divergence'. Jones (1992) divides the design process into three phases, divergence, transformation and convergence. The first one, divergence, is a phase of opening up for new ways of thinking, leaving old thoughts that are taken for granted, thoughts that you are conscious as well as unconscious of. In this phase you intentionally open up for uncertainty to get around preconceived assumptions, extending the boundary of a design situation. The purpose is to find relevant information for a design without 'imposing a premature pattern' upon it, so the phase can include elements of starting out closer to intuition than to theory, even though this phase involves both intuitive and rational actions.

Starting out closer to intuition is not a better way of carrying out design-based research, but research can gain something from it, since the definition of design research is not clearly set, and the field is not static in its foundations. Gislén explains it like this: if you have a question in mind from the beginning, it implies that you also have an idea of how things are and how they could be, an idea of what is possible and desirable. Such an idea can be a limitation in the design process, since questions that turn up during the process, during reflection and analysis, might be more productive (Gislén 2003 p. 250). There can be a point in reminding us of that design research is not only valid if borrowing methods and theories from other research fields, such as the humanities, for instance, and of that knowledge is not only produced by instantiating and implementing theory.

Why leaving intuition for theory

As mentioned, in the design process as defined by Jones (1992) the phase of divergence is followed by transformation and convergence. The phase of transformation is of finding patterns and structuring the outcome of the

divergent phase, to get basic insights about the design problem at hand, and set the boundaries of the problem. In the last phase of convergence, one should make all the decisions, hopefully on good grounds as a result of the work done earlier. In this last phase one sets the concrete and detailed design, one is reducing the uncertainty by working in the direction away from abstractions.



An upward direction of a design process, which can be compared with the phases of divergence, transformation and convergence.

The phases of divergence and transformation can be seen as producing a foundation for decisions, a foundation upon which future design decisions can be made. These three phases together, can be represented by moving upwards in the diagram. It can be an upward direction that ends in the convergent phase where the final design is based on the theoretical foundation that has been produced by design work in the lower areas of the diagram.

Jones (1992 p. 68) describes the transformative phase as the most creative phase, whereas the convergence phase, in some cases, can be automated. If all facts are already gathered and structured properly and ranked, the design solution to the problem can be given. Consequently, this final step of deciding which design to finally implement, is something that can be done by a computer or by people without an overall perspective of the design process. This phase corresponds to the uppermost part of the diagram, to found design completely on theory. It can be described as something non-creative, where the foundation leads, so to speak by definition, to a given design. In some areas such a derivation can be desirable, for instance, in safety-critical systems.

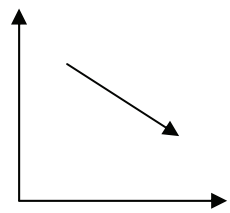
A design process with a progress upward can be desirable within research. The reason is that design carried out only on basis of intuition cannot present an example of how theoretical knowledge can be transferred into concrete design, which a progress upward can. To make knowledge available for others is central within research. The role of the design object for that purpose has been discussed by Hoddel, Streets and Wildblood (2002), Seago and Dunne (1999), and the UK Council for Graduate Education (1997), among others. One way of transferring knowledge through design can be to start out in the lower areas of the diagram and move upwards. Such a process would be to build theory out of design work, and, in the upper areas of the diagram, put that theory into practice. The final design can be an illustrative example, demonstrating transferability of the knowledge achieved.

In the scenario above, describing a research process with an upward direction, an evaluation of the design work with respect to usability might be misleading. If the aim is to build theory rather than to solve a defined problem, it could be more meaningful to look at how transferable the design work is with respect to the knowledge produced. Final design work could be evaluated with respect to how much it actually contributes to the produced theory and knowledge, and perhaps whether this could have been done in a different and better way. If the aim of the uppermost design piece is to be an example of instantiated theory, a central question for evaluation can be how well it works as such an example.

Working in a direction upward probably requires, to a greater extent than other directions, that the researcher reflects both during the design process and afterwards. One part of the evaluation can, accordingly, concern the success of reflection, and by which means the reflections can be improved and made more transparent to others.

Direction downward

Another design-based research process can be illustrated by lines with downward pointing arrows. A line starting out in *product drafting & exploration of theory*, approaching *product development*, can be an example, for instance, a process of starting out by doing design sketches and models founded on theory, and then continuing the work further down in the diagram. Such a progress can involve further implementation and product development that might influence and change the theoretical foundation. In reaching the lower right area of the diagram, the work can end in design based more on compromises within the design process, than on theoretical foundations. However, it can still be design work that can teach us something. The final design can contain knowledge of the design process, for instance, even if the design is not based on the given theoretical foundation.



A design process with a downward direction, which can be the result of compromises.

The research process can, for instance, be a matter of developing a system within the field of human-computer interaction with focus on usability issues. Initially a rough sketch can be made, starting out from theories of human factors and/or analysis of human behaviour from observations and tests, etc. Then the process iterates, and during the process, both design and theory are developed, by prototyping design and by putting theory into practice, trying it out. The theoretical foundation might be reconsidered as design problems occur, problems that can force the design

downwards in the diagram. This can be the case if the theories cannot be instantiated in reality, or if the final design solution, for whatever reason, is something else than what the theories suggest. When a solution answering the specification is found the product is being realised, a product that might no longer be founded in the original theory.

A downward directed line can be a visualisation of a common problem of translating theory into design, of the gap between analysis and design. As Buchanan (2001 p. 16) describes it:

> "*What is perhaps most important to remember as designers move deeper into the human sciences is that the universal propositions of the behavioral and social sciences do not lead directly to the specific, particular features of successful products. There is a profound, irreducible gap between scientific understanding in this area and the task of the designer.*"

A line in a downward direction can be a visualisation of the gap since an ideal line might start out from the same spot but instead go straight to the right. In such a case, the design would be strictly derived from theory and perhaps easier to explain, defend and argue in favour of. The difficulties of translating a theoretical understanding into a design can force us downwards towards explorative design, and this might widen the perspective. If the gap is recognised, the designer can work on it, try to reduce the gap through design experiments and perhaps come up with a more practical interpretation of given theoretical foundations.

If the starting point is theory, a direction downward can probably be more realistic than a horizontal one, since a horizontal line in the uppermost part would imply that we, as already mentioned, should be able to automate the design, i.e., actually be able to derive design from theory.

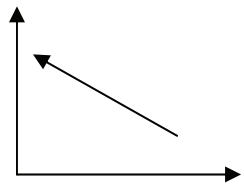
If comparing this scenario with the one with an upward direction, it can be more interesting and worthwhile to evaluate the final design work with respect to given requirements, i.e., the more traditional HCI-way, based on a specification of requirements. The reason is the different intentions. In the downward scenario above the intention is to develop a product with regards to a known context, and known users, etc, rather than to broaden and explore an area through explorative examples. Furthermore, evaluation of the outcome of research in a downward direction can

concern the way in which the design work has influenced and altered knowledge of the given theoretical foundation.

EXAMPLES

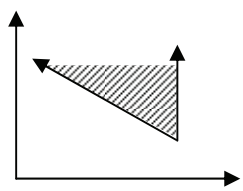
Below are some examples of how design-based research can be interpreted with the help of the diagram and directed lines.

A political motive of design is found in the PhD thesis of Gislén (2003) where design is seen as a way to break up views of science by questioning prevailing power structures. Her design work can be illustrated in the diagram as a line starting out quite low in the right area, heading left, upwards. Most of the design projects are explorative within the field of collaborative narrations and interpreted as positioned in the lower right area of the diagram. One part of the project Avatopia is positioned higher up, but to the left since it is a part that never was implemented. Avatopia is the final and the largest project in the thesis. It was a collaboration between different universities, research institutes and the Swedish public service television. The aim was to create a non-violent avatar community on the web as a collaborative narrative space for teenagers. The avatar community was closely related to a TV-program, which had the aim to raise questions about society, questions to be acted upon and debated in the avatar community. The avatar community was launched in the autumn of 2003 and four TV-programs were broadcasted. The design proposals of tools in the community for collaborative narration were never realized. Compared to the other projects and to the implemented version of Avatopia, those design proposals were to a greater extent based on the theoretical foundation of Gisléns thesis.



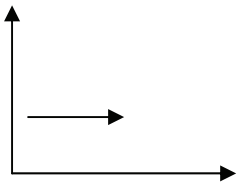
An illustration of the design projects in Gislén's PhD thesis.

The fact that the directed line goes towards sketches instead of remaining closer to products was probably not aimed for. The aim seems to have been to start out from the same point but instead continue straight up. The reason why this was not achieved might have been due to issues such as compromises with other participants in the project, or to funding. The result is that the instantiated design presented in the thesis does not give an example of the given theory. However, the design that is close to products can be seen as an influence for the theory, and the part of the Avatopia project that remained as a sketch, can be seen as a sketch of how an instantiation could have looked like.



A potential difference between intended direction and actual direction of a research process.

The Presence project (Gaver and Dunne 1999) can be described by a directed line heading straight to the right, ending in design examples. The

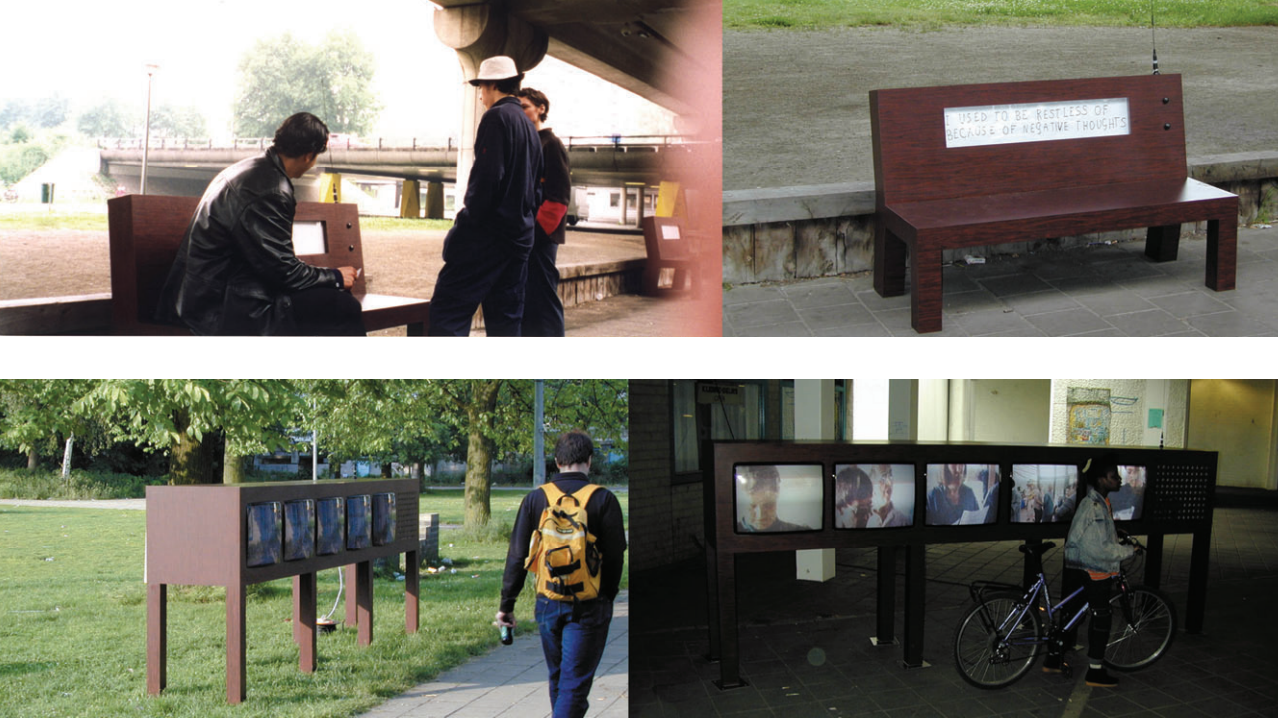


The Presence Project

project started with collecting material with the help of cultural probes (Gaver, Dunne and Pacenti 1999). The probes consisted of maps, cameras, postcards, etc, with rather playful instructions, for instance, to take a picture of something beautiful and of something boring. The probes were handed out to older people in three different suburbs in Europe. The project team encouraged the participants to respond through the different items and post them back as they wished. The researchers approached the incoming material merely as material for inspiration. They did not look at it as material that could or should be analysed with the aim to identify problems to solve, or as a material to base any specifications of requirement upon. Other research teams, however, have used cultural probes for such kind of purposes, which have been questioned by Gaver et al. (2004). In the Presence project the material that arrived was the inspirational basis for the design suggestions. The project is positioned near the middle of the theoretical foundation axis, and the method of gathering information is seen as one part of the theoretical starting point.

The final design prototypes were the Sloganbench and the Imagebank, tried out in Bijlmer, in the suburbs of Amsterdam. The bench had in the back rest a scroll with slogans so that people could choose which slogan to display. The slogans were handwritten by some of the older people in the neighbourhood and were things such as: "*Eerst was de fazantenhof vol met drugs nu gaatt beter*", "*I am divorced retired like music and a drink*", "*Laat je buren niet met je muziek meegenieten*" (Gaver 2001 p. 190). The Imagebank displayed photographs and scanned objects from the older people. Which pictures that were displayed, were supposed to be chosen by themselves in their homes.

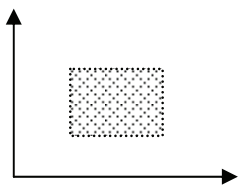
The reason for the straight horizontal direction in the diagram is that these two objects are instantiations of the method of cultural probes. The bench and the imagebank are portioning out slogans and images from the older people (to the others in the neighbourhood), which is very similar to what the probes did for the project team. The design is consequently a concrete instance of the theory they started out from and developed. A question is what the project would have resulted in if the project team had killed their darling, so to speak, i.e., the idea of portioning out inspirational images and messages.



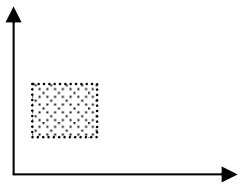
The Sloganbench and the Imagebank. Photographs first published in 2001 (Gaver 2001) by the Computer Related Design Research Studio, Royal College of Art. General Editor: Gillian Crampton Smith.Written by William Gaver. Designed by Ben Hooker.

Another question that can be illustrated in the diagram is if a more developed and final product can be more persuasive than a draft. If a design should be able to stand alone without the help of an explaining text, presentation or video, it should perhaps be found further to the right than the left. It might make the design work better as an argument. Another question is whether a design that is closer to intuition than theory is easier for people to grasp?

If the aim is design as an argument, it might, on the other hand, be a disadvantage if the design comes too close to a product. Product development may lead astray, away from the main idea to, in this case, more insignificant issues of shape or surface. If the design can be taken for a product ready for production people interacting with it may turn their attention to other things than what is intended. They may, for example, focus on issues of shape and colour. Dunne (1999 p. 106) points out that the thought of use can be fruitful and open up for more reflections than actually use.



Design as an argument?



Two examples of explorative product drafting.

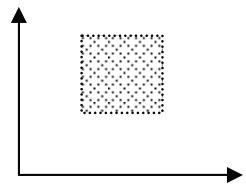
Two examples of design-based research that can be positioned within the field of explorative product drafting are the already mentioned design work of Dunne (1999) presented in his thesis, and design proposals of Gaver and Martin (2000). Dunne's design proposals are sketches and scale models made to encourage reflection and open up for discussions. They are based on different ideas of what it means, or can mean, to live in a world of interactive computational devices. The proposals seem like they should be positioned a bit closer to intuition than to theory. An example is the Thief of Affections that is based on the idea that devices are 'role models', meaning that when people use them they turn into the generic user they are designed for. The Thief of Affection is a kind of walking stick with an ear-plug that uses radar "*to caress the internal organs of unsuspecting strangers*" (Dunne 1999, p. 97), or their pacemakers as it turned out to be. It is designed for an otaku, described as "*a term used in Japan to describe an obsessive person, usually male, slightly perverse and socially dysfunctional",* while *"perversely attempting to experience intimacy by technologically groping the victim's heart*" (Dunne 1999 p. 97). This proposal embodies an alternative model of a user, an obsessed, perverse one, as a comment on who we might become if we would use it.

The design proposals of Gaver and Martin (2000) can also be categorised as within the area of explorative product drafting. One of their proposals is Democratic Advertising, an interactive notice-board where people can choose which posters and flyers they want to download and display. The different design proposals are visualisation and embodiments of their alternative values presented, for example influence, diversions, intimacy and mystery (instead of ones of efficiency and productivity). One might describe their design work as an instantiation of their 'theory' and not, as in Dunne's case, a question in the shape of design inspired by 'theory'. Gaver and Martin (2000 p. 216) say:

> "*we followed our intuitions and interests in developing the proposals, and allowed the space to emerge from the territories they covered. While the space thus defined is necessarily biased by our desires and interests, this approach has strengths in allowing the discovery of new areas and dimensions as unarticulated interests guide the introduction of new ideas*".

Fällman (2007) divides design-based research within HCI into two areas, design-oriented research and research-oriented design. He describes HCI

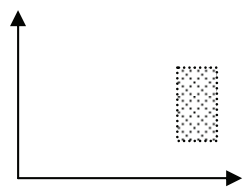
as a field where the core activity is to design new technologies. No particular distinction is made between HCI and interaction design. Design-oriented research is described as an area where research is the ends and design the means. It is a research process where you acquire new knowledge by involving design activities. Research-oriented design, on the other hand, is an area of design where research is the means. It is the creation of new products where research is just a way to drive the design.



Design-oriented research?

These two areas do not fill the whole diagram. If positioning them in the diagram, design-oriented research might be found on the upper part of theoretical foundation. Fällman describes such design to be made out of a problem setting, it "*strives to question the initially recognized limitations of a problem description*" (p. 197). The design is a way to seek to understand and explain, which is possible to do since the design is not paid for by a client or by end users. It is positioned in the middle of product development and is not described as the actual result. Design is just the means to get knowledge, through, for example, studying people's behaviour and experiences in relation to the design. Fällman (2007 p. 197) says that the design outcome of this kind of research is often anything but convincing products.

Research-oriented design is described as: "*Research-oriented design must take into account all the various aspects that may interfere with the goals of creation and change. It needs to deal with 'real' things, such as commercial aspects, cost, time to market, sales figures, political interest, user preference, etc.*" (Fällman 2007 p. 198) It is here positioned lower on the axis of theoretical foundation, since these kinds of 'real' design problems are not necessary solved by general theories, because every design project can be unique. The designer's judgement, gut feelings and intuition can play an important role. Fällman (2007 p. 199) points out: "*That design culture is based on intuition, taste, and personal experience creates tensions between the two cultures. This is because it is quite the opposite what would be expected from the research culture, where decisions cannot, at least ideally, come out of the researcher's own judgment, intuition, and taste.*" In contrast to design-oriented research, within research-oriented design the design is described as an important part of the final contribution. The design is also found at the rightmost part of the product development area of the diagram; the process is more focused on finishing and styling since the artefact is designed to be used and to sell.



Research-oriented design?

These two areas can be compared with the downward directed line on page 119. If the intention is to produce a product, the final design might have to be based more on intuition than on theoretical foundations, which could, but perhaps should not, be regarded as something troublesome within research.

COMMENTS

One thing several projects of design-based research seem to have in common is that they start out in the lower areas of the diagram and continue upwards. Two examples mentioned above are the design work of the theses of Gislen's and Redström's. Their main hypotheses were not formulated at the beginning of their processes. They came out of the practical and theoretical work and can be found in their later design work, not in the earlier work. Gislén (2003 p. 210) says that her perspective is something that has been articulated during the research process, and came as much from actions as from reflections. From the beginning she just had a general curiosity about collaborative narratives in digital media. Redström, as already mentioned on page 115, describes the first design example as his first design experiments in different areas, whereas the latter are more precise in their exploration. Such an approach of an upward direction might be fruitful if one is looking to gain new knowledge, and are open to knowledge of something else than of a beforehand chosen domain.

One could ask if this approach is more common within basic research than within applied research. One should not see the lower areas of the diagram as an area of basic research and the upper part as applied research. Applied research, to find a solution to a defined problem, might mean that the design work is more theoretically founded. Basic research often have the purpose of acquiring knowledge about and make a survey of an unknown field, sometimes guided by curiosity, which might be more related to intuition than to theory. However, both of them can be carried out in all areas of the diagram. One can acquire knowledge, for example, by picking a theory by chance more or less, and instantiate that theory through a design example, which can be described as basic research in the upper areas of the diagram. One can also solve a given problem when making something that is not founded on theory, which can be described as applied research in the lower areas of the diagram.

Within design-based research the design is part of the answer to a research question, which is different from research fields where design is merely one of the means. Within design-based research a design can, for instance, be an argument for a research topic. Gislén has one project in her thesis where the design works as an argument, and Redström has a couple (the later ones). All the projects of Dunne (1999) and Dunne and Raby (2001) are rather argumentative, which probably is due to the aim of their design. If the aim is that the design shall trigger people to reflect on their relation to electronic objects, the devices are probably designed to be an argument for such a reflection. The design can also be part of an answer to a research question, for instance, as an example demonstrating design alternatives. Design can be a way of not only acquiring knowledge but also a way to present it. Gislén says that at least one of her design projects contains knowledge in itself (Gislén 2003 p. 69). She describes her projects to be both investigations and proposals about how collaborative narratives in digital media can be designed (Gislén, 2003 p. 131). Redström (2001) and Dunne (1999) describe their design work as arguments in a material form. The role of the design in design-based research is different in different projects. It can be the answer to particular questions, or an argumentation on the topic in question, or a method of research, or a combination of any of these things.

DESIGN EXPLORATIONS

The practical work of this thesis is presented below in the form of different design explorations. They are a combination of investigations of aesthetics within interaction design and arguments for the importance of such kind of knowledge.

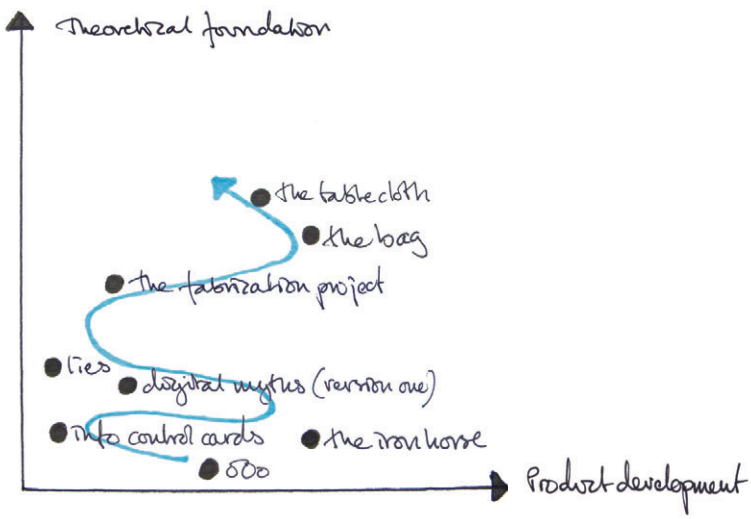
The initial explorations turned out to investigate what designing with respect to aesthetics of interaction can imply, even if they were not carried out specifically for that purpose. The result was that the initial projects partly framed the research topic. The following work was carried out explicitly with the purpose of exploring interaction aesthetics, and the more recent explorations have been carried out to achieve a more profound understanding of aesthetics, from a more specific perspective. For instance, by changing an interaction form or an expression of interaction. These later projects have worked as ways to examine how one by changing the expressions of interaction can affect the relation between devices and people. The design studies have resulted in prototypes, not of future products, but prototypes introducing alternative interaction forms and expressions.

Some of the design explorations work as reminders. Reminders both of the fact that we can consider how design is related to such things as dependence and anxiety, etc, and of the fact that interaction expressions of a design can affect how we relate to the design.

The design explorations contain certain knowledge in themselves. Part of this knowledge is probably transferable by describing the design, how it

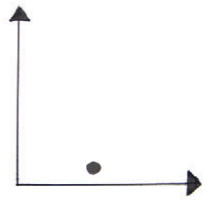
was carried out and how the device works. Other parts of this knowledge might only be transferable if people are allowed to interact with the design themselves. Exhibitions, for instance, can be an important channel for this kind of knowledge. Other parts of the knowledge, however, you might only be able to grasp if you can use the product in your own way for a longer period of time, in your everyday life. That kind of knowledge might also depend on whether or not you are aware of all design parameters that actually lead to the design. To live with the design might say something to the designer and something else to someone without insight in the process. Such knowledge might be hard to disseminate and transfer to people.

Below you will find a brief presentation of the practical work in a chronological order. Eight projects are positioned in the design-based research diagram, see figure below. Some of these examples are conceptual sketches or scenarios documented in papers or reports (Digital myths (version one) and the Fabrication project). Others are more or less vague design ideas, documented on a webpage (the Info control card and Lies). Other projects have been implemented and exhibited (oOo, the Iron horse, the Bag and the Tablecloth). Some examples are further developments of earlier work (parts of Digital myths is an elaboration of the Info control cards, the Bag is an elaboration of Lies, etc). Early drafts and conceptual ideas are presented together with implemented working prototypes, since they together present a process of design-based research. Certain ideas and issues have emerged in several projects and the aim of the following presentation is to make the research process a bit more transparent.



oOo

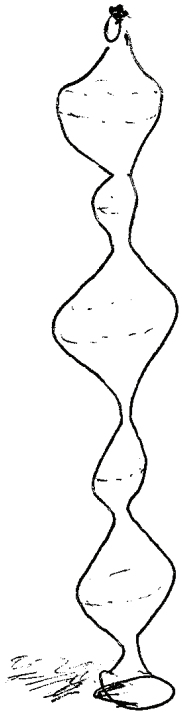
With the oOo project (Håkansson, Landin and Sandsjö 2002) we wanted to create a three-dimensional, continuous, pliable and dynamic shape. We wanted it to be fluid in its expressions and we had the idea that it should react to something or display some sort of information. That was what we discussed. We did not put words to any thoughts of exploring something in particular, and we were not inspired by any specific idea or theory. In our search for a dynamic shape we considered feathers, mould, tadpoles, water, air and small styrofoam balls, etc. We ended up with something we chose to call the blob, consisting of balloons that we, with the help of air pressure and valves, inflated and emptied. At some point in the process we started to search for a way of creating this blob so that people would be curious about exploring its language, its way of communicating. We concluded that to awake curiosity we had to expose some of the communication logic we had programmed, but not too much, because then the language might be too obvious. The final result we named oOo. It was a couple of meters long thing that slowly pulsated depending on how people moved in a room and how many they were. Since it was slow in its motions it also indicated whether people had been moving nearby recently. We stated that oOo is not a tool for something, it does not have any clear functions more than to exist. We presented it as an expression that exists only with the help of its observers. We described it as the design of the minutes the observers observe it.

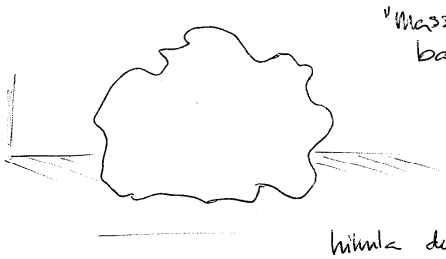


The position of the oOo in the design-based research diagram.

The idea that a device has its own way of expressing itself – that you have to give it some time to be able to learn its ways – is a recurrent theme in my work over the years. It can, for example, also be seen in the Bag project.

The lessons learnt from the oOo project concern how it is to focus on an expression in a design process. Much of what we did was exploring the expression we had decided upon at the beginning of the project. We explored it through looking at different materials, different shapes and ways of changing the shapes by programming. At the end of the project I saw the whole of the expression much clearer, being build up, on one hand, by us, and on the other hand, by the observers. What mattered were not only our choice of materials and shape, and our way of programming how you could interact with the blob. What mattered were also the actions of the observers since the design let them be part of the final result.





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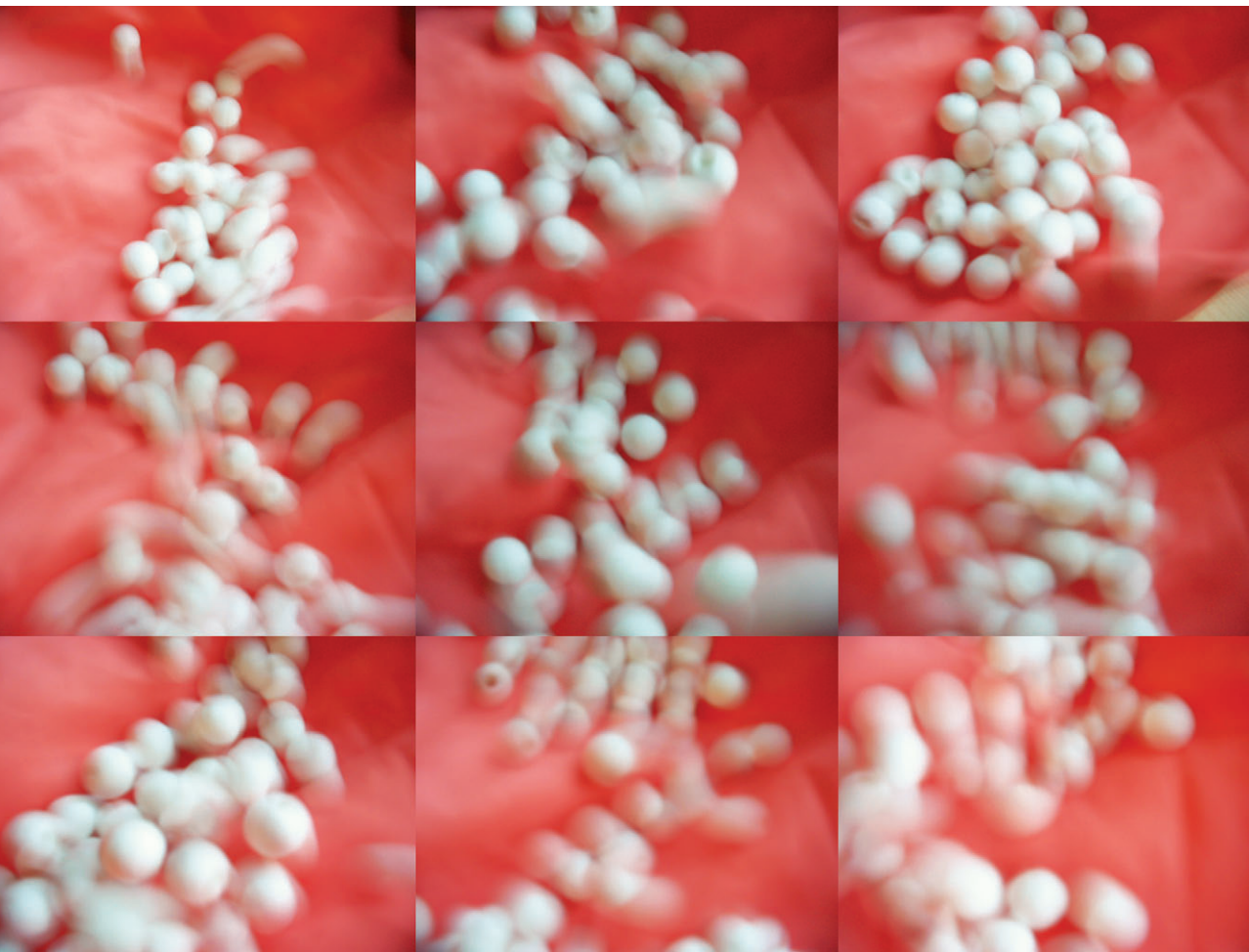

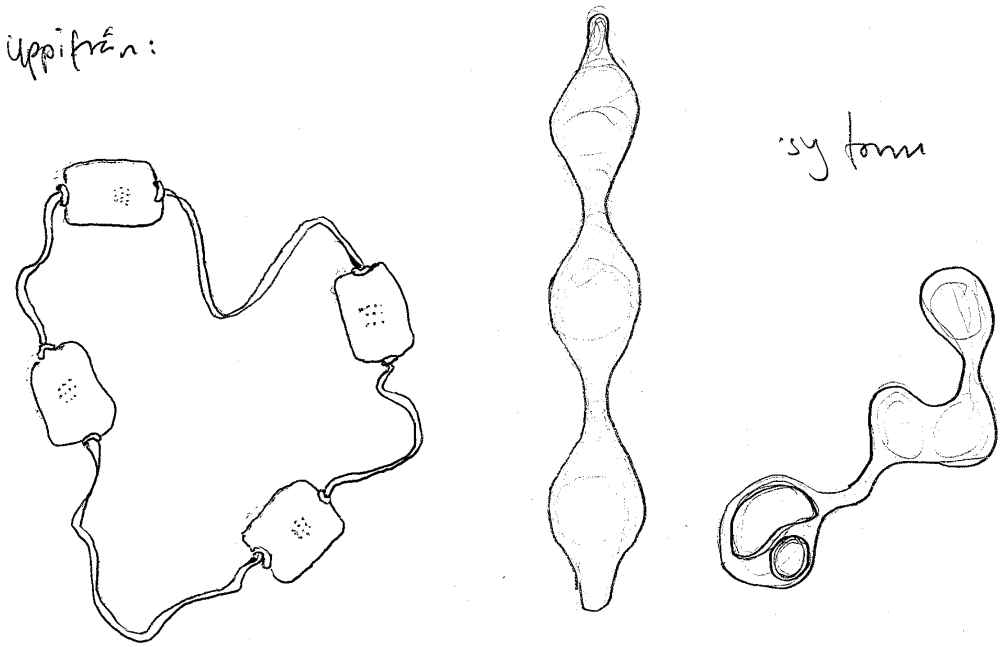
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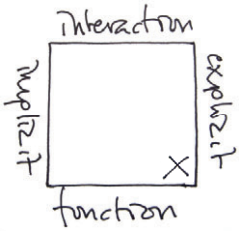
sy form

First three sketches from the left previous pages: Johan Sandsjö

In other words, the final expression when people interact with oOo is not something static, it differs depending on how people choose to interact. However, the parameters for the expression are given by hardware and software. In our report it says that we were not totally pleased with the result, we did not think that we had succeeded with the expression we were after, but we had come close.

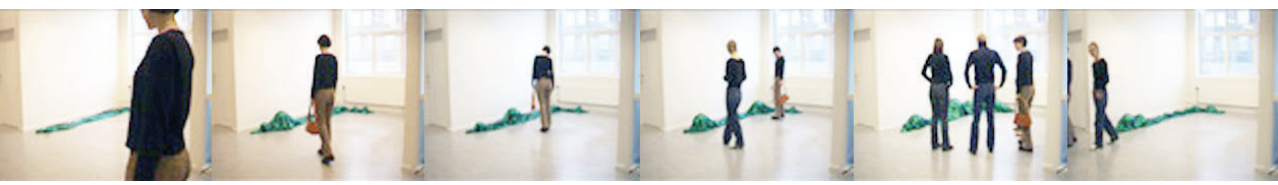


The indistinct form of oOo that may be expressed as curiosity.

Looking back at oOo from an interaction form perspective, I would say that what we aimed at was to create a certain degree of an indistinct form. With oOo we wanted people to realise that they could change the physical form of it, and we thought that it might be more interesting if it was not too obvious how this was done. In other words, we tried to make something where interaction and function clearly are related to each other, but, to some extent, in an indistinct way. Since the aim was that this indistinct form should be expressed as curiosity, the form had to be highly function dependent and explicitly defined in the design. If the form would depend more on interaction it might be expressed as confusion or anxiety, and if more implicitly defined, as alienation, expressions we were not aiming for.

Project team: Maria Håkansson, Hanna Landin and Johan Sandsjö

Exhibited: *Universeum* (Natural Science Discovery Centre)
Göteborg, 15-22 May 2002, as part of the exhibition Interactive futures



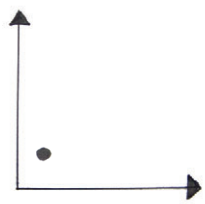
THE INFO CONTROL CARD

The info control card is a conceptual proposal of ways to share information about oneself. The inspiration came from a scene in the film American Psycho where the yuppies compare their business cards. The text on their cards is not as important as the choice of paper, font and colours. Their cards are symbols of success or failure and confirm the given hierarchy, even if they to the inexperienced eye might look the same.

The info control card proposal is not about solving a problem. It is an illustration of what is possible to do with the help of information technology. One use case is at the door of a popular nightclub. Instead of being picked out from the crowd by the nightclub doorman, because you are a famous face or a good looking girl, your card is scanned. Whether you are welcome or not will be based on the information the nightclub owner thinks is important. It could be information about your social life, since the card has a record of which other cards it has been near, or it could be information about how much you usually spend in clubs or in certain stores, on which brands, and in which cities, etc.

The info control card project centres on how data can be used in different ways and how data can be controlled. It is another perspective on what can happen when companies and services (for instance Google and Facebook) log users and their activities. In some card scenarios, for instance, the information was transformed into a gift or a voucher. You could, for example, sell data about yourself to a company to get a discount.

In the design-based research diagram I have positioned the info control card slightly higher up than oOo on the theoretical foundation axis. This is explained by the fact that the project was based on a more systematic search of how you might relate to information about you and others, and the value of a business card as a physical token. In the process I also considered my and other people's potential wishes of control or lack of control, attitudes towards spreading personal data and how one can express oneself in new and different ways, depending on context.



The position of the info control card in the design-based research diagram.

If I would develop the info control card further, I would explore the expressions of interaction of control and lack of control. They can be expressions of a distinct interaction form or of a changeable one. These expressions would be interesting to explore since the info control card can

be designed in two different ways. The card can be designed in such a way that it communicates to its owner that he or she has control over the information. This could be appropriate in the case of the business card mentioned in the section of digital myths, see page 97. Since if you have a business card and can control for how long the information will be accessible to others, it might be appropriate if the design also conveys that fact. The card can also be designed in such a way that there is an expression of lack of control. If the owner of the card lacks control it might be appropriate to also communicate that fact, through the design. It might, for instance, be the nightclub owner, or the company, buying information about customers, that control the information. The owner of the card can, for instance, choose to give away some unknown personal data to get into a particular nightclub or to get a discount.

Project: Hanna Landin

Control

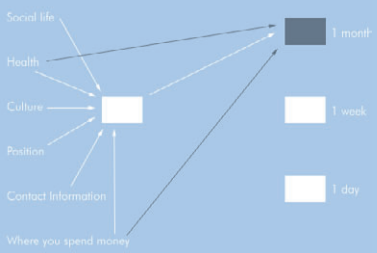
the Info Control Project

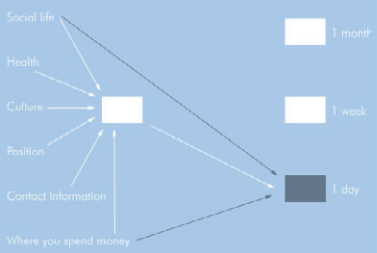
Your personal information is a gift if you want to share it with someone.

With the Information Control Card you can choose what updated information about yourself you want to share with who, and control the spread and accession.

Your personal information is a gift if you want to share it with someone.

With the Information Control Card you can choose what updated information about yourself you want to share with who, and control the spread and accession.





parents

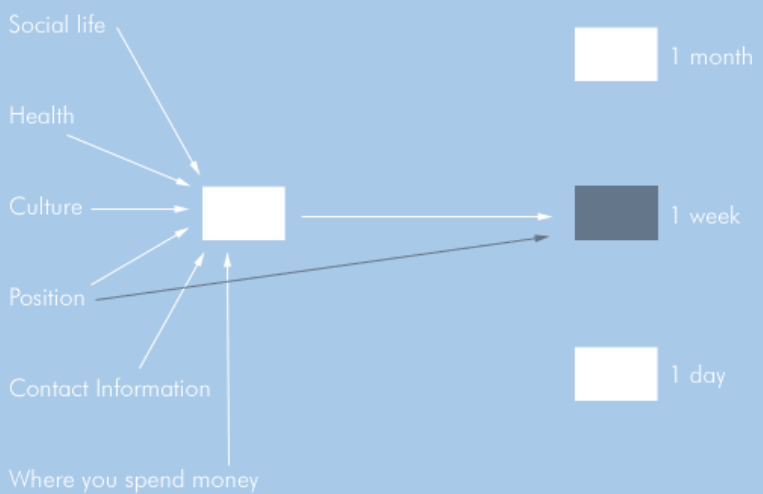
Your parents seem concerned about you. Last Christmas their present to you was a healthier lifestyle. Now they pay for everything that they consider is good for you. Every month they can see your expenses of yoga classes, trainers, fruit juices, etc. Every month they can make up their mind, being worried or reassured about your way of living.

doorman

You meet someone when you are on a vacation in Greece. You give that person a card that only contains information about your position, and only for a week.

f l i r t

The person does not know your name or phone number but is still able to see you, within a week.



THE IRON HORSE

The Iron horse was a bicycle that sounded like a horse. When you rode it different hoof sounds were played. Walk, trot or gallop depending on your speed. With the help of sensors the movements of the bike and the rider were tracked. If the owner (or the person with the key to the bike's lock) approached the bike, the Iron horse sometimes neighed a greeting. If the bike had been moving without pedal movements and the rider started to pedal again, the horse sometimes snorted in a certain way. Different snorts and neighs were played in different ways depending both on the programmed 'personality' of the Iron horse and how the rider rode it. The only sounds the rider could control were the pace sounds. All the different types of neighs and snorts were semi-random.

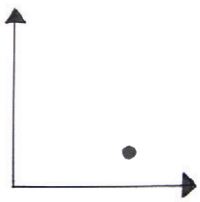
The Iron horse was also supposed to have a group behaviour, but it was never implemented. The group behaviour would change how and when certain sounds were played, depending on the behaviour of surrounding Iron horses. An Iron horse would 'want', for instance, to move in the same pace as surrounding Iron horses, meaning that your horse might start to gallop at a lower speed than usual, if surrounding Iron horses were galloping, etc.

One design decision in particular showed to be very significant for the character of the Iron horse. It is the sound of a cosy snort that was played with a probability of 50% within a 10-600 second interval, if the Iron horse was standing still or rode in walking-pace. This snort, that was not played regularly, turned out to be significant to give the Iron horse the expression of being 'alive'.

This project was a way to explore the boundaries of aesthetics within interaction design. For two reasons, we deliberately did not pay much attention to the visual expressions of the Iron horse. Firstly, from an aesthetic point of view, we were used to thinking of visual appearances. Therefore, we felt that we might learn more about interaction aesthetics if we tried to exclude the visual aspects. Consequently, we deliberately put all focus on the temporal aesthetical questions. Secondly, we wanted to encourage free play and imagination and thought that any visual horse-like attributes, such as a tail or mane, might just limit people or make the bike look dressed up in a ridiculing way.

Some of the sensors on the Iron horse.

We were fascinated by how we could encourage people's imagination and arouse emotions by borrowing sounds from a living being and playing them at well chosen moments. When exhibited, some people returned to the Iron horse several times for riding it, a mother begged her daughter to stop so that they could leave, a man said that he was very confused. The project led to reflections on how you with the help of computational technology can affect the expressions of a device, and how the expressions can affect interaction.



The position of the Iron horse in the design-based research diagram.

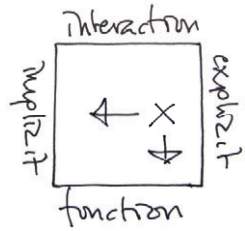
The Iron horse project put focus on the magical interaction form. The design of Iron horse created something more and something else than what actually is there. The magical form depends on how the different movements of the bike and the rider are related to the different horse sounds. By mapping the interaction of riding a bike to the sound expressions of riding a horse, we created a feeling of being close to a living being. The aim was the expression of imagination, since we wanted to create something that encourages play without stating any rules of how to play.

The magical form of the Iron horse is positioned in between interaction and function and is rather explicitly defined in the design. The magical form is due both to interaction and function. It is due both to what you can do with the Iron horse, ride it and think of it in certain ways, for instance, and to what it can do for you, play certain sounds at certain moments. These things are rather explicit in the interface of the Iron horse, which supports the form being expressed as imagination.

If the magical form instead would have been more implicitly defined in the design, the Iron horse, probably, would not express imagination as strongly as it did. If the connection between the movements of the rider and the sounds of the horse would not be apparent, there might be an expression of alienation or confusion instead.

The expression of imagination might also have been reduced if the form would have been more function dependent. The dependence of interaction might be necessary to spur imagination. If people's actions could not affect the interaction form as much, the design might not connect the rider's movements when riding the bicycle with the fantasy of riding a horse.

Besides reflections on what aesthetics of interaction actually entails, this project led to ideas about exploring the characteristics of computational technology. I wanted to put the characteristics into view, rather than hiding them. I wanted to try to make it more clear what in the form and expression of a computational device that comes from computational technology and what that does not.

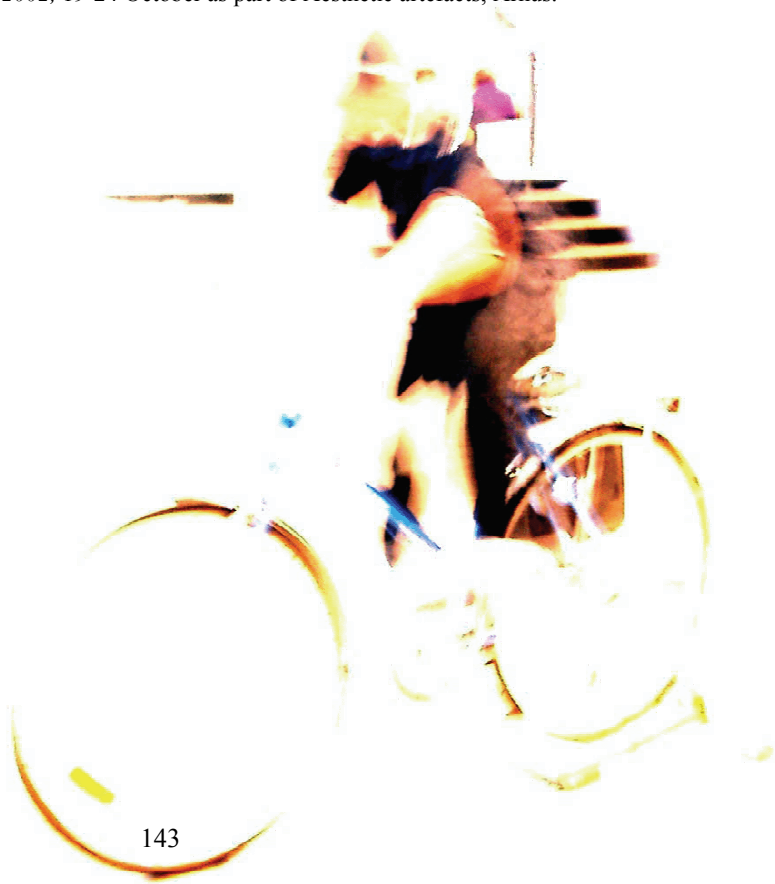


The magical form of the Iron horse being expressed as imagination in certain situations of use, together with suggestions of how to reduce it.

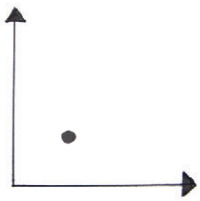
Project team: Magnus Johansson, Hanna Landin, Sus Lundgren and Johannes Prison

Publication: Landin, Lundgren and Prison 2002.

Exhibited: *Universeum* (Natural Science Discovery Centre), Göteborg, 15-22 May 2002 as part of the exhibition Interactive futures. *NordiCHI 2002,* 19-24 October as part of Aesthetic artefacts, Århus.



DIGITAL MYTHS version 1



The position of the Digital myth project, version 1, in the design-based research diagram.

With the master thesis project Digital myths (Landin 2003) I explored thoughts and ideas from the Iron horse project. I explored the characteristics of computational technology by trying to expose the material. The starting point was the fact that a user interface implies that someone decides, directly or indirectly, what people will be able to interact with and in which ways. By designing user interfaces, people's views of computational devices are designed, and through this myths about these computational devices are introduced. In the project myths were identified and analysed and design examples constructed to expose them.

The projects started out from ideas and thoughts about material, user interfaces, users, myths and computational technology. It resulted both in conceptual sketches and design experiments, which explain the project's position in the design-based research diagram.

The myths concerned clickable objects, digital trash, digital existence, to carry out something on a computer, the age of the digital material, digital graphics, the desktop metaphor with its folder structure, and to book something on the Internet.

One final conclusion of the project was that we perhaps should not strive to avoid myths per se. It is often fruitful to present a picture of a system rather than the system itself to people. However, it might be a good idea to be careful and aware of which myths that might be disseminated by doing so. The project was the starting point of further work, where the methodology of digital myths of this thesis is part of the final result.

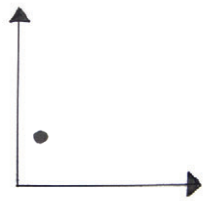
Project: Hanna Landin

Publication: Landin 2003

LIES

The conceptual pre-study project Lies was a way to further explore the characteristics of computational devices. It was part of a bigger project were computational technology, as a material, was explored through combining it with another material, textiles. The aim was to find out what intrinsic properties and qualities computational technology has, in comparison with other materials. The temporal aspect and the changing nature, which both are due to the duration of a computer program's execution, are examples of aspects that were explored.

Based on observations and workshops, a couple of scenarios were formulated. Some scenarios of suspiciousness were drafted, for instance, alerts popping up on your computer screen, telling you that some software with a name unknown to you had been successfully installed, or some software on you computer that is using data you have taped in earlier to play poker on the web, paying with your credit card, etc. There were also some initial thoughts of what digital trash is about, comparing to ordinary trash, and of how physical things can be worn and torn unlike information technology, and what this difference might result in. The pre-study resulted in reflections on how easy it is to lie and deceive with the help of computational technology. That trust and suspiciousness might be aspects to consider in different ways when designing user interfaces.



The position of the project Lies in the design-based research diagram.

The project is positioned close to the previous example, digital myths. However, it is positioned a bit to the left of it on the product development axis, since the scenarios were not instantiated by any design experiments.

Project: Hanna Landin, part of the IT+Textile project at the Interactive Institute, funded by Vinnova.

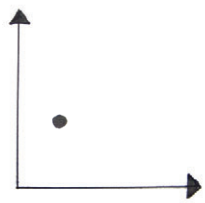

I read this mail and know that
already know but I thought that ther
Carl
Microsoft has been successfully installed.
At 09:11 2003-08-03 +0200, you wr
...hope you had an pleasant eve
see the attached file, please find t
OK

Lies.

THE FABRICATION PROJECT

The Fabrication project was a continuation of Lies. In this project we made some early experiments with different ways of using textiles as a display for information technology. We explored different techniques of making textile patterns dynamic and looked into aspects such as subtlety and slowness. The project explored aesthetics within interaction design further, this time in relation to aesthetics within textile design. By looking at how textile patterns could be made dynamical with the help of hardware and software, the aesthetical qualities of computational technology were added onto the ones of textile patterns.

The project is positioned in the design-based research diagram a bit higher up than previous projects. The position on the axis of theoretical foundation refers to the way this project is based on conceptual frameworks of understanding aesthetics within textile design and interaction design. The foundation was research on, and experiments exploring, how we can create, use and relate to textile patterns and information. The design of static patterns was compared to the design of dynamic patterns, and information presented through static patterns was compared to information presented through dynamic patterns.



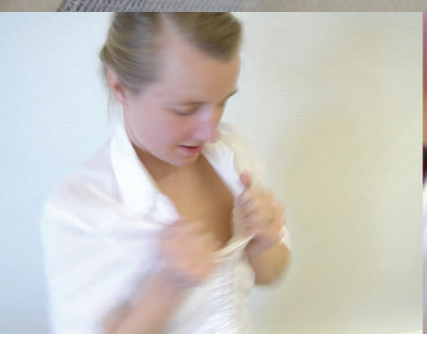
The position of the Fabrication project in the design-based research diagram.

We worked on two scenarios, one where a mobile phone is connected to the fabric of a bag, and one where a PDA is connected to the fabric of an apron. We discussed what kind of data that could be interesting to display from an aesthetic point of view, and how. Our conclusion was to aim at a display that is far more ambiguous than an ordinary computer screen, due to the aesthetical characteristics of dynamic textile patterns. We concluded that such ambiguity should be reflected in the software, that it should not only be the pattern making the information a bit more obscure. The goal was to give people an opportunity to interpret information, rather than just read it. We thought that it did not matter whether the pattern sometimes would be a fabrication, i.e., the aim was not to always present information in a 'true way', what mattered was to open up for different interpretations. Fabrication was also thought of in another sense. Usually, patterns are created at the same time as the fabric is created. In this project we were looking for continuous fabrication of the pattern.

Project team: Hanna Landin and Linda Worbin, part of the IT+Textile project at the Interactive Institute, funded by Vinnova.

Publication: Landin and Worbin 2004

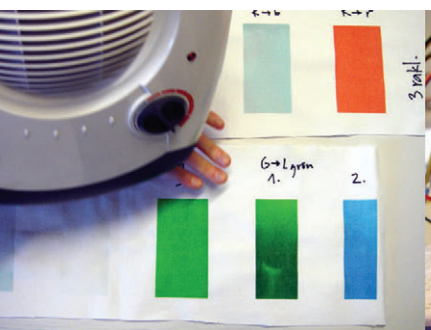
Material experiments.

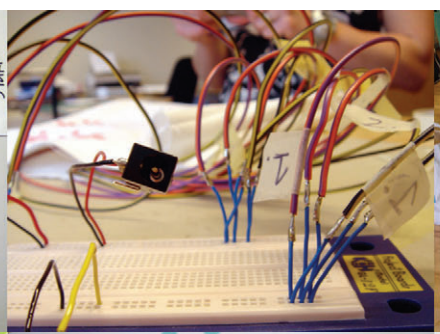


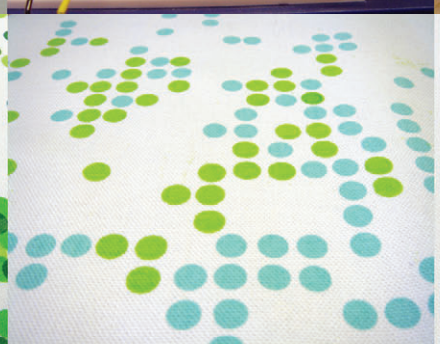
Where to present information?

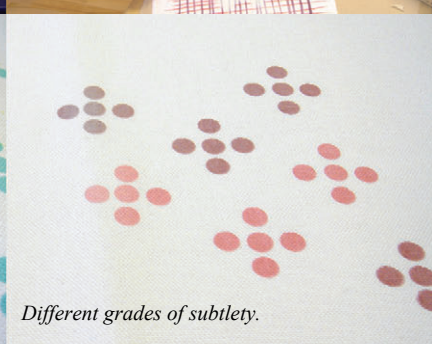
Textile by Saldo, the colour yellow is described in Braille.

Textile by Saldo, an interpretation of the film Bullitt scene by scene with gunshots, explosions, etc, and Steve McQueen as a red dot.

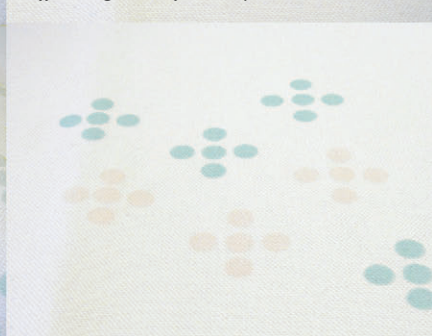








Different grades of subtlety.

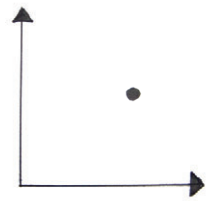



Sony Ericsson

Photograph previous page: Linda Worbin

THE BAG

The fabrication project led to the making of a bag connected to a mobile phone. The bag replaced the sound and vibrations of incoming calls and messages to a mobile phone with colour changes. The design objectives in this project were both to create an ambiguous display with the help of textiles, and to explore the magical aspects of computational technology. By the means of design I wanted to explore how one could affect the fact that people let themselves be dependent on information technology. A result was ideas of dependence as an expression of interaction. The Bag is positioned further up on the theoretical foundation axis than previous design explorations, since it started out with clearer objectives and ideas of what to explore and how.



The position of the bag in the design-based research diagram.

Mobile phones are designed to be distinct and consequently they often interrupt us. They announce communication attempts with a ringtone or vibrations in an obvious way. If we do not want to be notified in that way we are able to mute the phone and switch off the vibrator. With the Bag we explored if there could be something in between an unmistakable audible tone and silence, and in between vibrations and stillness.

We wanted to see if we could make it easier for people to choose, from one moment to the next, whether they want to be informed or not. If it is possible to let people, instead of the devices, decide. From a design perspective I felt the need to see what happened with my own relation to my mobile phone, to better understand the consequences of different ways of expressing things.

In this project we tried to reduce the expression of dependence with our new design by giving people a chance to be informed of incoming phone calls and text messages in a more subtle way than usual. We aimed at giving people more of a choice whether or not they wanted to be interrupted.

When you put your mobile phone in the bag and connect it to a microcontroller, the sound and vibrator are switched off. If the phone receives a text message some dots on the bag change colour. The dots on the fabric have been printed with a mixture of ordinary pigment and thermo-chromic printing dye and under the fabric flat electric heaters can switch on and off. The dots can change from different shades of grey to green, pink, purple, etc, and back again. Which dots and how often they

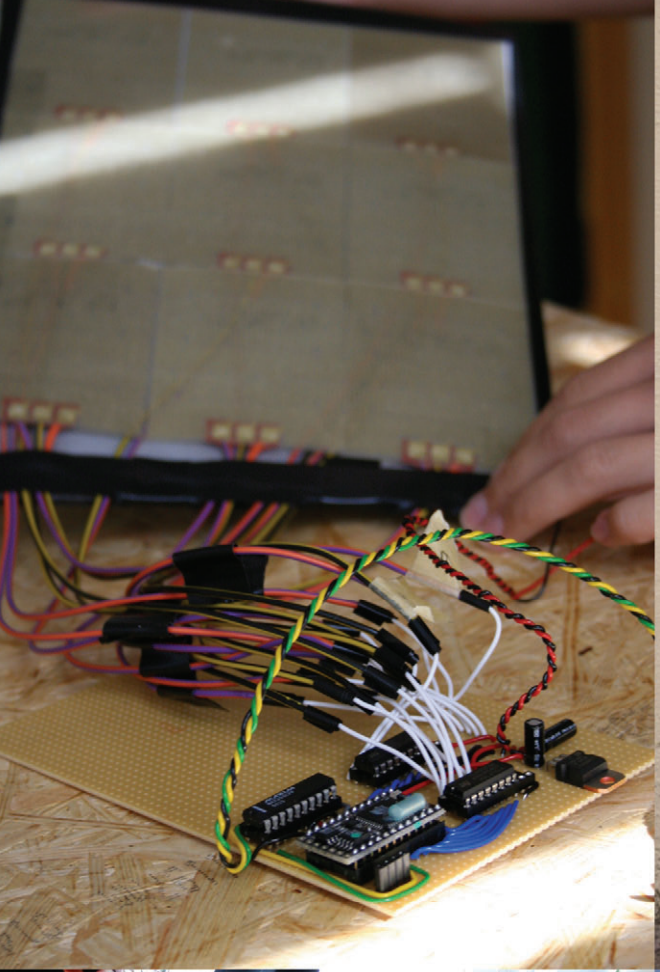
change colour depended on who the message is from, whether the phone number is stored in the phone book or not, etc. As long as the phone contains unread messages, colour changes appear on the fabric but in a rather slow and subtle way. A single look at the bag might not be enough to discover any messages, you might have to wait a minute and look again to be able to see a difference. If the phone receives phone calls other dots change colour. How and when depend on the caller, if the number is known, has called recently in a regular way or not, etc. The bag displays phone calls differently depending on if they are incoming right now or if someone has called earlier. It also matters how many missed phone calls the phone has and if they came from different persons, etc. The different conditions are stored in the software of the microcontroller.

The bag was designed so that you, when you take a look at it, may wonder what it is that you actually see. Is someone calling you right now or have someone called you earlier, etc? Depending on how interested you are and how important a phone call or a message is for you in a certain situation, you can decide if you want to pick up the phone or not.

The expression of interaction focuses on a more relaxed attitude towards mobile phones; it is not so much my responsibility to answer every call, instead it is more up to the caller to awake my curiosity through the pattern changes by, for instance, calling several times in a certain way. If you return to your bag and have eight missed phone calls and three text messages waiting for you, what you will see is not text informing you about that fact. Instead it is a slowly changing pattern in different colours that just hints that something might have happened, and you can choose to let it stay that way, i.e., let messages and missed phone calls be presented as a changeable textile pattern.

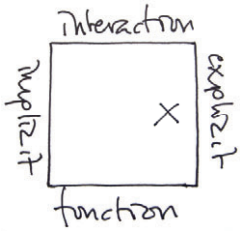
The bag was designed so that you, to some extent, can learn how to interpret it. Sometimes when it has been demonstrated, without explaining in detail in what way the pattern changes, people said that they did not see any changes. After some time, however, the change of pattern became obvious. We saw this as a sign of that we had reached our goal of a more subtle expression.

Photograph next page, upper left and right and lower left: Linda Worbin

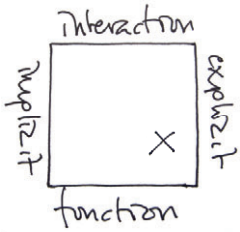


```
AT+CMGF=1
OK
AT+CMGR=57
+CMGR: "REC READ",
 f!r att se fotbol

OK
AT+CMGR=50
+CMGR: "REC READ",
```

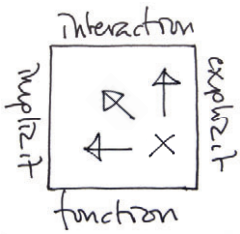
```
Call DefineCom3(InPin, OutPin, bx0000_1000)   ' DefineCom3 se SystemLibrary ' skriver såklart
Call OpenCom(3, 19200, BTIn, BTOut)           ' 3 står för port 3 som definierades i raden ova

Call ClearQueue(BTIn)
Call ClearQueue(BTOut) 'nödvändig?
                                                        'Chr(13) & Chr(10) ger radbry
Call PutQueueStr(BTOut, "AT+CLIP=1" & Chr(13) & Chr(10))        '[calling line idendification
Call Response
Call Delay(0.3)
Call PutQueueStr(BTOut, "AT+CPMS=""ME""" & Chr(13) & Chr(10))       '[Sätter minne som ska lä
Call Response
Call PutQueueStr(BTOut, "AT+CNMI=2,1,0,0,0" & Chr(13) & Chr(10))    ' [New messages indicatio
Call Response
Call Delay(0.3)
Call PutQueueStr(BTOut, "AT+CMGF=1" & Chr(13) & Chr(10))        ' [0= PDU mode,  1= text mode
Call Response
Call PutQueueStr(BTOut, "AT+CMER=3,2,0,0,0" & Chr(13) & Chr(10))    ' [slår på keystrokes ]
Call Response
Call Delay(0.3)
Call PutQueueStr(BTOut, "AT+CSDH=1" & Chr(13) & Chr(10))        '[För att få ut hur långt SMS
Call Response
Call PutQueueStr(BTOut, "AT+CPBS=""MC""" & Chr(13) & Chr(10))   ' [sätter phonebook-minnet so
Call Response
Call PutQueueStr(BTOut, "AT+CVIB=0" & Chr(13) & Chr(10))        '[0 = disable vibrator  1 = e
Call Response
Call Delay(0.3)
Call PutQueueStr(BTOut, "AT*ESIL=1" & Chr(13) & Chr(10))        '[1 = silent mode, 0 = stänge
Call Response
Call Delay(0.2)
```



The distinct form of mobile phones that may be expressed as dependence.



The indistinct form of the bag that may be expressed as independence.



If changing the indistinct form of the bag, the form may be expressed as anxiety, alienation or confusion instead of independence.

As discussed earlier, on page 63, the distinct form of mobile phones can be expressed as dependence in certain contexts of use. With the Bag we aimed for the expression of independence through an indistinct form. We tried to achieve that expression by designing a more indistinct and ambiguous display with the help of a dynamic textile pattern. By making it less clear what happened and when, we gave the user of the Bag more of a free choice of when to think of the persons that might be contacting him or her. In other words, we reduced the functions that can interrupt people and increased the functions that can inform in a subtle way.

The indistinct form of the Bag is more related to function than to interaction, which is another way to say that you cannot affect the indistinct form much with your actions. The distinct form of mobile phones is more dependent on what you can do. Your choice of ringtone, and vibration settings, etc, can affect the distinct form. In the case of the Bag, however, you cannot easily affect how the bag expresses the phone activities.

One could question what difference it would make if the indistinct form would not be positioned where it now is in the interaction form square. The expression might, for instance, be one of anxiety instead of independence if the form would be more dependent on interaction than function, since such a design could express that your actions may affect the indistinct relation between interaction and function.

The expression might be of alienation if the indistinct form would not only be more dependent on interaction but also more implicitly than explicitly defined in the design. The indistinct form would in such a case not be apparent in the interface but affected by your actions, which can make it hard for you to see which consequences your actions might have in certain situations. This could be the case if the bag had been designed so that you could affect the indistinctness but the interface of the bag would not reveal that fact. For instance, if you returned a missed call quickly, the bag might have displayed the next phone call more vaguely, without making this clear, and if you were using the bag rather seldom, the bag might have, for a while, displayed only some calls, etc.

Furthermore, if implicitly defined but function dependent, the form might be expressed as confusion. The indistinct form is in such a case not clearly and distinctly stated but dependent on the functions. It could be an interface that suggests that there is a distinct relation between interaction and function, though it is an indistinct one. Consider a bag, for instance,

with an image of a message icon printed on it, instead of the dots. Such a design might give you the impression that the image of the message icon will change colour if you receive a text message. However, if that is not the case, i.e. if some other part of the bag will change colour instead in an unpredictable way, the form is not that distinct as it might seem. Such a bag has an implicitly defined indistinct form which may be expressed as confusion.

Even if it seems so, the two images of calls and messages will not always inform you of new calls and messages. This is a version of the bag where the expression may be more of confusion than of independence.

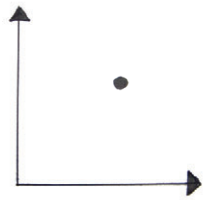
Project team: Hanna Landin and Linda Worbin

Publication: Landin and Worbin 2005

Exhibited: *Stockholm Furniture Fair*, Stockholm, 8-12 February 2006 and *Salone Satellite, Milan Design Week*, Milan, 5-10 April 2006 as part of the exhibition case of 'Body and Space' of the School of Textiles, Borås. *Röhsska Museet* (The Röhsska Museum of Fashion, Design and Decorative Arts), Göteborg, 8 June - 8 August 2006. *Dutch Design Week* in Eindhoven, 21-29 October 2006 as part of 'Brainport-Material Laboratory'.

THE TABLECLOTH

The Tablecloth is part of the explorations of interaction form and expressions of interaction. We had made a bag that explores the expressions of mobile phones, and the aim of the Tablecloth was to further explore the notions of form and expressions. By making a second accessory to mobile phones I wanted to get a deeper understanding of how different design decisions affect forms and expressions. The aim was to be able to look into possible differences and similarities by making another device that also changes the way mobile phones notify people.



The position of the Tablecloth in the design-based research diagram.

In the design-based research diagram the Tablecloth is positioned on the product development axis close to the Bag. The Tablecloth is positioned a bit higher up on the theoretical foundation axis, since the Tablecloth was based on slightly more developed ideas about what to explore and how. The outcome of the Bag project was the starting point, with insights and ideas of distinct and indistinct forms, of mobile phones expressing dependency, and of how this can be changed by changing the design, etc. With the Bag the dependency – independency aspect had been explored. With the Tablecloth I wanted to explore how to work on expressions of social presence.

Just like the Bag, the Tablecloth changes the way mobile phones express incoming phone calls and messages. With the Tablecloth there are no ringtones or vibrations, or colour changes on a fabric as in the case of the Bag. Instead, phone calls and text messages are presented by a pattern of burn marks. The aim is to accentuate the social setting around the table, as a way to see what happens if we value all incomings calls and messages equally and express them on the same display. The tablecloth adds up the phone events of all phones present so that there is no difference between your phone ringing and mine.

The tablecloth is knitted with cotton yarn, heating wire and a monofilament yarn. The heating wire glows and produces heat and is normally used in household products such as hairdryers and toasters. A copper wire is embroidered to the seamy side of the fabric so that the heating wire is connected in parallel at different places in a square like pattern. When mobile phones are connected to the tablecloth they are muted and their vibrators are switched off by a microcontroller. The microcontroller then listens to the activity of the phones and if a call or a message comes in, the power to a square of parallel connected heating

wires will be switched on. The heating wire heats up the cotton yarn and the result is a burn mark. The look of the burn mark will depend on several things: the knit, how the copper wire is embroidered, for how long someone is calling, if the person has called earlier, if the sender of a message is stored in the phonebook, etc.

The heating wire is sectioned into independent circuits. In between these segments, the monofilament yarn is used to create a similar look so that you cannot tell where the sections of heating wire are. Consequently, you cannot see beforehand where the cloth might start to burn. The final pattern is unpredictable since the burn-outs areas are chosen in a semi-random way by the software of the microcontroller, and since the number and character of incoming calls and messages matters.

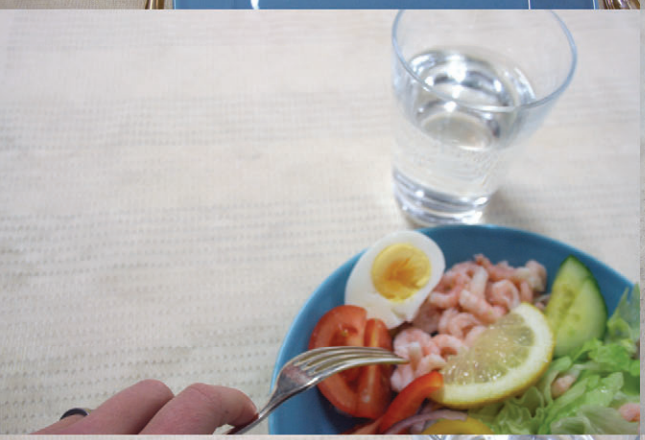
The dinner guests' mobile phones.

The Tablecloth is designed to be ambiguous, but not in the same way as the Bag. The Bag is ambiguous since it displays phone calls and messages in an unclear way, without a clear distinction between already missed calls and calls in progress, changing the colours back and forth slowly so you might not be sure of what it is you see. The tablecloth, on the other hand, displays incoming phone calls and messages clearly with the help of the burn marks, and it does that immediately and only once. The burn marks are irreversible so a message or a call will leave a trace that will not go away. However, the tablecloth is still ambiguous because you will not know whose phone that is receiving phone calls or messages. This follows from the fact that all phone activities are displayed on the tablecloth without reference to any particular person or phone. The focus is consequently not so much on people's choice of interpretation, but on how they relate to the given social context.

The scenario the tablecloth is designed for is a dinner where people respect and value the moment of being there. The idea is that they can be aware of incoming calls and messages but prioritize the social context around the table. People's attempt of communication is transformed into decoration, which is not only visual but tactile and also something that smells. The design of the tablecloth makes the occasion more important since the cloth can only be used once. It is a somewhat exclusive cloth where the pattern will be set during one occasion only, and forever wear the traces, as a memory.

Photograph next page: Linda Worbin

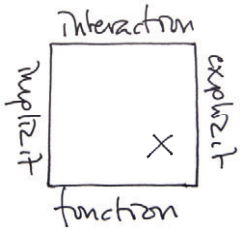









```
LC1 = 0
LC2 = 0
Call PutTime(0,0,0.000)
telefon = 1



Do

        outByte(1) = 0
        outByte(2) = 0
        outByte(3) = 0
        outByte(4) = 0
        Call Burn()
```



The indistinct form of the Tablecloth, which may be expressed as community.

Just like the Bag the Tablecloth has an indistinct interaction form. The form is indistinct since there is an indistinct relation between interaction and function – you cannot tell whose phone call or message is being displayed. Since the notification is clear and distinct, this indistinct form is not expressed as independence, as in the case of the Bag. At the dinner you know when there is a phone call or a message, it is displayed clearly and immediately. The expression of interaction is instead of community, since the indistinct form breaks up the differences between the different phones and merges their activities onto one display.

The indistinct form of the Tablecloth is positioned similar to the one of the Bag, even if they are not identical. The two different designs are both increasing the indistinct form, and decreasing the expression of dependence. However, where the indistinct form of the Bag supports the expression of independence, independence as an expression is not that strong in the Tablecloth since it is ambiguous and indistinct in another way, as discussed above.

Project team: Hanna Landin, Anna Persson and Linda Worbin

Publication: Landin, Persson and Worbin 2008

Exhibited: *Rydal museum*, Rydal, 1 June -12 October 2008

Photograph previous page: Linda Worbin

COMMENTS

Above the practical work is described in a chronological order. As already mentioned, I have chosen to present both minor and major projects since they together give a picture of how the research work has been carried out. The aim is to make it a bit easier to see how the process and the result, in terms of the framework and design methods of form and expression, are related to each other. There are several connections between the practical work and the result in terms of the framework and the design methods of training and critique. The magical form and the expression of imagination might not have been identified if we had not built the Iron horse. The expression of dependence of mobile phones might not have been formulated without the Fabrication project, etc. Other forms and expressions, and perhaps also another kind of framework, might have been the result if I had carried out other projects. In the same way as other projects might have been the result if I had thought about other aspects of computational technology.

The presentations of the explorations above show how some ideas and thoughts have recurred throughout the years. One of the recurring ideas is that we have to decide what we want to believe in since we cannot fully control or understand how things work. This is a circumstance which makes it easier to lie, or at least present a delusion, with the help of information technology. Another recurrent interest has been devices that are not invisible, seamless, or have the purpose to fulfil user needs, devices that instead have been made to explore an interaction alternative to what already exists. The Bag and the Tablecloth, for example, explores what happens if one changes the way mobile phones are informing us about incoming calls and messages, and the Iron horse was an experiment with what happens if one merged the two very different expressions of riding a bicycle and a horse. Another interest has been what computational technology implies as a material when prototyping and when it comes to expressions of interaction.

As mentioned, the design projects play different parts. Together they form an investigation on aesthetics within interaction design. They are examples of design alternatives for computational devices, and as such examples they are also arguments for the importance of knowledge of aesthetics of interaction. In addition to the insights into aesthetics, the projects can together be an example of how design-based research may be carried out.

One potential problem with design-based research is the fact that the design process may provide the designer with some knowledge that is not possible to be communicated through the artefact itself, or through text describing the project. For me the design process of the Bag and the Tablecloth, for instance, has given me a better sense of computational technology as a material. It has opened my eyes for how the expressiveness of devices can affect how people choose to interact. It has improved my sensitivity of forms and expressions. It is a kind of knowledge that I find hard to see how I could have assimilated through reading or talking or through interacting with devices. To get hold of also this particular part of the overall design knowledge, we might have to make and explore things ourselves, which is one of the reasons why exercises and methods are part of the result of this thesis.

CONCLUDING NOTES

The main contribution of the work presented in this thesis consists of three parts: a) The design explorations that are both illustrations of design alternatives and examples of how you can question and explore aesthetics of interaction. b) The framework and concepts of *interaction form* and *expressions of interaction*, which support reflection on aesthetical matters. c) The design exercises and the critical method that exemplify how you in design practice can develop a better sensibility to aesthetics of interaction. Together they contribute to the ongoing discourse on interaction design aesthetics.

The framework and concepts introduced in this thesis are intended to be of use when talking about interaction before there is any, i.e., before any design exists that people can interact with. The concepts do not refer to actual use or people's experiences. Instead they refer to the device itself, to how the device relates possible interaction to its functions, and how this relation can be expressed in certain context of use.

The aim is a richer language for the interaction design process, and there are several reasons why the framework can work in that direction: a) The framework encourages reflections on whether design decisions strengthen or counteract interaction forms and expressions. Different design options can consequently be assessed based on how much they can strengthen or counteract different wanted and unwanted forms and expressions. b) The framework separates expressions from experiences, i.e., the focus is on the design, not on people's feelings or perception. The framework

accentuates the difference between what a design can express in a certain context of use and what people actually experience when the design is put in a real context. One of the goals with the framework is that you shall be constantly aware of that you cannot be sure how someone actually will experience your design. Instead you are encouraged to focus on forms and expressions, defined by your design choices, and reflect on possible consequences of these. The aim of the framework is synthesis. c) The concept of interaction form is defined as the way in which a design relates interaction and function to each other, which can be done more or less explicitly. This definition opens up for discussions about how an interaction form of a device can change if you are changing the premises, i.e., if the form would be more implicitly defined in the design, or more dependent on interaction than on function, etc. d) The concept of interaction form comprises also what is implicitly defined in the design. This encourages reflections on what kind of interaction and function a design can result in that will not be apparent in the user interface. Not only matters of how people should be able to choose an option in a graphical user interface, or ways of navigating, are encouraged to be discussed in the design process. More subtle things such as how thoughts and ideas can be related to function can be considered, as well as, for instance, alternative interfaces, made by users.

The research has been conducted through explorative design. This is true both of the design explorations and the framework of form and expressions, with the related design methods of training and critique. The practical and the theoretical work are part of the same research process. Instead of the natural scientific way of exploring something, trying to interfere as little as possible, the result has been constructed. That is a basic part of engineering and also of all design activity. Instead of a generic result, a design is an instantiation and an example.

The last chapter presented a diagram as a tool for reflections on different ways of performing design-based research (also called practice-based and practice-led design research or research through design). Together with examples where the practical work of this thesis is positioned in that diagram the chapter presents a way to look at and discuss this kind of research. At the same time the diagram is pointing at the diversity of approaches since design-based research as well as interaction design are still not settled or homogeneous research fields.

As already pointed out in the chapter on related work, there might be a problem introducing concepts by exemplifying them by things that already exist. It is therefore important that the framework and the concepts of form and expressions are continuously developed by the designer in her or his own practice.

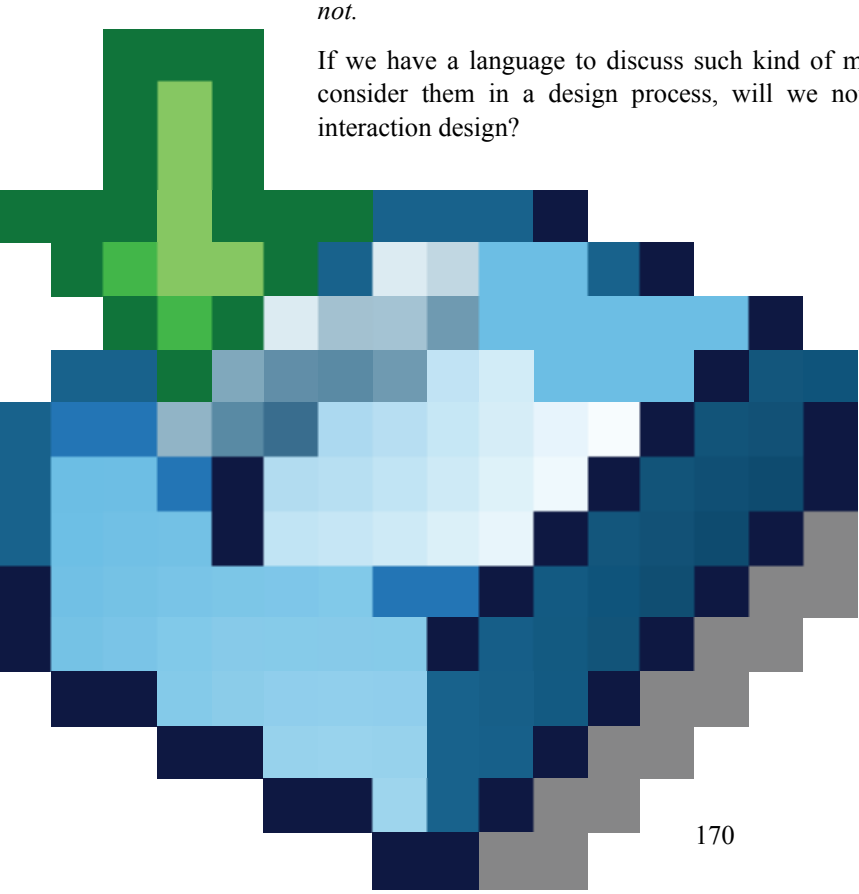
The goal, to be able to better discuss what to aim for in your design, and to become better at choosing among different design proposals during the design process, is in line with the related work that has been brought up. However, there are differences between the different perspectives. *Experiential qualities* constitute a language of feelings and experiences you want people to have when they use a device. *Interaction gestalt attributes* constitute a language of the attributes of a design that affect how people are able to interact with the design. The framework that has been presented in this thesis is a language of a design's forms and expressions, which can affect how people relate to the interaction with the device. Interaction is defined as what you can do with a device, which is not the same thing as actual use.

If one wants to be able to design for a user experience, the issue is to bridge the gap between user experiences and design. Löwgren (2006 p. 64) points out: "*You can never design a product that possesses a certain quality, but you can design to increase the chances that the use of the product will be experienced in a certain way.*" He says, as mentioned in the chapter of related work, that you cannot design a device that actually has an experiential quality, since it is a quality of use, what you can do is to design the conditions for the quality. However, the vocabulary of experiential qualities is about qualities and not about the conditions that might make them appear. The framework and concepts of form and expressions accentuate that we not only need a vocabulary of experiences and feelings and ways of perceiving things while interacting, we also need a vocabulary of the design per se. When we have both, we might be able to bridge the gap.

This thesis approaches the gap between design and use from the side of design, whereas other work approaches it from the side of experiences, McCarthy and Wright (2004) for instance. Much more work need to be done but the frameworks, concepts and methods that have been presented the last years, indicate that the work has begun.

If I receive an e-mail, a small icon appears in the lower right corner of my computer screen, provided that the e-mail program is running. New e-mails seem to be something that I want to be informed of. They seem also to be something that disturbs my work, get me off the track. When using my computer, I now and then take a look at the lower right corner of the screen. If I do not see any icon I continue what I am doing. However, if I suspect that the reason why I do not see any icon is due to the fact that the e-mail program is not running, my concentration is ruined. Then I start the program to see if there are any new messages that seem important. Consequently, I work better and can focus for longer periods of time if I think that my e-mail program is running, though it is not.

If we have a language to discuss such kind of matters, and the tools to consider them in a design process, will we not be able to do better interaction design?



Icon: Eudora, Qualcomm

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