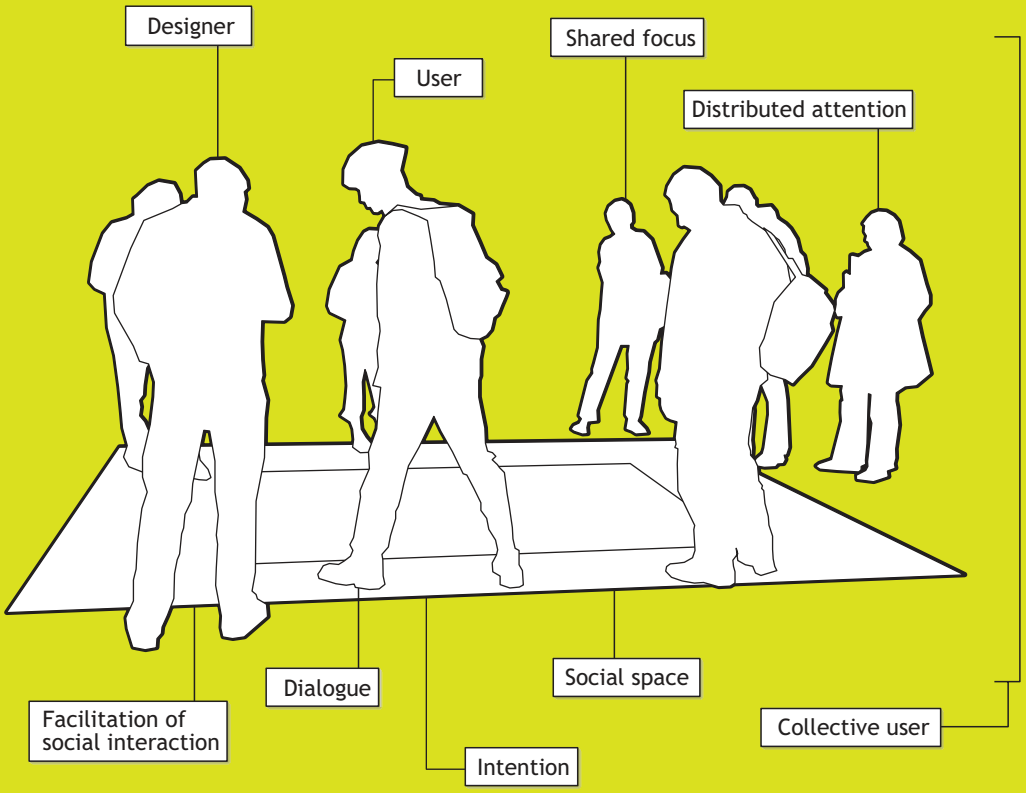
Aarhus School of Architecture, Department of Design
ISIS Katrinebjerg, Center for Interactive Spaces

Designing for Social Interaction



Physical, Co-located Social Computing

PhD Dissertation

by Martin Ludvigsen

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Denmark

December 2006

Summary

Background

This dissertation presents the investigations I have made in the last three years on how to design for social interaction in interactive environments. This research has been conducted within the Center for Interactive Spaces, ISIS Katrinebjerg and practical research projects have been engaged in collaboration with colleagues from the different disciplines working in the center, with external partners from industry and a range of users.

The starting point for this investigation has been a conviction that too much technology is designed for single users, since that is how we designers too often think of the world of use and applicability – technology as empowerment of the single person. This conviction extends to a hypothesis of humans not only being single individual users, standing alone, confronted with context. Humans also exists as parts of larger entities in collectives and social gatherings, who's interaction bears as much meaning and importance as individual interaction with digital technologies. This opens for the possibility that the most interesting point of reference for design in some cases might be this social entity rather than the individual. Design basically deals with creating meaningful artifacts and "meaning arises out of, or is derived from, social interaction with ones fellows" as Hallnäs and Redström (2006) write.

Purpose

Designing for social interaction is a relevant issue to address from an interaction design research standpoint as computational technologies permeate increasing aspects of our everyday lives, and as such are part of creating the social spaces within which we live. As designers are confronted by the challenge of designing and facilitating relevant forms of social interaction, the complexity of this design space can be overwhelming. The reflections and experiments presented in the dissertation are aimed at exploring this design space and build a conceptual understanding for future reference. The social design space has been approached from a range of angles through mainly three different projects; the *iHome* project, the *Future Hybrid Library* project and the *Nomadic Play* project. This has lead to the three perspectives that the main contributions are developed within; how do we describe this design space and what we want to design? Who are we designing the social space for? What and how are we able to affect through design?

The goal of this dissertation is to increase awareness about the potential we have as designers for creating social spaces with and around these technologies. This awareness is established by developing and relating words in conceptual frameworks, aimed at enabling the designer with ways to describe and conceptualize future design proposals. I seek to achieve scientific validity of my work by expanding "the repertoire of possible action" (Latour 2004) for designers through introducing these words into the design community, both in relation to practice and research.

Results

This challenge is addressed by summarizing and presenting the central publications I have been part of publishing during the project. These are submitted as Part IV of the dissertation, and, all but one, these are written in collaboration with colleagues from the projects.

Before this the first part of this dissertation is introducing the research context, describing the applied research methods and presenting the experimental design cases. In Part II the design experiments and the experiences from these are reflected upon and summarized in order to present the experiences at the edge of what I know now about designing for social interaction, in the form of unfolded concepts and *design sensibilities*. The concepts presented are concerned with:

- Developing a framework for addressing the *level of social interaction* designed for.
- Refocus design attention from the individual users to the gathering at large – *the collective user*
- Discussing *facilitation as a designer's stance* when confronted with designing for social interaction and developing innovative platforms for collective action

Part III concludes on the presented reflections and discusses the methods applied in this research project. This means that the PhD project presents at least three types of contribution: Firstly, the projects and prototypes developed, demonstrated and presented both in their relevant use-contexts and at research conferences and seminars; secondly, the peer-reviewed papers that have been accepted and presented to conferences around the world describing the projects and reflecting on the designs; and finally the extended and collecting reflections presented in this dissertation tying the project work together around the subject of *designing for social interaction.*

Method

The fourth possible contribution that has developed in the course of writing the dissertation itself is the discussion on the nature and idea of design research – based on experiences from this project and the applied research approach; research-through-design. This discussion links design research to a wider philosophy of science, discussing the impetus behind conducting research from an experimental design research perspective.

Research-through-design means to investigate a subject by applying creative design methodology and experimentation to the context and subject matter of study in order to gain knowledge – and, as importantly, to investigate possible futures and potentials of this subject. Design research in this form does not only report on how the world is or have been, but inquires into how the world can become.

Dansk Resumé (Danish Summary)

Baggrund

Denne afhandling præsenterer de undersøgelser jeg har lavet i de seneste tre år om hvordan man designer for social interaktion i interaktive omgivelser. Denne forskning er udført indenfor rammen af Center for Interaktive Rum, ISIS Katrinebjerg, og de praktiske forskningsprojekter er udført i samarbejde med kolleger fra de discipliner der er repræsenteret i forskningscenteret samt eksterne samarbejdspartnere fra virksomheder og en række brugere.

Udgangspunktet for undersøgelserne har været en overbevisning om at for meget teknologi bliver designet til enkeltbrugere, eftersom dette er hvordan vi designere for ofte opfatter rammen for brug og anvendelighed – teknologi der beriger det enkelte menneske. Denne overbevisning peger på en hypotese om at mennesker ikke bare er enkeltstående individer konfronteret med en kontekst. Mennesker eksisterer også som dele af større enheder i kollektive og sociale sammenhænge, hvis interaktioner er lige så vigtige og meningsfyldte som individets interaktion med digitale teknologier. Dette åbner for muligheden af at det mest interessante at fokusere på som designer i visse tilfælde, kan være denne sociale enhed frem for individet. Design beskæftiger sig grundlæggende med at skabe meningsfyldte artefakter og "mening opstår ud fra, eller er afledt af, social interaktion med ens medmennesker" som Hallnäs og Redström (2006) skriver.

Formål

At designe for social interaktion er et relevant emne at beskæftige sig med fra et interaktions-designforsknings standpunkt, idet digitale teknologer gennemtrænger flere og flere områder i vores hverdagsliv og dermed danner ramme for de sociale rum hvori vi lever. Idet designere bliver konfronteret med at skulle designe eller facilitere relevante former for social interaktion, kan kompleksiteten af dette designrum være overvældende. De refleksioner og eksperimenter denne afhandling præsenterer, udforsker dette designrum og opbygger en begrebslig forståelse til fremtidigt brug. Det social designrum er blevet angrebet fra en række forskellige vinkler gennem hovedsagligt tre forskningsprojekter; *iHome*-projektet, projektet *Fremtidens hybride bibliotek* og *Nomadic Play*-projektet. Dette har ført til de tre perspektiver som hovedbidragene i denne afhandling er udviklet indenfor: Hvordan kan vi beskrive dette designrum og det vi ønsker at designe? Hvem er det vi designer sociale rum til? Hvad og hvordan er vi i stand til at påvirke gennem design?

Målet med denne afhandling er derfor at øge vores bevidsthed om de potentialer vi som designere har for at skabe sociale rum gennem og omkring disse teknologier. Denne bevidsthed etableres gennem beskrivelse af begrebsapparater hvis formal er at give designere mulighed for at beskrive fremtidige designforslag. Jeg søger at skabe videnskabelig validitet af mit arbejde ved at udvide "repertoiret for mulige handling" (Latour 2004) for designere ved at introducere disse begreber ind i designfeltet, både i forhold til forskning og praksis.

Resultater

Denne afhandling adresserer denne udfordring ved at sammenfatte og præsentere de centrale artikler, som jeg har været med til at publicere gennem projektet. Disse udgør afhandlingens Del IV og er alle på nær en, skrevet i samarbejde med kolleger fra projekterne. Før dette introducerer Del I til forskningsfeltet, beskriver de anvendte metoder og præsenterer de eksperimentelle design cases. I Del II reflekterer og sammenfatter disse eksperimenter for at præsentere erfaringerne herfra på kanten af hvad jeg ved i dag om at designe for social interaktion i form af udfoldede begreber og *design sensibiliteter*. Disse begreber omhandler:

- Udviklingen af et begrebsapparat til at beskrive de *niveauer af social interaktion* der designes til.
- Flytte designfokus fra de individuelle brugere til den sociale sammenhæng i sig selv – *den kollektive bruger*
- Diskutere *facilitering som et grundindstilling for designere* i forhold til at designe for social interaktion og til at udvikle innovative platforme for kollektiv handling.

Del III konkluderer efterfølgende på disse refleksioner og diskuterer projektets anvendte forskningsmetode og -resultater. Dermed præsenterer dette ph.d.-projekt mindst tre forskellige former for videnskabelige bidrag: For det første de designprojekter og prototyper der er udviklet, demonstreret og præsenteret i de brugssammenhænge de er udviklet til og på forskningskonferencer og seminarer; dernæst de *peer-reviewed* forskningsartikler der er blevet accepteret og præsenteret på internationale konferencer og beskriver disse projekter og reflekterer på de udviklede designs; og endeligt den udfoldende og sammenfattende refleksion præsenteret i denne afhandling, der binder projekterne sammen omkring emnet *design for social interaktion.*

Metode

Det fjerde mulige videnskabelige bidrag, der er udviklet i løbet af færdiggørelsen af denne afhandling, er diskussionen af fundamentet og ideen bag designforskning – baseret på erfaringerne fra dette projekt og dets tilgang til forskning – *forskning-gennem-design*. Denne diskussion forsøger at koble designforskningen til en bredere videnskabsteoretisk diskussion, i forhold til den bagvedliggende bevæggrund for eksperimentel design forskning.

Forskning-gennem-design betyder at udforske et genstandsfelt gennem anvendelsen af kreative designmetoder og en eksperimentel tilgangsvinkel til dette genstandsfelt, for derved at indhente viden – og, i lige så høj grad, for at undersøge mulige fremtider og potentialer for dette felt. Designforskning i denne form beskriver derved ikke kun hvordan verden er og har været, men undersøger hvordan verden kan blive.

Acknowledgements

The process that is culminating with this dissertation is far from an individual accomplishment. I have been part of many different social gatherings that have inspired, pushed and refined the reflections that are presented here, and in all the practical design experiments I have only participated in a larger group effort to design, build and implement ideas into reality. I will thank all these people for contributing to the existence of the book in front of you.

First and foremost I want to thank my friend, colleague and wingman through the entire process. Andreas Lykke-Olesen has been an invaluable part of conducting and concluding this project, and in making sure it was fun too.

Also the rest of my colleagues at Center for Interactive Spaces have contributed to this work immensely. All projects that I have been part of have been approached collaboratively and head-on in good spirit. Eva Eriksson, Martin Brynskov, Marianne Graves Petersen, Jesper Nielsen, Peter Gall Krogh, Kaspar Rosengreen Nielsen and the rest of the team – thank you. And this goes for my advisors Kaj Grønbæk and Jørgen Rasmussen as well. I have been fortunate to be able to conduct this project within a frame – the Department of Design and the Center for Interactive Spaces – that has been loose and uncharted enough for crazy ideas to emerge and be pursued, and tight enough to make good inquiries into these ideas and to reach to the finish line.

Mark D. Gross and Jodi Forlizzi from Carnegie Mellon University helped me too by giving me another perspective on this project and research field, by welcoming me into their work in the spring of 2006. And then there are all the people we called users and participants through all the design projects – they have all contributed to the ideas that I now present in the following pages.

Then I also want to thank my good friends Finn Voldtofte and Tina Ranløv for holding a high perspective and helping me to do the same. The entire Collective Intelligence Practitioners Initiative and the life-work community (virkefællesskab) are included in that thought. Likewise are the good people from Moving the Edge. You have all inspired me to believe and insist on the sanity and necessity of this project.

My family has also been of great help in this process and most importantly Lotte Kofod Erichsen who has been a tremendous support through most of this long process. Thank you.

Many more have influenced and inspired me along the way to this point, and I thank you all.

I am excited to see what the next steps are going to be. The future in front of us is going to be the most interesting thing I have ever embarked into.

Love
Martin Ludvigsen, Århus December 2006

Table of Content

Structure of the Thesis

This dissertation is the tangible outcome of the three year doctoral project I complete by handing in and defending the dissertation. The format of the dissertation is that of a summary and reporting on the work I have done and published in the last three years, and as such it binds the published work and project work together with a theoretical and discussing layer that reaches beyond what has previous been said, written and published from this project.

The dissertation is divided into four parts. Part I is the introductory chapters needed for positioning the work in its research context: general introduction, applied research methods and experimental design cases used in the project. Part II is the discussion based on the design cases. Here they are related to other similar discussions and the potential and limitations to designing social spaces with interactive technologies are unpacked and conceptual understandings of these are developed. Part III is devoted to a meta-reflection on design research itself, based on these last three years of experience with the field as a multidisciplinary field of several interests. Part IV is a selection of the central papers I have been part of publishing during the project.

Part I

Chapter 1: Introduction: Introduces the work and positions it into the field of design research and relates in to similar efforts within the larger scientific field of Human Computer Interaction (HCI), as well as introducing the context that this work has been carried out in at the Interactive Spaces Research Centre.

Chapter 2: Research Approach: Describes the methods I have applied in the project and how several methods have contributed to the overall research-through-design approach.

Chapter 3: Experimental Design Cases: Introduces to the experimental design cases that are used as the base for reflections. These are also described in the papers of Part IV, but in this chapter the technical and practical descriptions are distilled out from the following reflections in the dissertation in order to have these stand out as clear as possible.

Part II

Chapter 4: Levels of Social Interaction: Describes and discusses the first part of the conceptual understanding of the potential design space when designing for social interaction. The definition and discussion of these concepts are based on

the installation of the iFloor prototype in use context and on the theoretical foundation of Erwin Goffmans sociology of public life.

Chapter 5: The Collective User: Introduces the expansion of the concept of the user where the user is not only an individual participating in social interaction, but the user is the collective. Potentials and relevance of this proposal is discussed mainly on the background of the iHome project.

Chapter 6: Platforming: Discusses how designers can approach the design of social interaction as a facilitation of emergent social behavior. The chapter revolves around designers' limitations towards defining actual social interaction as it will take place in actual future use.

Part III

Chapter 7: Reflections on Design Research: Presents a discussion in a philosophy of science discussion on defining design research, and specifically research-through-design. This approach towards the evolution of knowledge and human potential is discussed in a view of design and science from the Enlightenment to today.

Chapter 8: Conclusions: Frames the proposed concepts as contributions to the design thinking when engaging and designing for social interaction. Future work and further challenges are discussed and proposals for emergent research questions are presented.

Part IV

Part IV consists of 7 selected papers from the last three years of research. All have been peer-reviewed and presented at international HCI and interaction design conferences. References to these papers in Parts I-III are marked with square brackets i.e. "[…]" and the publication details are provided before each paper and in the beginning of Part IV. The papers are not presented in original layout but formatted to fit the overall layout of this dissertation. In chronological order:

Paper 1: *From Bovine Hordes to Urban Players*, MUM2003: This paper reports on design concepts developed at the 2nd Convivio Workshop in Rome in the summer of 2003. We address the issue of social interaction from a perspective of power relationships between tourists and inhabitants of the Eternal City. As technology enhances the individual user's abilities and independence it removes him or her from engaging in social context. Our design proposals counter this trend by proposing services that positions the tourist in the local social context depending on interaction with local people.

- Galloway, A., Ludvigsen, M., Sundholm, H., Munro, A.. From Bovine Horde to Urban Players: Multidisciplinary Interaction Design for Alternative City Tourisms. Workshop paper for Designing for *Ubicomp in the Wild Workshop at MUM 2003*. Norrköping, Sweden, 2003

Paper 2: *Help Me Pull That Cursor*, OZCHI2004: Describes the design and implementation of the iFloor into the context of the Main Library of Aarhus. The overall findings from the user observations are outlined and several implications for design perspectives are addressed with focus on both social and spatial interaction as well as the design process.

- Krogh, P.G., Ludvigsen M., Lykke-Olesen, A.: Help me pull that cursor: An Interactive Floor Supporting Community Interaction. *In Proceedings for OZCHI2004*, Wollongong, Australia, 2004 - (Best Paper Award)

Paper 3: *iHome Values*, ECCE: Reporting on the user studies performed within the iHome project, this paper outlines how we found and defined the basic challenges that the iHome project was to investigate. We conducted a range of interviews and visits to homes and different kinds of families, and found a variety of issues and ways to balance and negotiate media use at home.
- Petersen, M. G., Ludvigsen, M., Jensen, H. F., and Thomsen, A.: Embracing Values in Designing Domestic Technologies. *In proceeding for European Conference on Cognitive Ergonomics 12*, ECCE12, York, UK, 2004

Paper 4: *Aesthetic Interaction,* DIS 2004: In this paper we introduce the notion of aesthetic interaction as seen through the theoretical framework of pragmatist's aesthetic as developed by John Dewey and Richard Shusterman. The idea of an engaged aesthetic experience is related to interaction design and we point to areas of focus for future interactive design.
- Petersen, M.G., Iversen, O., Krogh, P., Ludvigsen, M., Aesthetic Interaction - A pragmatists aesthetics of interactive systems, (2004). *In proceedings of ACM DIS2004*, Cambridge, MA, USA, 2004

Paper 5: *Designing for Social Use in Public Places,* DPPI05: In this paper I outline the conceptual framework for understanding levels of social interaction in public space. Based on the implementation of the iFloor prototype I develop these concepts with heavy inspiration from Erwin Goffman's sociology of behavior in public spaces. This discussion is unfolded in chapter 4.
- Ludvigsen, M., Designing for Social Use in Public Places – a Conceptual Framework of Social Interaction: *Proceedings of Designing Pleasuable Products and Interfaces, DPPI 05*, Pp 389-408. Eindhoven, The Netherlands, 2005

Paper 6: *Floor Interaction*, CHI05: This short paper presents and discusses the use of horizontal spaces and floors as interaction surfaces. We compare this to architectural uses of floors and the social affordances of plazas and urban spaces, based on three examples of interactive designs from the research centre.
- P. G. Krogh, M. Ludvigsen, A. Lykke-Olesen, M. G. Petersen.: Floor Interaction: HCI Reaching New Ground, *Proceedings of CHI05*, Pp 1717 – 1720. Portland USA, 2005

Paper 7: *Mock Games,* DIS 2006**:** Here we report on the Nomadic Play project and its theoretical underpinnings as well as the preliminary user involvements. Based on these we present a new genre of pervasive play where the boundaries between fixed rules and negotiated social practices are opened and the game then becomes a socially negotiation. Finally we present the DARE! game design, where users themselves construct dares and challenges each other, using mobile phones as the technical platform.
- Brynskov, M. & Ludvigsen, M. (2006). Mock Games: A New Genre of Pervasive Play, *Proceedings of Designing Interactive Systems 2006* (DIS 2006), June 25-28, 2006, State College, PA, USA, pp. 169-178.

Other published and peer-reviewed work

Then there is a range of publications that I have not included in this dissertation, as they are not essential to the overall argument. They are however still peer-reviewed and presented at conferences in the international research community, and as such they are part of and contribute to the overall academic achievements in the course of the PhD-project

Paper 8: *Playful Interaction,* Appliance Design 2003: This short paper reported on the vision video prototype entitled 'playful interaction' and the ideas behind it and its role in the interdisciplinary research project WorkSPACE.

- Mette Agger, Peter Krogh, Martin Ludvigsen; Playful Interaction; *First international Appliance Design Conference; proceedings* p. 119-121; Bristol, UK, 2003

Paper 9: *Designing between Public and Private Space*, Disappearing Computer Workshop 2003: In the Disappearing Computer Programme under the European Union several workshops were conducted bringing researchers together from the 12 projects, discussing areas of shared interest. Here the goal was to go deeper into a discussion of privacy and UbiComp.

- Ludvigsen, M., Designing between Public and Private Space; position paper for DC workshop on Public and Personal Artefacts in Ubiquitous Computing Environments; Hirschhorn, Germany, 2003.

Paper 10: *How to Address the Aesthetics of Interaction*, NIRES7: This research school was on exploring how aesthetics can be addressed in the interdisciplinary context of interaction design. For one week international participants – mainly PhD-students – were designing in groups and attending lectures.

- Ludvigsen, M., On How to Address the Aesthetics of Interaction and Why I Believe it is Important to Do So, position paper for NIRES7, Århus, Denmark, 2003.

Paper 11: *Mission from Mars*, IDC 2005: I briefly collaborated in the iSchool project in creating and holding a workshop with children in 7th grade. The focus was on understanding how the pupils used their school-bags in relation to their lives with school mates, the class-room and the schedule on a school-day. We established a shared narrative to build a kind of confidential space for these conversations.

- Dindler, C., Eriksson, E., Iversen, O.S., Ludvigsen, M., Lykke-Olesen, A.: Mission from Mars - A Method for Exploring User Requirements for Children in a Narrative Space. Presented at IDC 2005 on June 8 - 10 Boulder, Colorado, USA, 2005

Paper 12: *Help Me Pull That Cursor,* The Australasian Journal of Information Systems: A journal version reprint of the paper presented at OZCHI with the same name. [paper 2]

- Krogh, P.G., Ludvigsen,M., Lykke-Olesen, A.: Help me pull that cursor. in *The Australasian Journal of Information Systems*, Sydney, 2005

Paper 13: *Designing for Nomadic Play,* IDC2005: This poster presented user studies conducted in the preliminary work in the Nomadic Play project. We interviewed children from kindergarten age to 9th graders, to hear and see how they used digital technologies in their everyday, to how they played and constructed social situations. We finally involved groups of kids in designing proposals for technologies through participatory design processes.
- Brynskov, M., Christensen, B.G., Ludvigsen, M., Collins, A.-M., Grønbæk, K. (2005). Designing for Nomadic Play: A case study of participatory design with children, poster presented at ACM Interaction Design and Children 2005, Boulder, CO, June 8-10.

Paper 14: *Bthere or be Square*, Wonderground 2006: A group of colleagues and I held a workshop in Göteborg, where we engaged a group of architectural students in exploring hidden layers of a particular urban space. The work was collected on a shared map in the central square and was thus open to comments from passer-bys. The layers focused on included advertising, digital hertzian space, social spaces etc.
- Eriksson, E., Ludvigsen, M., Lykke-Olesen, A. Nielsen, R., Bthere or be Square: A Method for Extreme Contextualization of Design. *Presented at Wonderground – Design Society's international conference*, November 1-4, 2006, Lisboa, Portugal.

Paper 15: *Design Research in Conflict With HCI*, Danish HCI-Research Symposium 2006: This position paper addresses the current situation of design and design research as participant in the research field of HCI. This discussion is unfolded to a much higher degree in chapter 7 of this dissertation.
- Martin Ludvigsen, Design Research in Conflict With HCI. In *Proceedings for Danish HCI-Research Symposium 2006*, November 15th, Århus, Denmark

Part I - Chapter 1

Introduction

In this chapter I will address issues that link the motivations for this project with the technological trend of ubiquitous computing and the notions of interactive space, social computing and interaction design, as these are all fundamental concepts for the framing and positioning of this dissertation. After that I will give a brief overview of the collaborative context of the research work and the content and argument of the dissertation.

1 Social technologies

Most technologies have a social impact when they are put into actual use, enabling certain forms of interactions and potentially disabling other forms. Computational technologies are defining a range of interactions today both on-line and in physical space. Bill Mitchell, dean of MIT's School of Architecture sees this as a question of how we choose to live in the world and how we then design this world by mixing code and physicality:

> Where will we get together? What sort of places, forums and markets will emerge in the electronically mediated world? What will be the twenty-first-century equivalent of the gathering at the well, the water cooler, the Greek agora, the Roman forum, the village green, the town square, Main Street, and the mall? […] For us equipping a place with its genius [loci] has simply become a software implementation task … By virtue of the rules it encodes, it can facilitate some activities and discourage others. It can even enforce ethical and legal norms. Code is character. Code is the law.
>
> (Mitchell 1999) p.85, p. 50

To me, this points to the immense design challenge it is to reposition social space in the technological evolution of today and tomorrow. As the frame of future social interaction is defined through design processes, we need to be sensitive and clear about this as a daunting potential, and address it consciously in design of future spaces and artifacts.

1.1 Motivation

As society moves towards being more and more individualized in the hands of the empowered single user, designing for the "social creature" (Erickson and Kellogg 2003) is a renewed focus on the role and potential of technology, products and systems. In John Thackara's *10 Power Laws* he states it directly and pragmatically "Power Law 1) don't think "new product" – think social value" – and – "Power Law 2) Think social value before tech" (Thackara 2006). The social context is crucial to the success of a product in the market place to such an extent that Thackara, taking a proactive position towards the role of the designer, flips the design space and argues for a focus on the social value and relevance of a design before any consideration on the physical form, style and technology of the product. The social becomes the primary reason for the product. However, Gaver states that "designing new technologies often requires speculation of their social effects, a form of social theorizing that is often naïve when actual events run contrary to expectation" (Gaver 1996) and projecting these two statements onto Hallnäs and Redström's definition of interaction design as "designing the acts that define intended use" (Hallnäs and Redström 2006) this argues for an actual need for addressing, translating and relating social understandings to interaction design – in the language of design, intended for the broad design community as well as the design research community.

The social use and context of an artifact can determine a product's[1] success as a meaningful object of use. Several products in today's marketplace can be viewed in this perspective; from the omnipresent iPod to mobile phones and web-based applications for both mobile and desk-top internet usage. For more in-depth excavation of these subjects there have been several books published in the last few years e.g. (Mitchell 1999; Rheingold 2002; Thackara 2005) these however are broad descriptions, discussions and trend analyses of society as a whole. In this dissertation I try to go a little deeper into a much smaller problem, namely how to design for social interaction in this world where technology is able to frame our lives, and as such I have less discussion of society and more focus on practical tools for thought and action in design.

Plenty of research and commercial products are already today focusing attention on social mechanisms and developing web- and screen-based designs for enabling social interaction and utilizing social mechanisms in tagging, linking etc. But the physical aspect of human sociality is not yet fully explored even if we have been fine-tuning these abilities in millennia. Desktop and laptop computers present in most workplaces and homes are inherently single-user interfaces and might connect single users across the globe, but they are unfittingly designed for the sensitive and complex social situations of physical and co-located social interaction.

A preliminary and foundational hypothesis of this PhD project is that the single-user interface of the personal computer is enabling the protrusion of the ego and disabling collective aspects of human beings. The more time we spend with computers

[1] A product is defined here in an as wide as possible understanding beyond a physical object: A product is that which one person is willing to pay for in money, attention, participation or otherwise in order for another person to make this product available. The willingness is due to the fact that what is offered is meaningful to the buyer in the context of his or her current or future life. A product is then the pivot of a meaningful interaction.

designed like this, the more focus we give to ourselves and our individual position in life. We are stressed and time-warped by this increased focus, and this is not due to computers as technology but of how this technology is designed. Therefore it is a problem that needs to be addressed in interaction design. My personal standpoint, and part of this preliminary hypothesis, is that human beings grow, evolve and learn from each other – in interaction. When computers connect people through a world wide chaotic, anarchistic web of discussions, businesses, ideas and everything else, this is a fantastically mind-blowing potential in our world. But perhaps we are leaving the physical social human being behind in our fascination of the wonder of the web. Computers as a basic technology are becoming ubiquitously present and emphasizing and reintroducing the physically embodied social and collective user into this design effort, is the mission of this project. The vision is of a world where collective intelligence (Pór 1995; Malone 2006) is supporting evolution through better designed platforms for social interaction and collective action.

1.2 Ubiquitous computing as interactive spaces

The notion of Interactive Spaces is a derivation of the vision of ubiquitous computing. This is a technological trend that evolved from the beginning of the 90's and is usually credited as first proposed by Mark Weiser (1991) and fellow researchers from the XeroxPARC research lab. The vision of ubiquitous computing is a world where computation is present in basically any mundane everyday artifact, in order for computational functionalities to be as present and efficiently helpful as possible in the everyday life of ordinary people. As developed at XeroxPARC, these visions were mainly devoted to the sphere of work-related use of computing, but they also address how work-life and personal life could interweave in future scenarios. Researchers developed working prototypes of different sized computational devices that would be able to fit into the process of work like any other physical artifact. Ranging in size from the smallest palm-sized tabs, the slate-sized pads to the big-screen boards, the group held that these devices would be spread around the office environment connected to a network and thus provide extended hyperlinked functionalities wherever, whenever. Pads would lie around in piles like paper and folders, and boards would be found in every office replacing white-boards. The technology, or rather its functionality and the abilities it would present, would be ubiquitously present as an integral aspect of how we perceived the world (Dourish 2001).

1.2.1 UbiComp and the ubiquitous 80's

Ubiquitous computing has been a powerful vision. In the last fifteen years the scientific and industrial development in this direction has been steadily increasing. In a historical perspective on computation and interaction ubiquitous computing presented an alternative to the mainstream development of computational technology in the time it was conceived, and not only that, it was part of a conceptual breakthrough in the relationship between technology and the people using technology.

A few years earlier than Mark Weiser and colleagues were coining ubiquitous computing, participatory design was moving into a wider audience and was explored by not only Scandinavian computer scientists but moving beyond Scandinavian context to e.g. the US. At the same time in the US Donald Schön published his book "the reflective practitioner" (Schön 1983) about how professionals think in the context

of their practice, colleagues and the materials they engage with. Lucy Suchman published her "Plans and Situated Action" in 1987; a book dealing with some of the same issues but more closely related to the use of computers or human-machine communication. Probably most influential Terry Winograd and Fernando Flores's book 'Understanding Computers and Cognition' (Winograd and Flores 1986) is from these years where this major change was brought to the public's eyes and formulated into the theoretical foundations of several research fields. Although not in a coherent theory, but in various sub-fields dispersed throughout the Human-Computer Interaction (HCI) research field, it is interesting that these changes in perception were expressed almost coinciding.

Olav Bertelsen has summarized it as a development from a *pre-HCI* understanding where the human user had to adapt to the machine in e.g. factories and airplanes, *first generation HCI* where "the focus was on the perception and cognition of the individual user in isolated interplay with the user interface; the aim was to minimize the cognitive load on the user by optimizing the interface to best fit the general human" (Bertelsen 2006). *Second generation HCI* then is the move from the isolated and generalizable user to use in context by skilled people: "On this background the tool perspective evolved, emphasizing that the user was not an attachment to the computer-based system" (ibid.) Bertelsen further argues that in all these turning-point publications the shared foundation of the new ideas was a critique of the Artificial Intelligence movement dominating at this time.

Another way to look at it is through which visions for the future were dominating the development of technology. In the beginning of the 1980's virtual reality was the dominating technological vision as reported by Paul Dourish (Dourish 2001). The computer had become so powerful that it was able to simulate (in vision, not reality yet) the full sensorial input that the user would need to move around an artificial world and act using his or her full body potential in the virtual environment. The vision of virtual reality was that people would be able to meet in this almost unnoticeably different world free from physical constrains like gravity, geographical distances and any of the laws of nature if they so desired. The computer would, as has also been the case in many of the visions that came after virtual reality, become invisible to the person using it as he or she is completely immersed into the experience the computer presents. The immersing was achieved by interfacing as closely to the body's sensorial apparatus as possible; goggles over the eyes, gloves on the hands and full-body suits. But the limits to this modeled world became apparent as the optimal model of the world would have to be the world itself and limitations of computational power denied this to become true (Lanier 2004).

Virtual reality as a vision was technology as the ultimate container of everything and thus everything was subordinate to technology. With the acknowledgement of the physical reality as the place where interaction takes place, and computation simply being a part of this context, computers had to be designed in relation to the users and the context they were inserted into. Thus this new perspective on computing brought an increased attention to interaction, and designing contextually meaningful human-computer interaction.

This is surely a crude sectioning of history of computation and interaction, but for the argument that I wish to wield here it suffices to make this distinction of before and

after computers were seen as being *in* spatial and social context. The evolution of computational technology beyond the desktop and this focus on social and spatial context and physical, embodied interaction is the reason interaction design has evolved as a relevant part of this exploration, and as a research field of its own. Design needs context, context needs design.

Today at least four different labels are used to describe this new trend: Ubiquitous computing, pervasive computing, augmented reality and ambient intelligence have overlapping although not identical meanings. Ubiquitous computing is mostly focused on bringing units with computational capabilities into the every corner of everyday and work-life. Stemming from this pervasive computing has a slightly more environmental focus, although the difference is hardly noticeable at times. Augmented reality is focused on overlaying the physical reality with digital information and linking e.g. digital information to objects with various tags (Mackay 1998; Grønbæk, Kristensen et al. 2003) or making a visual overlay onto the world as seen through goggles e.g. (Mann 1996). Ambient intelligence is some of these ideas taken a bit further to where these computational objects are not only interconnected but also adaptive and responsive in a proactive way, presuming use situations and adapting to contextualized use (Aarts and Marzano 2003). This is done to let the computer sort and simplify the information and interaction overload of a ubiquitous computing environment. All four are focused on bringing physical and embodied qualities of the users and context in play in interacting with computational artifacts and applications.

1.2.2 Spatial perspective

At the Center for Interactive Spaces we work by the notion that the context of the technology and the people around it can be regarded as a space of interaction. This is to some extend similar to Embodied Interaction (Dourish 2001), but where Dourish takes a strong emphasis on the user and his or her internal experiences and relation to technology, the spatial perspective is based more on the types of affordances that is presented to users as several technologies are connected and co-located in the same physical space, enabling new forms of use to emerge. Space is then the container of interaction as well as the technology, and it is the constellations of these technologies that will bring forth new forms of use.

Mark Weiser states: "The hundreds of processors and displays are not a "user interface" like a mouse and windows, just a pleasant and effective "place" to get things done"(Weiser 1991). As he points to these technologies as such an integral part of peoples everyday lives that they are unnoticed in their technological form, he also point towards how the machine becomes the context of use, merging with inhabited space. The user uses a computational functionality, but not a computer as such. The user engages his technologies in collections of functionalities and appropriates them as places as he or she ascribes meaning to them. Following Harrison and Dourish (1996) the space is what the designer constructs and the place is then what it becomes after the users have started using it, and vitalized it with meaning in actual living context.

> In such a world, we must dwell with computers, not just interact with them. Interacting with something keeps it distant and foreign. If you are only interacting with your spouse the relationship may be in trouble. We dwell

> with nature, and roommates, and anything that we let enter us, and we it. Dwelling with computers means that they have their place, and we ours, and we co-exist comfortably. Unfortunately, our existing metaphors for computers (and nature, for that matter) are inadequate to describe the "dwelling" relationship. And no metaphor is more misleading than "smart".
>
> (Weiser 1996)

Central to design efforts in Interactive Spaces is the belief that the user is the smartest and most intelligent participant in this interactive space. We design for inhabited use and we explore how computational capabilities can be related to and accessed by the users in context. This is done through a range of perspectives engaged from both technical and design-oriented disciplines (InteractiveSpaces 2004).

1.2.3 Interaction design

From the perspective of the design field, this spatial approach is the combination of what Buchanan describe as the two new fields of design dealing with designing actions and environments (Buchanan 2001). As design is engaged in these explorations in collaboration with other disciplinary stances that are participating in Interactive Spaces' projects, the collaborative effort of making the new is centered on the creation of technical prototypes and installations informing each discipline's perspective. The word interaction stems from, as Buchanan says

> We call this domain "interaction design" because we are focusing on how human beings relate to other human beings through the mediating influence of products. And the products are more than physical objects. They are experiences or activities or services, all of which are integrated into a new understanding of what a product is or could be.
>
> (ibid.)

In collaboration with Hallnäs and Redström's definition that "interaction design is designing the acts that define intended use" (Hallnäs and Redström 2006) we here find the core of what it means to design interaction. Designing the products or artifacts that will have this mediating effect on people in the interactive spaces is the challenge, and the product is the prototype and the boundary object (Star and Griesemer 1989) for the collaborative efforts. In this sense, the 'interaction' in interaction design can also address the fact that the development of these designs is best undertaken in teams where interaction between disciplinary stances is foregrounded as a way of expanding thinking about the subject matter.

I believe that the interaction designers' approach in this scientific field of research is somewhat different from that of our collaborating partners in HCI, which I will discuss in the chapter following this introduction. As a research discipline design has a different starting point and different approaches than the disciplines dominating HCI, but these differences live in coherence in the field as I see it, with tendencies to conflict but not in such a way that co-existence is impossible. I further argue that a stronger formulation of design as a research discipline in its own right can strengthen our standing in HCI research, and this would not only benefit design research, but the HCI community as a whole. Thus chapter 2 is a description of the particular applied methods of this project, and chapter 7 is a discussion of the scientific perspective on

design research in general with a particular focus on research-through-design methodology, based on the project-work at hand.

1.3 Design for social interaction

Under the headline "the ubiquity of the social" Erickson and Kellogg states that "As humans, we are fundamentally social creatures" (Erickson and Kellogg 2003). The issue of social use of computational technology has been approached in HCI for a number of years. With the advent of ubiquitous computing and interaction design the issues of designing technology that empowers social spaces is becoming increasingly important. As Mark Weiser says: "by pushing computers into the background, embodied virtuality will make individuals more aware of the people on the other ends of their links (…) Ubiquitous computing (…) reside in the human world and pose no barrier to personal interactions" – and – "This development carries the potential to reverse the unhealthy centripetal forces that conventional personal computers have introduced into life and the workplace" (Weiser 1991). And much has happened since Mark Weiser first envisioned the social potentials of ubiquitous computing, but at a general level we need to develop further understandings of this social potential as new application areas appear, and as computational technologies disperse into every corner of our everyday lives. This is not merely limited to computers and computational systems development, but to product design in general as technological convergence merges the two into an inseparable whole.

1.4 Designing for social interaction in HCI

Zooming in on the context of interaction design as taking place within or in parallel to HCI, several different approaches is already engaged in this establishing of design knowledge about the social behavior of users, in order to, ultimately, create better designs. In HCI as broadly defined as possible – the relationship between humans and their technologies present and future – there is already a range of concepts in use about social interaction. Several research fields look into aspects of social interaction within defined domains such as work related in CSCW and social computing in relation to internet technologies.

1.4.1 Hypermedia and social interaction

From the inception of hypermedia and hypertext technologies the idea has been to augment the human capacity to overcome and overlook large amounts of data. By linking individual documents and other types of data, the workflow in using the data can be enhanced. Douglas Engelbart, who is often looked at as the inventor of hypermedia, describes the impact of hypermedia as "augmenting the human intellect and boosting our collective IQ" (Engelbart 1995). The notion of collectivity in our interactions with and in relation to computational technology is also discussed in this dissertation, but the technological focus on augmented documents and physical context is not engaged, although work in this field has been undertaken at the centre (Grønbæk, Kristensen et al. 2003; Hansen, Bouvin et al. 2004; Grønbæk 2006; Hansen 2006). Social hypermedia on the World Wide Web is in almost exponential growth right now and, when looking more towards the social implications and less towards the technical, is often referred to as social computing.

1.4.2 Social computing

The concept of social computing, although it could conceptually encompass everything regarding computers and social activity, most often refers to being social on the internet and in distributed net-based applications, like games, instant messaging (IM), chat-rooms and corporate net-meeting-spaces and of course blogging and image- and video sharing.

The connectivity of the internet enables potentially enormous social gatherings to take place. We already see this in Massive Multi-user Online Games (MMOGs) such as World-of-Warcraft (Blizzard 2006), Everquest (SOE 2006) and Eve Online (CCP 2006) to mention some of the most successful examples. This is not only a *very* big business (Times-Online 2006) but also an emerging form of socializing that creates new forms of social behavior. As such it is subject to a lot of research, from sociological and design-oriented perspectives. Parallel to this trend there is also the social structuring of information following introductions of Web 2.0, or semantic web, technologies (Wikipedia 2006b), most notably 'blogging' or posting personal and professional information on web-sites or blogs (weblogs). Blogs are used to post different forms of information, as have been done with web-pages since the inception of World Wide Web, but the difference is in the continually updating of the pages, often readable through RSS-feeds, which connect people of overlapping interests and evolves sub-cultures of web-pages, or rather the bloggers behind them and the people that read them. Web 2.0 denotes a range of technologies that are used in the 'blogosphere' (Wikipedia 2006) to interconnect blogs and make the content available for use for posting on connected web-pages. Similar to the emergence of the blogosphere we see a range of web-based applications like IM's, voice-over-IP telephones services, chat spaces and others using the web to connect across geographical distances.

Social navigation

The concept of social navigation has been introduced as a form of the social filtering as web 2.0 is instigating (Dieberger, Dourish et al. 2000). Social navigation is an augmentation of the web-browser or web-page where each individual page presents to the user how many people have gone where i.e. which links on the pages has been clicked the most. The metaphor behind this idea is that of the urban environment where one is able to navigate through the city and find the most interesting places by looking for where other people have gathered. For example even in a completely unfamiliar city, one can tell through these social markers that if a restaurant has only a handful of guests at a Friday evening, then the filled restaurant two blocks from there probably serves better food and is worth the wait. Users of the website or database then leave hints by their behavior in the context, and the application builds a memory of recommendations at a very low level, somewhat similar to traces left from extend use of a physical object.

Social translucence

Social translucence is a term developed by Thomas Erickson and Wendy A. Kellogg from IBM's social computing group e.g. (Erickson and Kellogg 2003). As was the case with social navigation social translucence seeks to translate aspects of our embodied relation to the familiar physical world and how we relate socially to each other in this physicality, into a networked application. There have been developed many different

forms of social software like virtual reality meeting rooms and chat-spaces where the idea has been to make a believable translation of social cues in order to have social interaction take place as transparently as possible. Although Erickson et al. sees that this translation will never be fine grained enough to fool our finely tuned social abilities they still aim for communicating social cues over the net. Thus they use minimalist visualizations, "social proxies", to represent online presence in meetings and work groups in distributed work environments. The social proxies are then visible to all participants in the group and, especially if it is in a work group working together over a longer period of time, the view of the web-presence of colleagues can support collective interaction and self-organizing, which of course is important in distributed work groups.

1.4.3 Computer supported collaborative work

Computer supported collaborative work (CSCW) was coined in the beginning of the 80's. The focus of this field is to develop software and hardware that will enhance efficiency, productivity, connectedness and knowledge sharing in work settings. Early on the focus in the field was extended beyond the computer and computer's interface in itself to a broader outlook on the entire office setting (Grudin 1990; Crabtree 2003). The cooperative or collaborative aspect of CSCW puts a natural focus on the social interaction of colleagues in structuring and performing work. Several models have been developed for understanding these social relations, their relation to computer technology and the potential in design of such computer systems. Framed within the work setting where efficiency, performance and completion of tasks are primary, they are hard to redefine to a non-work context. However, some of the basic understandings of how people behave and construct their everyday activities are still relevant when designing for social interaction outside the work-sphere.

At the same time these differences in the subject matters of CSCW and the types social contexts that this project is dealing with, makes it relevant to explore and describe new conceptual frameworks for interaction design research as opposed to system development research. Of course we should look towards this existing body of knowledge to find inspiration and concepts that are relevant, but at the same time we must be sensitive in handling this knowledge and how it applies to other contexts like 'play', 'leisure' or 'experience'. Computer Supported Cooperative Play (CSCP) as defined by Ishii (Ishii, Wisneski et al. 1999) had, based on these founders' research interests, an inherent focus on tangible interfaces for play in physical environments. The relation to CSCW resides in the fact that the types of activities that are supported are sports and games known from children's play like ping-pong – co-located and competitive and/or collaborative, and as such reminiscent of the contextualization of office and work activities. However an extensive theoretical background similar to that of CSCW is not present in CSCP before later examples (see e.g. [paper 7] for an overview of these) where theories of play are actively used to enhance understandings of the designed artifacts. In several of these examples the focus is widened from tangible user interfaces (TUIs) to the physical and social context; co-located as well as geographically distributed, connected through various network technologies.

CSCW in general has been, in my opinion, dominated by evaluationists and computer systems developers, psychologists and computer scientists. The interaction design perspective as a creative disciplinary perspective has not been foregrounded in much

of the theoretical and scientific discussion in the field, and as such I have not taken a starting point in CSCW in my inquiry in the project. Explorations in CSCW have decidedly informed much of the theoretical background in this project, and as work and leisure merges closer, the distinctions might become unimportant. However, I still hold that when looking at contexts where there are no efficiency motivator and task that necessarily needs to be performed, we are dealing with users in a completely different mindset than that of a work-setting.

1.5 Research context

The challenge in this project has been to gain experiences from and reflect upon creating social spaces, by taking part in creating novel technological installations and applications. These reflections are here collected into a dissertation that will hopefully inspire and enhance designers' knowledge of social spaces and enable them with a wider and more solid repertoire of actions in future design situation. The research has been conducted in projects with certain limitations and preliminary definitions of the design spaces approached, and the funding for the centre and collaborative industrial partners have all contributed to this refinement of each application area.

1.5.1 Design-oriented and technology based

The work in this dissertation is directly focused on bringing new knowledge about how we design for social interaction within the field of interaction design as seen as a creative design field following Buchanan's separations of the design field (Buchanan 2001). Interaction design is here defined as part of the new revolution in design, where the older parts of the design discipline have dealt with 'symbols' and 'things' in graphic and industrial design respectively. Interaction and environmental design are now directing design towards actions and spaces, thus framing human activity over time. There are several different views on what interaction design is and in which discipline it is embedded – is it a technical engineering discipline or a creative, aesthetically founded design discipline? Following Buchanan's distinctions I support the latter standpoint, and the contributions of the research work at hand should be read in this context of interaction design research.

The Centre for Interactive Spaces is a multidisciplinary research group based on doing projects with industrial and commercial partners into the emerging technological field of ubiquitous or pervasive computing. At the centre we are a range of different disciplines from computer scientists, software engineers, media- and information scientists, to interaction design researchers like me. The collaborative nature of the projects in the centre affirms the multidisciplinary approach to the development of new technology with the field of HCI in general and ubiquitous computing environments specifically. The funding for Interactive Spaces has been directed towards technology development and industrial collaborative partners have engaged in projects with specific interest in gaining insights in technological potential of the domain areas of each project. Thus when Buchanan refers to services and experiences as potential products of interaction design (ibid.) we have limited ourselves to dealing within the domain of computational technologies. This focus is still very wide and has provided more than adequate material for explorations. But it is one of the framings of the design space in all projects we have engaged, and it means that in all projects a goal has been to create working prototypes and further develop these prototypes based on feedback from context.

Co-location has also been another starting point of the projects that I have been engaged in. We have looked at the social interaction potential from this point and subsequently related it to social interaction and communication over networked communication channels. As mentioned this resembles the outset of early days CSCW, but is the opposite approach from the standard web-based social computing perspective. Users are here still placed in front of monitors often by themselves, whereas we aim at designing technologies that engage users in the richness of physical social space.

Lastly the explorations through the projects in the centre have all been engaged with several perspectives in parallel. As Dourish (2001) explains social computing and tangible interaction is tightly interwoven through the perspective of embodiment. In accordance with this perspective e.g. social and spatial explorations have been engaged in parallel in the Centre, and even though we have not participated in exactly the same projects, the collaborative efforts of this PhD-project and that of Andreas Lykke-Olesen (2006) can be seen as a collective exploration of interaction design frameworks and potentials in dealing with digital interactive spaces.

1.6 Summary dissertation

As mentioned this dissertation is written to sum up on the work I have already done through the research project I have participated in. In summing up I will also recast some of the findings into a higher perspective of how to design for social interaction in interactive spaces.

1.6.1 Content

The dissertation is structured in four main parts. At the beginning are the introductory chapters that lead up the main reflections. First of these are of course this chapter, a report on the research methods I have applied in the project, and a chapter where I describe the experimental design cases that are used as background for reflections in the next part.

Following this, in Part II, three chapters are devoted to each of the aspects of "designing for social interaction" that I believe I am able to say something new and relevant about. These are first a description of the levels of social interaction usable when designing different kinds of social interaction for different purposes. Secondly I go into an expansion of the conceptual image of the user as an individual with an alternative perspective on designing for the collective user through e.g. forced collaboration. Thirdly follows a reflection on the limits to what the designer can do in defining the use of a social space. It is no surprise that such limits exists, but how can they be characterized and used fruitfully in the handing over of an interactive environment from the designers and developer to the actual users – from fictional to real use (Hallnäs and Redström 2006). These three chapters are reflections of the practical research-through-design work I have been involved in during the last three years, and the conclusion that follows will, as mentioned, sum up on the concepts used in the reflections.

However, before the concluding remarks of the dissertation, part III presents a chapter with an overall reflection on what design research then is, based on

experiences from the last three years of practical design research. Being part of this interdisciplinary research field of HCI and ubiquitous computing has led to a need to reflect on what design research is in this context and how can it be said to be a valid, scientific form of research on equal terms with the rest of these disciplines. Coming from a disciplinary background in architecture and design without a strong academic research tradition, I have found it necessary to develop a coherent reflection on what constitutes a designers modus of making a scientific work in research context. When I say that the tradition I come from has no real scientific tradition, I mean with regards to what I have found is called research-through-design, the design approach and thinking applied as a scientific modus operandi. In design there has for a long time been research into the processes and thinking of designers as seen from outside or the periphery of the discipline.

The fourth and last section of the dissertation is a selection of the articles I have written with colleagues and alone during the PhD-project. As each of my colleagues have different research foci, most of the published papers are describing research projects and prototypes from an overall view, and not necessarily going into depth with the issues of social interaction. This then points towards the overall purpose of the dissertation; to recap and relate this project work into a focused argument on designing for social interaction.

Part I - Chapter 2

Research Approach

2 Interaction design research

In the research field where we discuss and explore the relationship between humans and the technologies we create, there are several different paradigmatic perspectives at play. Basically there seems to be two axes of distinctions; one between the technological and the human centered approaches and one between the constructive and the analytical approaches. The first of these is about how the researchers think about the context, and the second is concerning what they do in the context. To some extend all of the disciplines participating in the field can be said to be design-oriented, since the overall aim of the field is to contribute to the development of better technologies.

Interaction design and interaction design research have developed over the last 10 years (Hallnäs and Redström 2006) in relation to HCI. Participants in interaction design come from a range of different disciplinary approaches to design and development of technologies, the creation and proposing of the new is what rests at the centre of the discipline. Following Hallnäs and Redström's and Buchanan's definitions of interaction design in section 1.2.3. this discipline can be said to reside in the constructive and human-centered ends of the axes.

As part of the general HCI research field interaction design research participates in the same endeavors as the rest of the field. In order to understand the potential of future technologies we build prototypes and make designs that will elicit new knowledge about these potentials. Where other types of research fundamental to HCI e.g. psychology or ethno-methodology engage in this shared overall focus in understanding the present as a resource for extending into the future potential, interaction design and e.g. experimental computer science has the focus directly on creation and exploring through testing of this future potential. This relationship between the two is best viewed as a productive, confronting and iterative cycle. As William Gaver states: "These [sociological] theories are often too simple, which means that the systems don't lead to the sorts of social interaction expected. This then leads both to a clarification of social behavior and a refinement of the systems – theory leads to design, which leads in turn to new theory" (Gaver 1996). Hallnäs and

Redström address the stance of interaction design as a scientific discipline by defining that

> Design research shows the possible in more or less systematic ways – in contrast to prove what is true or describe the actual." (…) "Through practice we expose basic questions related to the 'why' normally implicit in our foundations, thereby using design practice as a way to perform experiments to develop theory. [Furthermore, experiments suggest and] highlight hidden problems, forgotten issues, open up new perspectives, ask the new questions, define and present basic concepts.
>
> (Hallnäs and Redström 2006).

The difference between the different disciplines taking part in HCI might be subtle and since design as a concept is in constant flux as well as in confluence – merging from many disciplines, the role of interaction design research might become muddled. Where traditional science process has been of having knowledge or a hypothesis and then testing it to prove or falsify it, the creative stance of interaction design research explore through creation, which is a somewhat subjective practice that engages intangible and hardly definable potentiality (Stolterman 2005), and builds knowledge based on how these creations are received in context. Thus we might be looking at a different stance towards the basic scientific thinking through interaction design research. Generalizing knowledge from the single experiment towards the wide design community as well as the HCI community then needs to rely on a different form of falsification than what is normally construed as the basic truth in scientific studies, stemming from Karl Popper (1963). In (Latour 2004) Bruno Latour lays out an alternative range of falsification principles that is able to encompass the subjective stance of the design researcher, through a notion of questioning whether the researcher as well as the subject matter are interested in the study being conducted, meaning the researcher must abandon his objective position and acknowledge himself as part of the experiment. Interaction design research is in this sense a part of this new wave or shift in science.

In the following I describe how I have undertaken the project at hand and which scientific methodological framework this work is to be read in. Some of the concepts that I will use here are based on the extended philosophy-of-science discussion of design research that I have included in part III of the dissertation. This discussion has not been one of the formal parts of the research project, but as I come to the end of the project and have gained a few insights on the matter, I thought it would be interesting to relate the current project to these more philosophical discussions. The discussion states that there is nothing dubious per se about design research and that the mode of inquiry that I have applied in this project, namely research-through-design is a valid form of research. However for this chapter I will restrain the extended discussion and describe only the applied research methodology I have used the last three years. This division of the methodology discussion into a 'local' and a 'global' perspective might be artificial, but in the following it has been helpful, not only to separate my particular process of inquiry from the more general discussion of methodological stances in a science of design, but also to separate my post-reflection or reflection-on-action on this general nature of scientific stances from the reflection-in-action (Schön 1983) as the project has developed. Put together these two chapters constitutes, as solid as I am able to make it, a foundation for the validity of the work presented.

2.1 Applied research methods

Defining the research methods and defining the methodological base of a project is somewhat like joining a school of inquiry and by that explain readers, especially the examination committee, on what grounds the work and dissertation can be judged and commented. However, joining such a school has been difficult for me since I do not see any such solidly defined school of design research, let alone a variety of such to choose between. Research methods have then been applied as needed and in collaboration with colleagues during project work.

However, as a designer engaged in research efforts I have followed the following tenets as a methodological outset:

- I use design to explore the relationship and potential between human beings and their technologies. My research method is design research, research-through-design, a constrictive and creative inquiry into the field of Human-Computer Interaction and Interaction Design.

- Design as research method is an approach to inquiry equal to other approaches, and is both valid and rigid when used scientifically and reflected, and is able to produce interesting results and insights that expand our knowledge and ability to act.

First of all I should distance my talking about design research from the discussion of what has become known as 'design science'. Design science claims, mistakenly in my opinion, that design as method is scientific in an old-school sense of this word, meaning that the design process can be approached solely through deductive and logic means. This is a discussion of methodology within design and basic understanding of design thinking, which is based on a disagreement on whether designs should rely on the creative, aesthetic and subjective approach mentioned earlier, or design must be engaged in a strictly logical way. Participating further in this discussion goes somewhat beyond the aim of this chapter. Research-through-design is a discussion of the design process and approach, aesthetically and creatively grounded, as a relevant approach to scientific studies.

2.2 Research-through-design

The emerging scientific frame of research-through-design is growing out of the fact that designers and design schools engage in scientific inquiries into a range of different fields, in most cases – including this particular project – within the field of Human-Computer Interaction. This perspective is then concerned with design as the *method* for looking into fields other than itself, as opposed to methodological studies of the design process and studies into the cultural, economic, art- and style-eras of the designed objects.

The 'through'-ness of the research perspective denotes the fact that the researcher is interested in a particular subject matter when going into the design project. This subject matter is then observed and engaged through design, both as in design thinking and in design process. The distinction of design research approaches revolves around a difference in subject matter or focus of the investigator. Related to the research-through-design category are two supplementing categories describing

other equal but different interests in design research. The "on" category is concerned with the product of design, thus being the oldest of the schools of design research. The "in" category is focused on the creative processes of designing and is what one could call the school of design methodology. Lastly there is the "through" category, which is the where the design process itself becomes a scientific method of inquiry. This means that the subject matter can be outside the world of design – the central point being that discovery is attained through a creative and aesthetically founded process in which a strictly logical progression of thoughts cannot be assumed.

Christopher Frayling, on who's distinctions this framing of design research is based, defines research-through-design as part of a new tendency where scientific studies shifts position from an arms length principle to one of engagement, one of deeds and not merely words (Frayling 1993). He defines it as "developmental work – for example, customizing technology to do something no-one had considered before, and communicating the results" (ibid).

Daniel Fälman (2003) has furthered this discussion by distinguishing between research-oriented-design and design-oriented-research. In these two categories the latter is devoted to inquiries and knowledge developed for internal use in the design community, for the sake of design. The first is directed towards a subject outside design, and devoted to finding out about this subject.

Engaging a subject matter from and through a design perspective makes the research project approachable in a multidisciplinary context like HCI, as results can be used, discussed and inspire in many different disciplinary perspectives. However, it also opens up to the danger of misunderstanding the results and judging them by the standards of other disciplines, on the debatable scale of relevance vs. rigor, as seen from different paradigms of research (Kuhn 1962).

2.2.1 Aesthetic inquiry

Before explaining the methods that have been applied in this project and as such constitute the methodology, I will briefly explain the notion of aesthetic inquiry. This is not a method per se, but more a stance towards the exploration of ideas and possible futures as well as the current context. In a research context it becomes a position towards epistemological evolution, as I will further describe it in chapter 7.

Interaction design research can be approached from many different disciplines, revolving around the potentiality (Löwgren and Stolterman 2005; Stolterman 2005) of technologies. This potentiality is what can be created and how it can affect the contexts it is brought into. As I discuss in chapter 7 there are two parallel trends concerneing interaction design research. One trend is what I call the confluence of design: meaning that the concept of design and designing is applied in many different disciplines and from many different bases - both aesthetically and artistic based, and from a cognitive and natural science base. Löwgren makes the distinction between these two as *creative* and *engineering* designs (Löwgren 1995). Confluence also means that the concept of design is in danger of being watered down until it can mean anything done by anyone (Krippendorff 2006). The opposite trend is what I call the conflict of design. Here both types of design, but most distinctively the creative type of design is looked upon as not being a fully scientific approach, and thus struggling to be accepted into the wider HCI field. I claim that the basic difference between the

two types of design lies in the applied epistemological base of discovery and building of knowledge, which subsequently points to how they are appreciated as science and design. The engineering type of design is basically built onto an epistemology of logic whereas the creative design thinking is based on an *equally valid* epistemology of aesthetic discovery.

In this project, although I have collaborated with other people from other fields of study in multi-disciplinary projects, I have basically applied this aesthetic mode of inquiry. This means going into the context of interest in a creative stance, looking for this potentiality of technology in social and physical context.

2.3 Methodological elements

Defining the stance I have taken in this project are such elements as engaging in design case experiments to explore contexts, collaborating with a range of different research disciplines and engaging the questions or hypotheses through design thinking. This has then been manifested in design processes where I, with my colleagues, have used participatory design methods for exploring use contexts and developing design proposals based on this and our knowledge of the technological feasible and desirable. This process has then led us to one of the most important aspect of the collaborative research conducted under the Centre for Interactive Spaces – prototyping. The building of things as well as software and collections of technologies into interactive contexts or spaces has been the base for making reflections and developing theory of interaction towards the wider research field of HCI and interaction design. Lastly we have not only worked in a prototyping perspective, but have engaged this both inside and outside of the research laboratory. The interventional aspect of the applied methods of the research projects under Interactive Spaces, is of course in strong relation to the participatory design perspective, and seeks to make the development with users, in as engaged relationship to the context of inquiry as possible, come full-circle. Making these distinctions between the different aspects of the applied research-through-design approach result in a wide description of how I have gone about this particular project. Other designers engaged in research from the same stance might utilize other methods, and research-through-design is not limited to this set of methods.

2.3.1 Experimental design cases

Engaging research topics through the research-through-design approach means to conduct a form of case-driven research, where the individual cases are the designed systems or concepts proposed and tested by the designers themselves. Using cases to develop hypotheses and to test these is to some extend comparable to the prototype that practicing designers use for refining and testing ideas during the design process. Implemented into context the prototype becomes what I call an experimental design case. The 'case' concept is one of many related concepts brought into design research from social sciences, and here the concept has been debated in recent years. Case-study research is provocative in relation to the general notion of science as the outcome of the study often relies on a single empirical instance or extended observation of one person or group, which is then researched in depth as opposed to quantitative studies where trends can be monitored through statistical filtering. In the case-study the researcher must develop rigor through broad and deeply interested

descriptions, and through having his proposed hypotheses reformulated by the empirical results.

Bent Flyvbjerg (2006) has explored some of the hesitations towards case based studies, and argues against misunderstandings of the method in relation to scientific validity and relevance to the community the attained knowledge is presented in. He basically states that the specific case *can* be used for valid scientific results even if (and actually because) the scientists must base their findings on only a single case. In the design perspective the study is often based on one single instance of the innovative product or installation, and the study of the interaction and activities around this artifact is then of a case-like nature and subject to some of the same misunderstandings as sociological single case-studies.

In the standard notion of science a valid result must rely on a large quantity of samples and repeated experiments. In order for something to be claimed as true it must be repeatable, also by others than the inventor or initiator of the first experiment. This is in many fields of science, e.g. medicine and physics, still a very good mode of scientific self-regulation. However, in some sciences repeating an experiment is just not possible. The single case can contribute to the scientific collective's building of knowledge as it tests and explores knowledge and assumptions of a subject matter to a much more detailed depth then any form of quantifiable inquiry would be able to attain. As Bent Flyvbjerg (ibid) writes:

> One can often generalize on the basis of a single case, and the case study may be central to scientific development via generalization as supplement or alternative to other methods. But formal generalization is overvalued as a source of scientific development, whereas "the force of example" is underestimated.
>
> (Flyvbjerg 2006)

Furthermore Flyvbjerg concludes that the scientific validity of the case-study is often reinforced by the fact that by conducting deeply engaged studies the researcher is more likely to reinvestigate his or her hypothesis as the continued confrontation of it with actual life is more likely to rephrase the insights that initiated the inquiry in the first place: "researchers who have conducted intensive, in-depth case studies typically report that their preconceived views, assumptions, concepts, and hypotheses were wrong and that the case material has compelled them to revise their hypotheses on essential points." (Flyvbjerg 2006) p. 17

Clearly the design researcher is invested in the study as it him- or herself who have made the artifact that is studied. By expressing the hypotheses and presumptions and the how they changed during the process of inquiry, the design researcher makes a far more interesting and thus falsifiable and valid piece of science, than if hiding behind statistical, quantifiable or numerical evidence. This is in line with Bruno Latour's notion of understanding and presenting scientific results as proposals rather than as attained truths (Latour 2004).

2.3.2 Collaboratively investigating cases through perspectives

The design projects that I have been involved in during this PhD-project have all been inherently multi- or interdisciplinary. They have been conducted in design teams with

people from various disciplinary backgrounds, and they have been designed to inform several perspectives in their outcome. Thus developing the prototypes and making the experiments work in the design cases were the collaborative focus. The prototype becomes the centre of activity between the different disciplines, or boundary object (Star and Griesemer 1989) that holds the entire project focus or intention through the process. It is not simply that the designers with the ideas meet the computer scientists with the skill to make the ideas happen. As the design processes unfold all participants, and users related to the context, are engaged in the design and innovation process. This implements a range of perspectives from which the subject matter is explored. Maintaining these multiple perspectives on the project during every step of development has been a very fruitful way of increasing our insights through the eyes of our colleagues at the centre.

An example is the interactive floor iFloor, where my part of the developmental process was to hold the perspective of social interaction and make sure that the final prototype and intervention was able to inform this part of our research. Likewise my colleague Andreas Lykke-Olesen (2006) had a parallel perspective where he was investigating space as interface for his PhD-project. So in the same project we can have more than one perspective efficiently in focus as we are more than one participant in the developmental process and each participant takes the responsibility of one perspective. This does not mean that the exploration is up to this one person, as ideas for innovations are expressed by all members of the team, but that the issue is continually addressed as ideas move back and forth over the drawing boards. The design process is then formed and informed by these several perspectives being held by team members. Holding a perspective in such a way benefits the entire project as well as the individual participant. Holding the perspective is not a role being played, but the fundamental reason for participating in the project in the first place, and as such it is a live and intentional perspective.

	Space as Interface	Tangibility, palpability	Context Awareness	Augmented reality	Aesthetic Interaction	Playfulness	Social Computing
iHome			x	x	x		x
iSchool	x					x	
Nomadic Play			x	x		x	x
Future Hyb. Library	x	x			x		x
Children's Library	x				x	x	

Table 2-1: The research perspectives of Interactive Spaces, and how they are informed by several projects.

The research platform of Interactive Spaces can be seen as a manifestation of this idea of multiple perspectives at play in several projects. As can be seen in table 2-1 each perspective is applied in several projects and is then also informed by several prototypes and trials in context.

2.3.3 Participatory design

Participatory design (PD) methods (Bødker, Ehn et al. 1987) are essential for developing meaningful pervasive computing technologies and interactions. This is to some extend a matter of research tradition and personal opinion, but nevertheless I strongly hold that since computational and technological possibilities are so abundant in this line of research, it is important to question whether a new idea is relevant to a context as we know it, or as we might be able to forecast it becoming, and develop ideas based on a contextual understanding.

PD was first conceived as cooperative design in the 1970's and 80's as part of a move to democratize computer technologies in the workplace (Kyng 1991). It was a politically laden move that was to empower the workers in relation to management when developing new systems for workplaces, and democracy and emancipation were key elements in participatory design efforts in development of workplace technologies. This task and tool orientation has been and is still central to PD, but the approach has developed beyond this and is now applied in e.g. designing of interactive technologies for children (Iversen 2005) or for leisure time or family life (Hutchinson, Mackay et al. 2003). This moves the focus not only from task to softer subjects of leisurely activities, but also to examining the values that are at play and the experiences that make the use of technology meaningful. Most distinctively the focus has been broadened beyond problem solving to reaching for visions and discovery of novel applications. Through the years a range of methods have been developed for this purpose, and going into the discussion of these is beyond the scope of this dissertation.

All the design cases in this project have been started out and carried through with an emphasis on participatory design and involving users in almost every aspect of developing the designs. We have studied and engaged users in the contexts of their everyday lives, at home, in public spaces, and in school yards and kindergartens. Furthermore we have asked users to design with us in all three central cases, and we have tested our ideas and prototypes with users both during and after the prototypes were made.

The methods we have applied have been varied and adapted to each context we have engaged, and thus we have not used any of the described and formalized methods from the participatory design literature. Some of the methods I have been part of applying have been written into research papers in order to share experiences and let others test the same approaches, reflect on them and eventually be inspired by them to develop their own methods. This shows what one might call our methodological frivolity or promiscuousity with regards to the direct application of methods. Using a method is always a question of using it in context and rearranging it specifically. A method is then more about adapting a mindset and understanding experiences from using it than it is a cook-book recipe that can be automatically applied to a problem. Communicating methods in research settings to colleagues becomes then what Flyvbjerg with reference to Thomas Kuhn (Flyvbjerg 2006), calls exemplars that

contribute to the entire knowledge base in the field and becomes the experiences that the expert is able to draw on in applying his mindset in doing. In the methods versus mindsets discussion the mindset is the most important to relay between practitioners, as it denotes the stance of the practitioner and the specificity of the method is basically the steps that the practitioner can go through and adapt if the situation calls for it.

2.3.4 Prototyping

Another aspect of designing in context and exploring technologies through experimental design cases is the process of prototyping. Prototyping is a way of manifesting hypotheses and essentially letting the context talk-back in the research (Schön 1983) or letting the objects one has constructed and the context they are to work in *object* (back in)to the research itself (Latour 2004) – to the questions put to the test by the scientist and to suggestions or concepts he or she is trying to fit onto the situation. Building and testing ideas in real life in this way, has been a central issue in maintaining relevance in this research project.

Like participatory design prototyping has been an integral part of all our projects in Interactive Spaces. And similarly the approach has been part of the background tradition of the research context of Interactive Spaces, where developing prototyping approaches has been part of systems development with a user-involvement focus (Bødker and Grønbæk 1991; Grønbæk, Kyng et al. 1993). This focus has been maintained and developed throughout the projects in the centre, and, as the space of collaboration between designer, computer scientists and users, the prototypes have been extremely powerful tool. This contextualizing effort is important in testing designs and prototypes, especially when we base our findings and ultimately our relevance criteria on the fact that we have developed the designs in relation to users in a participatory design process.

Andy Crabtree (2003) has described prototyping in CSCW systems development as "a software development methodology that introduces a foundational element of communication and feedback from the use practice into the design process" and divides the methodology into four steps of *functional selection, construction, evaluation and iteration* (Crabtree 2003). He also defines three interrelated forms of prototyping; *exploration, experimentation and evolution,* denoting how the prototyping is approached in different ways during the design process. First *exploration* is used to develop an understanding of the context one is designing for, and elaborate on previous user studies. *Provotypes* that elicit such knowledge by deliberate pushing the limits of the social, professional context of use (Mogensen 1994) can be seen as part of this type of approach. *Experimentation* is building on what was found in the exploration process, refining and sorting in ideas and implemented functionalities. *Evolution* then is more focused on the technical implementation and making a stable system that supports the right tasks in the right way, and as such closer to an actual system implementation or product release. In the process of this PhD-project I have mainly been involved in exploratory prototyping where we have tested ideas developed with and inspired by users in the actual context and on running technological platforms. This has been the case with particularly the iFloor prototype and the process of the Nomadic Play project. In the iHome project our prototype reached such refinement and was worked on for so long

that it extended into the experimentation and evolution phases and was stabilized and installed into an actual home for two weeks.

Design interventions as action research

Design research with a strong emphasis on testing hypotheses in concrete contexts and building prototypes that aim at changing the current practices can also be described as constructive science or Action Research. It has been suggested (Kasanen, Lukka et al. 1993; Hevner, March et al. 2004) that a collected category of constructive science can be said to encompass all these efforts trying to take the test into actual context. At the same time this notion has similarities to Action Research (Argyris, Putnam et al. 1985) although the subtle distinction is in either presenting the context with a construction as an object, or by presenting the "construction" as an idea, process or artifact that is to be introduced into the context. Both are aimed at changing the context and testing the possibility of change, however the first is object- or system oriented, whereas the latter sees itself as applied behavioral sociology.

Research-through-design *is* both action-oriented and construction-oriented, and as such can be seen as part of each of these perspectives on science. But design research holds enough validity in itself as a genre of science to maintain independence of both familiar categories, also for its sub-category research-through-design. When design methodology and design thinking is used in research activities the scientist will inevitably engage in change and construction, or proposing construction, as this is fundamental to designs subjective creativity and leaning forward in action towards a concrete problem or context.

2.3.5 Subjectivity

At the basis of research-through-design as a scientific approach is then the controversial stance that it is based on a creative, aesthetic and subjective approach to the world and to gaining knowledge on the world. As mentioned, this is problematic as seen from a traditional natural science-based notion of science, as there is an automatic or systematic assumption that subjective results are almost certainly lacking general applicability. However, when design is applied as a method of inquiry there will necessarily be subjective aspects involved as design choices must be made in order to create a design to e.g. test hypotheses or intervene a social context. Adding to this the individual talent of each designer participating in creating the prototype or intervention will affect how the design is received in the context, and as such the design choices are not only subjective but even aesthetically founded and relying on the creative ability of the researchers.

2.4 Results and contributions

The results of this project are presented in the form of conceptual frameworks and design sensibilities. The vocabulary that comes out of this frameworking will enable designers to better grasp and design spaces of social interaction. These words are meant to open, refine and expand possible actions for the designer.

2.4.1 Frameworking

The idea of communicating scientific results in the form of conceptual frameworks is well-known and used throughout the disciplines of HCI. Several of these frameworks have tried to address design and to be e.g. short forms of an extended knowledge

based on the theories of another discipline (Sutcliffe 2005) or concretizations of very deep investigations of philosophical theories (Dourish 2001). Paul Dourish explains that his conceptual framework is formulated in a range of principles for design, seen as a vocabulary and conceptual apparatus for thinking about design opportunities and features: They point towards "things to pay attention to when designing". He wants to present principles as opposed to rules, guidelines or recommendations that would suggest what to do, as he finds that this would be inappropriate based on the variety of settings where embodied interaction takes place. Hornecker (2005) describes the structure and purpose of making conceptual frameworks in design research, pointing to a range of approaches like e.g. 'design sensibilities' a concept introduced by Ciolfi (2004) distinguishing findings of design research from cook-book guidelines, making them more pliable and inspirational to designers. Ciolfi too finds guidelines to be prescriptive of action, and thus potentially insensitive to particular contextual requirements. The design sensibilities on the other hand, tease inspirational insights into future design processes. Hornecker defines the framework she presents in distinct levels, offering "soft guidelines" arguing that easily accessible recommendations are preferable in order for the framework to have actual or direct applicability to practicing designers. These soft guidelines are not seen as strict rules but guiding the designer to an understanding without having to read through the entire and cumbersome theoretical apparatus.

Decidedly there are many different ways of presenting new concepts that hold expanding perspectives on potential design spaces. In the work at hand the theoretical frameworks are presented as interweaved conversations unpacking concepts, sometimes related to each other in diagrammatical form and sometimes simply as an argued expansion of a known concept from the design process such as "the user". As is the case for the above mentioned researchers, the point of the concepts I present here is to affect design practice and design research. I do not hold any formalized ideas as to which forms are best suited for designers to be able to understand. In the above theoretical works the frameworks refrain from dictating actions, but seek to affect future action through developing and relating words. The vocabulary I present as my contribution has the same kind of goal. The reflections and the words are used to point out potentials in designing. On this side of the hermeneutical gap (Hallnäs and Redström 2006) their function is to widen design spaces for the projections over the gap, extending the possibilities for proposals. In the concluding chapter all the central concepts are related to each other for an overview of the contributions.

2.4.2 Taking part in the discussion of technology, people and interaction

Although much can be said about what special role design and design thinking holds in the HCI community, the main forum for this research is within the general HCI community and here results have to be communicated to a diverse range of disciplines in order to maintain relevance and interest. Even though design is concerned with the particular this concern can be reflected in a higher and more generalizable interest in the relationship between humans and our artificial context – our technologies. The interest and the argument of design will most often – like it is the case in this study – be centered on "what is possible" as opposed to "what is real" (Buchanan 1995)

So, the product of the kind of design research that I have conducted is multifaceted. Firstly there are the range of prototypes that are developed through user studies and user participation. Secondly there is the effect that the intervention with the prototype has in the context it is introduced into. Then the results of the first two instances are reported in scientific journals and conferences in a reflected manor both on the individual experiment and its relation to the overall discussion of interaction and technology. This combination of results is a good foundation for introducing the results of scientific research into the practicing design community, as this resembles practical design work and positions the research as an avant-garde exploring new areas and knowledge of the design field.

2.5 Summary

This project is based on a research-through-design methodology and uses design methods to explore into the subject matter at hand – the potential for social interaction in physical, interactive environments. Through the project hypotheses have been developed in the individual collaborative projects based on the overall perspective of this PhD-project. In every instance of project work collaborative efforts have been on building prototypes to test hypotheses coming from different participants' research perspectives. This dissertation is then devoted to collecting experiences and reflections from these collaborative projects into a coherent proposal for conceptual renewal of the idea of designing for social interaction with computational technologies. Rigor of this project is maintained through making thorough descriptions of these concepts and relating them to other similar thoughts, as well as through conducting the research projects with a focused interest on the context and its feedback. Relevance is likewise maintained through this relating of results and by proposing, based on the experiences from each project, expansions to the "repertoire of actions"(Latour 2004) for designers.

Part I - Chapter 3

Experimental Design Cases

3 Design Cases

In the course of this PhD.-project I have been engaged in a range of different and very diverse design projects. Of these are five projects I have been particularly involved in, and which I primarily will use as background for the reflections in this dissertation. A common feature of these projects and my participation in them is that I have been holding the perspective of social interaction in all the design processes. This does not mean that every social aspect that is developed in each project is my idea visualized through shared design efforts. It simply means that possibly a range of projects could be scrutinized through the perspective of social interaction, but I have chosen these projects as I know they relate and investigate the different relevant aspects of designing for social interaction that I will discuss in this dissertation.

In this chapter I will give technical and functional overviews of the projects so this information is to a side when the designs and the processes are used for further reflections in the following chapters. The cases are listed the chronological order they were finished and the respective prototypes and applications were tested and brought into its real context.

3.1 Peripheral cases

What I call the peripheral design cases are two of the first designs that I delved into from a research perspective looking at social interaction. Both of them is actually designed in the months before I started the PhD-project while I worked in the research project WorkSPACE (Büscher, Mogensen et al. 2001; WorkSPACE 2003) under the EU's Disappearing Computer program in framework 5 from 2001 to 2003. The first is a video prototype where we explored how physical and spatial qualities could be utilized in designing ubiquitous computer artifacts for landscape architects. The second case is comprised of three individual designs that condensed discussions about and visions for tourists visiting a city, made in the "white atelier" of the 2nd Convivio research school in Rome, August 2003.

3.1.1 Playful Interaction

Playful interaction is part of a multi-string vision for how office-work could be addressed in a ubiquitous or pervasive computing future in a highly distributed and project oriented discipline of landscape architecture. In the WorkSPACE project we had developed the software application Topos (Büscher, Mogensen et al. 2001) which translates many of the spatial qualities of architects' workflow into a virtual environment or three-dimensional visualization. As the intricacies of this software application and visualization grew, the discussion on the physical, spatial aspects of collaboration were restated by this video prototype. How do people share materials and meet in their actual workflow during the day? And in following this question we came also to explore that part of the architectural workflow that has to do with inspiration for creative solutions in design project-work. The spatial arrangement of physical materials in the current design office or studio is both a means for structuring the work by organizing spatially as well as positioning oneself in an overview position where one can be inspired from previous thoughts and related projects. If the future office of architects were to completely shift to the use of digital formats of resources, we wanted to explore with this video how to retain this inspirational, and as we called it, playful relationship to the material [paper 8].

Digital materials are manipulated and positioned on pervasive displays around the office through manipulating a ball. The ball is central to the playful character of the office. We saw it as a metaphor or symbol on the transference of energy between co-workers, as it could be used as a container of files and thrown from one colleague to the other, and also as the generic interface artifact used to manipulate objects thrown onto displays. The ball is then a physical clip-board as well as a mobile track-ball. In the course of the video the ball is used for moving materials around in a private office space, and for bringing materials to a meeting and displaying them in the meeting room. Finally, in the lobby area of the studio, the ball is used in collaboration to pick up shared materials for inspiration.

The visions in the video prototype was never realized beyond this state, although several of the ideas and design concepts have been references in other design processes, like the emote [paper 4] and the iFloor [paper 2].

3.1.2 From Bovine Hordes to Urban Players

In the 2nd Convivio Research School in Rome (Convivio-net 2006) I was part of the atelier led by Alan Munro. We investigated city experiences and specifically developed ideas for how visitors to Rome would be able to get another kind of experience interacting with the local inhabitants. While investigating many different aspects of urban experiences based on inspiration from Italo Calvino's "Invisible Cities" we found a general annoyance of the heavy tourist load on the central parts of the city, as experienced by the locals. Of course these people also make a lot of money from the tourist industry, but their relationship to tourists were distanced since they found tourists to come to the city and only care about them selves and arrogantly ignoring the wider urban culture of Rome. There was an uneven power balance between the locals and the tourists and we saw a clear distinction between the two groups. Most of the social interaction taking place between the groups was around fiscal transactions of goods and services.

So in the following brainstorms we focused on how we could change this power relation and give a tourist a totally different experience than walking from site to site in big groups and never really get in contact with an actual Roman. [Paper 1] reports on the best of these ideas and I will briefly recapture them here as well.

The *Tour Shirt* is a proposal for a service for tourists to experience another Rome than the one shown on guided tours and by guidebooks. The Tour Shirt is ordered and printed in the tourist agency and then the visitor puts in on and then ventures into the city. The idea is to print the stops of the tour on the back of the Tour Shirt so the tourist does not actually know where to go specifically. She must then ask her way around and have the people she meet interpret the images on the shirt. Some of these images are easily recognizable like the Coliseum and others are generic and open for interpretations like an image of food or coffee, or images of ruins but without a clear indicator of exactly which ruins. The tourist and the local must then talk at best they can and find out where to go next. We envisioned this as a service and alternative experience one would try in order to get another view of the city for maybe a day or two.

Figure 3-1: The Tour Shirt makes the wearer – the tourist – dependable on social interaction with the surrounding context, as the route he follows is kept out of sight to himself.

The second idea was less of a service and more technological. The *Cube* was also an example of how a tourist could explore the city alone or in a very small group. When the cube as rolled it randomly, but depending on where it is in the city, selects an image to be shown on the cube. The cube is six LCD screens encased in transparent rubbery material that would stand the rolling in the streets. As the cube shows a picture the tourist must then again get help to find out what place the image is representing and how to get there – asking the local population for directions. As the cube fills up with the images, it becomes a souvenir in itself and can be brought home as a reminder of the trip.

Both ideas were developed and tried as experience prototypes (Buchenau and Suri 2000) and the experiences from these are in the paper, and as a process this gave us a very rich inspirational material. The idea with both designs was to burst the bubble of

independence around the single user, as have later also been addressed in e.g. the iFloor. We argued that *meeting* and talking to other people in the context one is visiting is a very much different experience than going around and *looking* at these people instead. And going for a cultural tourism experience like this might appeal to many people after having seen the 'must-see's' of The Eternal City. Our work can be seen to fall within a broader tradition of research, however, as in *Design Noir* (Dunne and Raby 2001) our practices sought to probe our social condition and following (Gaver, Dunne et al. 1999) p.25 we also sought to "provide opportunities to discover new pleasures, new forms of sociability, and new cultural forms … [to] shift current perceptions of technology functionally, esthetically, culturally, and even politically."

3.2 Central cases

The central cases of this PhD-project are those that I have engaged directly in at the Interactive Spaces Research Centre. These are the Future Hybrid Library, the iHome and the Nomadic Play projects. All three have been collaborative projects where no one participant can be credited with other than proportional credit for all ideas emerged as the conceptual explorations have been done in groups. That is also means that none of the projects directly are designed to investigate a explicated hypothesis about social computing or social interaction from the start. I engaged in them since they were very likely to become informative to my project, judged by the nature of their contexts and the project partners. Each project has one or more industrial partners attached who were involved in the design process and developing the final prototypes.

3.2.1 The Future Hybrid Library and the iFloor

The iFloor prototype as also reported in [papers 2 and 5] was the outcome of the design project undertaken in collaboration with the Århus Main Library. The Main Library are moving to a new building in a few years and is in a process of exploring what a new library, or multimedia house, should offer its users and society in general. The library is looking at several challenges in the coming years as technologies change how the infrastructure of the library service works and as knowledge and information are communicated in new media forms.

Figure 3-2: Talking to users at the library about what works, what doesn't and what they dream about for a future library.

We found that the library and the librarians are excellent in supporting people in finding exactly the right knowledge on a particular subject, but if knowledge is

defined as something not only in books or on the web, but something emerging between people in interaction, then this poses new challenges for the library as well. As handing in, reserving and checking out books at the library are all automated processes the library should to a higher degree than today support this form of knowledge finding and sharing through social interaction and serendipity. These were points we discovered through an extensive design process with user interviews and participatory design sessions, and they were the starting point on which we developed the iFloor

Basically the iFloor is a large projected display positioned in the main arrival area of the library. It is a questions-and-answers forum where everyone can post questions and replies by using their mobile phone. Messages are sent to the floor as sms, or alternatively by email from one of the computers standing in the same exhibition space, if you didn't want to spend the sms or was living in one of the 10% of Danish families that does not have a mobile phone (Statistics 2004). Questions and answers are browsed at the floor by moving a cursor over each question and seeing the answers by this.

The floor was projected onto a thin sheet of white PVC by a projector hanging from the ceiling. Questions and answers were received by a computer at the university and sent to the computer running the iFloor software locally in the library. Users' positions around the floor was tracked by a webcam and the software Retina (Valli 2004) using so-called 'blob'-detection to position users in the tracked 1 meter perimeter around the displayed floor. These positions were sent to the Macromedia Flash program displayed on the floor and translated into attractor points that pulled in the shared cursor. As more users approached the floor all the attractor points were calculated into a vector defining the cursor's movements.

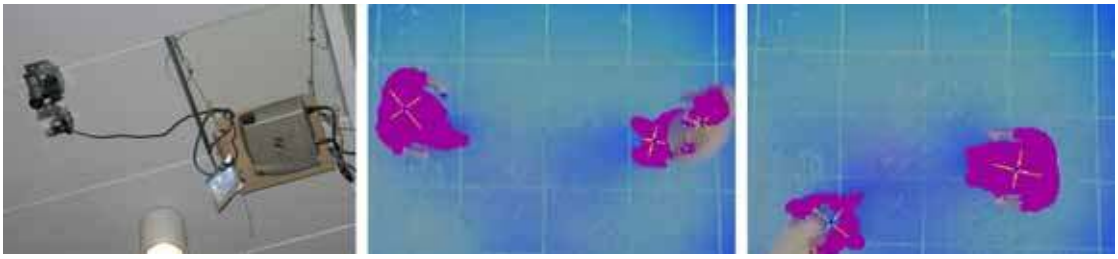

Figure 3-3: The tracking of users with the Retina software.

The iFloor holds a maximum of 15 questions at any given time. When new ones enter the oldest are removed. The questions are evenly distributed around the floor rotated 360 degrees towards the closest edge. This maintains readability from every angle around the floor and entices people to move around the floor to read several questions, which again influence the cursor's position. A user's influence on the shared cursor is showed by a virtual string connecting the position of the user to the cursor. If the user steps onto the display the string will disappear and a small dot in front of the user will show the disconnection. Each question has up to five answers tucked in behind it and these unfold in a fan-like animation when the cursor is dragged over the question. At the same time a tool-tip pops up with the telephone number one must send the messages to.

Users then move around to drag the cursor to the question they want to read, and by spreading out the arms or feet a single user can attract more than one string and thereby get more influence on the direction of the cursor. Stepping out of the tracked area will send the cursor floating back to the centre of the floor. If more than one person is present around the floor each will have one or more strings attached, pulling the cursor in different directions. This makes it necessary for users to negotiate on where to take the cursor. This can also lead to playful interactions around the floor like virtual tug-of-war. As in any other public space, one user is seldom alone, and as one starts to use the floor others will soon step up to observe this user and at the same time influence the system as they walk into the tracked area to read questions. In this way we tried to make a direct translation of the properties of the physical public space, as the use of the digital interface becomes as intrinsically shared as any other public space. This is further unfolded in [paper 5] (Ludvigsen 2005).

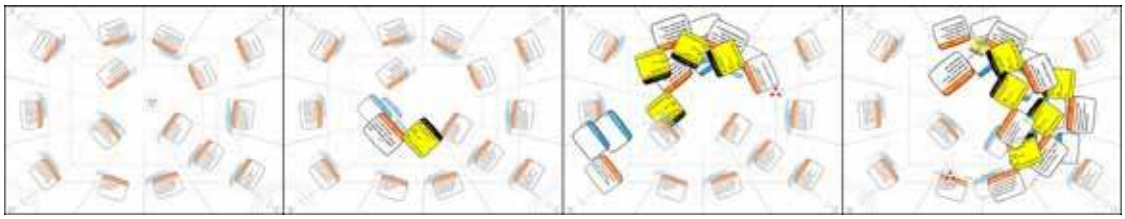

Figure 3-4: Questions unfolding as the cursor is dragged around the iFloor.

The iFloor was set up in the main lobby of the library for two periods of three weeks and. In this time we got more than a hundred postings to the floor and it attracted a lot of attention from passer-bys in the public space of the library.

Figure 3-5: People using the iFloor.

The iFloor was awarded the Danish Design Award's Vision Prize in 2004 and has as such been noticed in a larger community than the interaction design research community.

3.2.2 iHome and the MediaSurfaces

In the iHome project we developed several different prototypes testing several different ways of augmenting media uses. The overall focus of the project was to investigate new forms of interacting with media in the home as most physical formats are disappearing and being replaced by purely digital formats. The physical and social interactions with and around these materials are then impoverished, and most corporate future visions are direct translations of a personal computer standing in the living room using the television as monitor. This is unsatisfactory limiting social as well as aesthetic interactions in the home, and the goal of the iHome project was to explore new possibilities in the frame of ubiquitous computing technologies.

For the purpose of explaining the project here I will only describe the final prototype we developed in the project, the MediaSurfaces and the reason and purpose of this system. The experiences we gathered when we installed the system in a real family's home for two weeks, are used in chapter 5 and in (Ludvigsen and Petersen forthcoming)

Basically there can be said to be three types of SmartHome projects in the HCI and interaction design community. First are the ethnographic studies that chart how the domestic settings actually work and how complex they really are. These studies have uncovered a wide range of interesting patterns of uses of the home and also of the technologies within the home – how they are woven into everyday life and what kind of activities the home as such supports (Crabtree, Rodden et al. 2003; Swan and Taylor 2005). Second are the poetic and provocative designs from design researchers e.g. the interaction design group at RCA in London (Gaver, Bowers et al. 2004). As mentioned above in section 3.1.2 these explorations basically seek to discover new forms of sociability and uses of technology. The aim of this research is also to influence how the design community thinks about the purpose and context of the technologies we design. Thirdly are the corporate research groups. Here we see a lot of work sponsored by large producers of domestic appliances and products like Philips (Aarts and Marzano 2003; Hollemans and Buil 2005) and Samsung (Kim, Chung et al. 2004). These are of course aimed at developing the next big things for the home electronics market, but they are research efforts in the fact that they uncover new aspects of home activities and develop and design innovative prototypes that discusses these same challenges as the rest of the Smart-Home field; how should we live with ubiquitous computational technologies in our homes. As the focus is more realistically oriented to a near future these research efforts are less likely to question the basic juxtapositioning of technology and e.g. values in the domestic context [paper 3], and it is dominated to some extend of engineering thinking; what-is-possible as opposed to the more design-oriented what-is-desirable (Löwgren 1995). As the iHome project was sponsored by Danish HiFi-manufacturer Bang & Olufsen we had the product development focus of the third branch close to our project goal and definition, but part of the project was also to try and explore and develop the potential of these new challenges e.g. developing in the frame of 'aesthetic interaction' [paper 4]. The iHome project was thus placed somewhere between second and third types of research projects.

With the MediaSurfaces prototype we addressed these issues by installing a range of displays in different locations of the home enabling several different points of entry and modes of interaction to digital media and materials, respecting that even

individual users changed preferences about access to digital materials e.g. music in improvised and unpredictable ways [paper 3]. So the MediaSurfaces system that we installed in the home of a family in the beginning of 2006 was comprised of four different displays each intended for particular uses. In the central space of the home at the dining table in the kitchen a large projected display was the shared surface for co-located and collaborative use. Here the family could watch images and browse the web e.g. finding the next holiday destination. As I will come back to in chapter 5 an unforeseen use of this display was that the 13 year old son in the family installed World-of-Warcraft (Blizzard 2006) on the computer running the display and invited his friends from school home to play this computer game as if it was a board game. At this display the users interacted with the resources and software with Mimio-pens (Mimio 2005). Then we had another display installed in the kitchen, a smaller display with a touch-screen interface, so the MediaSurfaces software could be used without pens while preparing food or talking to each other, to quickly change music or the like. The third display was an augmented television where the MediaSurfaces software could be used in a more leaned-back situation interacting with a remote control with motion sensors [paper 4]. Lastly we set up a display in the hallway for putting images and other types of media up to decorate the space and experiment with making subtle communication, distributed over time, in the family like we saw when we visited a range of homes in the beginning of the project (Petersen 2004). Here specific locations had become places of communication between family members where messages were left to read and things to remember were left to be picked up later (see also figure 3-7).

Figure 3-6: The displays in the dining table, the kitchen and in the living room as a TV.

The software of the system is developed in particular for a domestic context, and as such is inspired by lessons from the range of empirical studies of the use of domestic materials as described above. It consists of a generic interface as illustrated in figure 3-6, which is then appropriated in different ways for the different places in the home.

Key objects in the media surfaces system are people, places and collections. This is to some extent inspired by the work of Crabtree et al. (2003) who point to a taxonomy of ecological habitats, activity centres, and coordinate displays to give shape to the various forms which the socially organized production and consumption of communication and media in the home may take. Using the same graphical interface across different platforms we wanted to design for recognizability at the same time as providing different types of displays and interactions.

Adopting a metaphor well-known in a domestic context, we talk about a chest of drawers. The left-most part of the screen in figure 3-7 shows the contents of the currently opened drawer. Drawers are opened through clicking the knobs in the vertical bar. A series of portraits indicate personal drawers. Each family member has a drawer and the family may have a shared one. The letters on the drawer edge below the portraits; TV, B, K are references to the four places in the home since each place is also associated with a drawer. This is designed because we wanted to experiment with, and let it show through use, whether the family would use persons or places as points of reference for particular resources. In the work area in the middle of the screen materials can be manipulated, copied, deleted, played and organized into collections, and on the rightmost vertical bar one can shift between *players* where materials, like images, web-pages or movies are shown in a full screen mode.

Figure 3-7: Managing contents of collections. The 'drawer' is open to the left in the second and third pictures.

Technically, all materials are stored on a home-server and only references to materials are manipulated. As exemplified in figure 3-7, we use collections as the prime means for organizing materials. Collections can hold heterogeneous materials, and in our current implementation this includes pictures, movies, music and web links. Each collection can be viewed in different ways; sorted by name, by date and also returned to their persistent spatial position as they were originally placed in the collection. In this way, we make it possible to organize and reconfigure collections spatially in whichever way is the most appropriate. In figure 3-8 one of our user families are gathered around the table display using the MediaSurfaces system. In such a situation the content of the collection can be organized around its center, making content viewable from 360 degrees.

Figure 3-8: Using the Mimio pen to interact with the digital material in a group. Participants must negotiate the use of the pen.

On the hallway display we only showed materials in the 'player' mode since there was no input interfaces connected to this computer and images were sent to it from other locations.

Finally each user could also import new materials directly for the web, from the hard drives of the computers and sending e.g. images from mobile phones via Bluetooth.

The MediaSurfaces prototype was first installed in our lab at Interactive Spaces and here we invited four different families to try the system and give feedback on functionalities and the overall ideas behind the system. One of these families had been part of the project for a longer time and had been interviewed earlier in their home and visited the lab before to see earlier prototypes. Based on these conversations we made several improvements to the design before it was moved into a fifth family's home.

3.2.3 Nomadic Play and the DARE! game

The Nomadic Play project is concerned with making playful interactions and technologies for children from the age of 7-12 years and sponsored by the LEGO foundation. We started out by looking at media use habits of kids from kindergarten age to teenagers to give us a sense of where the people in our target group were coming from and headed towards. The children in this group are right where they stop caring about things like construction toys and, at least in a Danish and Scandinavian context, are starting to use mobile phones and playing computer games instead of games with physical toys.

Furthermore the mobile phone is the only computational platform that is equally used by both boys and girls, so designing playful activities for this platform would, we argue, also move against this trend of a digital gender divide, recently in focus by e.g. UNESCO (Primo 2003). Lastly we saw from these studies that using the mobile phones as console for running the games would allow us to enter into the social context of the tweens in a realistic way, supporting their lifestyle on their own terms. To be more specific, we are interested in designing support for more or less structured playfulness among preteen children, in a way that emphasizes humour, friendly battle and identity construction using pervasive computing technologies. We are not designing learning environments (embedding a rhetoric of progress) and we are not designing games (creating a "magic circle" with no or little relation to the social and physical realities outside it). So for this type of activity we needed to define a new genre of pervasive play; Mock Games.

A mock game is a type of peer interaction that combines elements of pervasive gaming and transformative social play. It is a role-based game of emergence involving social reality, explicitly formed by and forming communities. It invites humor and friendly conflict as primary ingredients in social interaction. Real identities are constructed and blended with play roles. Compared to existing game genres, perhaps a mock game comes closest to a game show or location-based game. A mock game is then an open-ended "game show" for small communities with no clear distinction between the roles as producers, participants, and audience. No matter how we define mock games, a main feature is that systems within this genre holds a constant invitation to *transgress boundaries* between fiction/reality, physical/virtual, quantifiable/fuzzy, negotiable/absolute, hectic/slow, open/closed, serious/mocking etc.

	Strict rules	Changing rules	Few rules
Fiction	Pacman		'House'
Some fiction		Mock game	
Non-fiction	Traffic		Hanging out

Table 3-1: Participants are not bound by any rules unless they agree with others to be so, and they can find themselves in any mix of fiction and non-fiction.

The most central feature of this new genre, we propose, is the ease of transition across the boundaries between fiction and nonfiction and between playfulness (few rules) and gaming (strict rules) (Table 3-1). For social phenomena, this creates a situation where e.g. roles and identities that are being created may not easily be separated. As tweens construct their identity, it may be difficult – if not impossible – to separate the various inspirational sources from the resulting identity, as is further unfolded in [paper 7].

Figure 3-9: Playing StarCatcher in the streets of Århus

The first prototype of a mobile game was the StarCatcher game, which we tried out in the summer of 2005 with a bunch of kids involved in another project about future learning environments. In the breaks between classes we had several groups of them running around the streets of Århus. The StarCatcher game is a simple capture-the-flag game with GPS-receivers connected to mobile phones and a star placed somewhere in the urban context. Two teams then collaborate to find the virtual star and get to it first while staying close enough to each other for the Bluetooth connection between the phone and the GPS-receiver to work. The winning team won only the honor and bragging rights, and the experiment showed us that a very simple technical and functional game play could easily spur engaged social interactions.

The latest prototype of the Nomadic Play project, which is also our first example of an actual mock game, is the DARE! game. It is a socially embedded mock game of challenge, and users can challenge their friends with different kinds of tasks. The challenges are either readymade or can be constructed through an interface on a mobile phone. The game itself is inspired by classic social games as spin-the-bottle and truth-or-dare, and the key component is the challenging of friends to do things normally not within social acceptance.

The DARE! game has three overall stages. The first is choosing or constructing the challenge. Challenges are supplied with the game as well as the tools needed to construct new challenges from scratch. Challenges are basically constructed in a slot-

and-filler fashion based on a linguistically inspired understanding of a challenge as an activity. An example could be as follows: "I(sender) challenge you(receiver) to take a picture(action) of the one of the boys in our class you like the most(object) within a day(timeframe)". These simple distinctions then make up the building blocks that can be creatively reconstructed into new challenges and written by the children themselves (Figure 3-10). The second part of the game is giving and taking the challenge. The 'price' in points awarded for taking the challenge is negotiated between sender(s) and receiver(s) and as then challenge is performed the entire community can follow the progress and results. This leads to the third part of the game, which is the community life of the challenges. The community is defined by the ones participating and can be a small group of friends, a school class or an entire school. This means that there is a social awareness around the challenges and that the social experiments are seen by the larger group when challenges are sent, received, negotiated, accepted, evidenced and accomplished. The final step of a challenge is to be accepted by the sender and finally socially accepted by the community, leading to discussions and chats on the challenge and the participants. In this way we have designed a way for the community to be alive and present even when the user is not physically present where the action is.

Figure 3-10: The DARE! interface with the challenge elements and camera interface for executing the challenge

The Nomadic Play project is still ongoing at the end of this dissertation and looking towards conducting full user-test and in-context trials of the game. The team is still developing the software and doing further refinements of the game concept, especially in relation to incorporation of physical context and tangible interactive objects. We stress the importance of developing and testing the game it into a community practice and let it become part of the everyday tween life and see how the game as well as the practice around the game evolves over time.

Levels of Social Interaction

Reflections and explorations

In the following three chapters I will reflect on and bind together the project-work from the perspective of designing for social interaction. The reflections are based on exploratory studies into the potential of interactive spaces enabling social interaction, and on the concepts I and my colleagues have used and addressed as we have ventured into these explorations. As the design experiments continually have uncovered aspects of the challenge of designing for social interaction, my understanding of the research question has evolved significantly. This means that this is not a summary simply presenting the achieved and published again, but a summary that seeks to present the explorations at the edge of what I know now about designing for social interaction. Most of the published papers have been written with my colleagues and have reported on research projects, research prototypes and research questions. In this respect the papers have had to fulfill multiple purposes, and have not been exclusively devoted to unpacking understandings of designing for social interaction, but focused on other of the centres research themes as well. This is then the main reason for building a further layer of reflection on top of the already peer-reviewed work. As this rule has now been established, this first chapter is then the exception that confirms the rule. The following conceptual framework has been presented for the *Designing Pleasurable Products and Interfaces conference* in 2005 in [paper 5] and I will here go through some of the same arguments as in the paper and reflect the findings and concepts towards a wider scope of literature.

4 Designing for social interaction in public space

The experimental design case of the iFloor directly engages us in the discussion of designing the social space. The findings presented in this section are of course done within a frame of an installation in a physical space and as such might not be directly transferable to the wider perspective of interactive product design and the development of interactive technologies. However the reflections extracted from the experiment have general relevance when applied into a framework for understanding

differences in social interactions. This understanding is meant for enabling designers to make more qualified design proposals when projecting ideas across the hermeneutical gap (Hallnäs and Redström 2006) in the design process, and as such the conceptual framework does not provide predictive power or certainty to the design process, but more likely it presents *projective power* by giving designers an expanded vocabulary for discussing and refining the designs of social interaction potentials.

4.1 Rules of social interaction

To address the different types of social interaction that can take place in a public space, I refer to Goffman's studies of rules of behavior in public life. These understandings are underlying the later findings and reflections of designing for social interaction. Furthermore they also present a frame for describing how we perceived the library the prototype was designed for as a design space and the potentials it held to our explorations.

Erwin Goffman is an important figure in sociological studies. In the 50's and 60's he studied social interaction in middle class society in the US (Goffman 1963), and described a range of mechanisms and rules that govern how social gatherings are structured and how people act in these situations. In the following I will briefly run through some of the foundational concepts that Goffman presents, in order to ground a designer's conceptual framework of social interaction.

Three central concepts to Goffman's understanding of the rules of social gatherings are the occasion, the situation and the encounter. Rules that define social interaction are part of either one of these three levels and as levels for understanding the social gathering their internal relationship is that the first contains the second which again contains one or more of the third. To understand what happened as we introduced the iFloor to the public library it makes a good reference to hold the design case up to this basic framework, and on the basis of that describe the level of social interaction in a conceptual framework of social space.

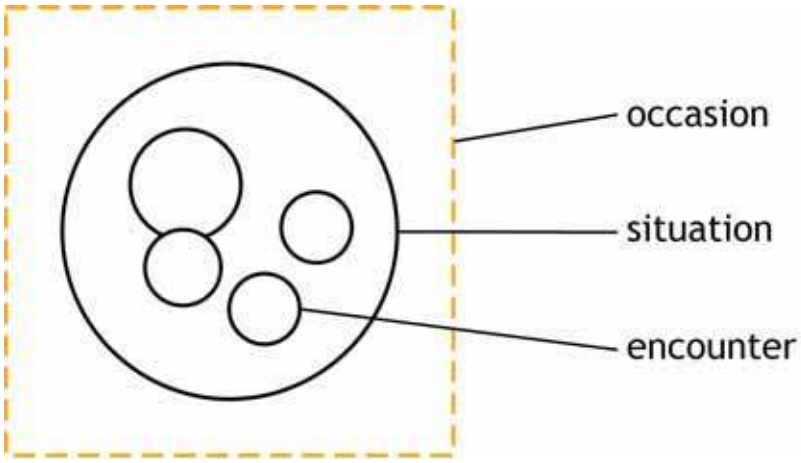

Figure 4-1: Layers of rules defining social interaction

The occasion is the social construct we have of a given gathering. It is what we already know or should know about how to act in the social circumstances we are in,

before entering it. Each occasion is a prescribed frame of how to conduct at e.g. a funeral, a formal party, on a city bus, or at a heavy rock concert, learned by experience or observation. Encountering an unknown occasion requires drawing on knowledge of similar situations, and as such the rules stemming from the occasion level are referring to general conduct in the public sphere. Examples of rules defined by the occasion could be whether one sits down or stands up at a concert – which could also be evident from the physical layout of the concert space, or whether a certain type of clothes is required at the event, or how (if at all) one would address strangers in the given social situation.

The situation then is the specific manifestation of the occasion. Influencing the situation are among other things the amount of people present and the room or spatial arrangement in which the situation takes place. A situation is "an environment of communication possibilities" (Goffman 1963) p. 196 in which everyone entering the situation is accessible to the other participants in the situation. In the social situation communication is both expressive and linguistic and messages are conveyed through physical gestures, appearance, and posture as well as spoken words. Rules defined at the situational level are such as how loudly one would talk depending on the music, how one would react to being pushed or touched in a crowded room or where one would position one self in relation to others present etc.

The encounter or the face-to-face engagement is the smallest unit of social interaction. Consisting of only two or more people currently present in front of each other, focusing on a shared object, it also constitutes and delineates norms that shape the interaction. Even though a given occasion defines a very formal code of conduct, an encounter might evolve into a more informal interaction if e.g. two friends meet and talk about some very amusing shared experience. An example of encounter proprieties is the distribution of attention to the people in the present encounter. Rules defining interaction at the encounter levels can be difficult to discern from the situational, but they are focused at the interaction of those engagements or encounters that make the situation, and the encounter is a more dynamic 'unit' that forms, changes and disappears in flux during the situation. Both the situation and encounter rules are improvisational and depending on the dynamics of the gathering as it evolves, but the situation is the entire social space whereas the encounters are smaller units of interaction. Furthermore occasions themselves are depending on cultural and sub-cultural differences. Thus the three concepts are not able to define rigidly all types of social gatherings but they are helpful in understanding where the rules that shape social interaction come from, and as such they are fundamental to Goffman's structural understanding of social interaction as layers of rules, one containing the other.

Defining rules such as this Goffman's aim was to generalize observations and reflect on what made social gatherings work. The generalizing of these rules should not be seen as a mechanistic description of social space which would then hold predictive power over future gatherings, but merely as a framework for understanding types of rules imposed on social interactions.

4.2 Design intentions

Based on the process of engaging users and staff of the library into our explorations and idea generation of design for the library context, we decided on making an interactive floor situated in the entrance area of the Århus Main Library. Users' and staff's responses to defining the problems of the current library ranged from the very concrete – e.g. that there were not enough reading spaces in the building – to higher-level problem statements like how to introduce new books to people when library users can make reservations from home, pick up the reserved material in a special room and hand it in at the end of a sorting robot. As new technologies are introduced such as these, librarians have to come up with new ways of influencing users and expand their ideas of use of literature and other types of media that the library can offer. Furthermore we were interested in seeing if we could connect users with similar interests, as we found that people interested in all kinds of sub-cultures were not meeting each other at the library even though they went there to read the same magazines. Based on these insights we defined a set of relevant challenges to address in the design.

First of all we wanted to design something that would break the individual bubble (Thackara 2005) around the users of the library. The library occasion defines behavior as quite if not silent, task-oriented and direct. There is not much improvised and random conversation going on among strangers in the library, and as such it resembles other public spaces where private space is merged with public space, and there is an agreement 'to mutually ignore each other, without any implications of hostility" (Paulos and Goodman 2004). At the library we wanted create a situation where another more engaging form of social interaction could happen, and as such we were going against the overall rules of the occasion; bursting the bubble.

Secondly we wanted to make this platform for social interaction stand out further by introducing a form of interaction that was unknown in the library context. Physical interaction and playfulness (Agger Eriksen, Krogh et al. 2003) is not the normal way to go about your business in a library, so while breaking the rules of the overall library occasion we wanted to introduce another set of rules that could open up to informal social connections. We could have introduced a more readily recognizable form of interaction through making e.g. a café area for reading books, but introducing a well-known occasion such as this, we thought, would be counter-productive in convincing people to actually collaborate and start conversations with strangers. The café is still a place where conversation is not needed or necessarily expected between strangers.

Thirdly we wanted to design this platform of playful and social interaction as close to a walk-up-and-use interface as possible, since the library is a public place and must allow for interaction by all; children, elderly, families, handicapped, teenagers, scientists etc. One of the strong points that came out of our cooperative design efforts with the librarians was this strong emphasis of the librarians' sense of mission: They see the library as a fundamental part of the institutions of a democratic society. As the schools provide citizens with the knowledge they need, the libraries provide them with the knowledge they want – both things are needed in an open society. This was of course a strong motivation for an accessible interface. Placing the interface on the floor, illustrating a plaza, was part of this effort [paper 6].

In [paper 6] we describe and introduce the floor as a new surface of interaction in HCI. Floors seen in a broad architectural frame can be understood as either streets or plazas (Stjernfelt 1996). To unfold the meaning of this we looked to the classic European city where streets lead pedestrians in a direction whereas plazas exist as junctions between intersecting streets. The distinction between street and plaza lays in the controlled framing of the space. Street understood as floor is a surface that holds a certain direction which supports the understanding and perception of the space from a certain point of view, whereas the plaza is the floor where there is no perfect viewpoint and where the perception evolves as the pedestrian explores the space. As a shared surface between users, interactive floors as plaza hold opportunities for creating truly shared interfaces. IFloor being placed in the central space of the library, a public place with a public task of being open to any citizen, it needs to be egalitarian and accessible. This is supported through the walk-up and use interface providing equal and collective access for all library visitors.

4.3 Design exploration

As the iFloor in technical and practical terms is already described in the previous chapter as well as in [paper 2 and 5] I will go straight to unpacking the hypotheses that we had embedded in the design. As the previous intentions were the outset for the design process there were also tacit ideas about designing for social interaction that were part of the design process. Through observation and reflection of the impact of the iFloor I developed these understanding into a framework of social interaction in order for these assumptions and conceptualizations to become more clear and ready-at-hand in future design processes. I will now go trough this process of reflection and end up with explaining the framework and its potential implications. Implementing the iFloor as a prototype in the library for two trials of three weeks, gave us a lot of feedback form different groups and individuals before, while and after they used the floor. We found, not surprisingly, that not all of our assumptions and hypotheses were right, and this gave insights into the potentials of the social space as a design material.

Figure 4-2: Bodystorming and trials with tracking in the lab.

4.3.1 Walk-up-and-use

Our intention to create an interface that would allow most if not all people to participate in the forum, were in most respect a success. The mobile phones that were used as interfaces for posting questions are close to ubiquitous in the Danish population, and in the rare cases where some did not have a phone, or was hesitant to spend a SMS on the trial, there were PCs standing around the space where one cold send an email instead.

The tracking of the position of the users included all the curious bystanders and people passing by just wanting to see what was going on. As they came close enough to the floor the cursor started moving towards them and they would affect the interface in the same way as everybody else. However, when no one was using the iFloor-installation there seemed to be a hesitation towards going forth and trying it. Either people just stepped right over it without noticing it, or they halted back not knowing whether it was a piece of art (which one does not touch, of course) or some other form of exhibition. Goffmans notion of 'occult involvement' (Goffman 1963) p. 75) tells us that in the public space people will frown upon strange behavior and seek to not get themselves into a situation where others will think of them as engaged in inappropriate actions. Thus the iFloor attracted many more people when other people were present and using the floor, both when it was the designers and when it were other users. In this way we sometimes had to 'kick-start' social interactions around the floor, although we first tried to put up posters explaining that the floor could be used and how. It was first when we used *people to attract people* that it really worked.

This made it clear that no form of social interaction can be installed in a vacuum. There will always be a context of the interaction; the space, the participants and their expectations, varied as they may be. In a social interaction design there must be sensitivity towards the existing social form and expectations – the occasion – and some form of bridge must be made to enable the participants to engage in the type of social interaction that has been designed for.

4.3.2 Forced collaboration, play and negotiation

When designing the iFloor we wanted to make an interface that forced a collaborative interaction onto the users as they engaged with the floor and more than one were present around it. This is achieved by only providing the one cursor and letting everyone affect it, and also through the arrangement or orientation of the messages on the floor. As they were evenly distributed around a centre the reading direction or position of each message was 360 degrees around the brim of the floor. This made people walk around the floor influencing the cursor and mingling personal spheres. By this we tried to impose a new set of rules in contradiction to the normal social rules of the library. At the iFloor it was necessary to talk to you neighbor in order to get to where you wanted to go with the cursor, instead of being impolite. This actually worked very well and we saw conversations between strangers trying to figure out how to use the floor, how to get to a certain message, and how to send a SMS to the floor posting a question, answer or remark. With this latter function the communication was mostly very young people telling somewhat older people how to do that, which has nothing to do with the iFloor as such, but more on the general acquaintance with mobile phone functionalities. We were excited that it was possible to introduce and enable collaboration between total strangers in the public space through such an interface, actually creating a collective by minimizing total control over the computer, and delegating it to the social negotiation.

The playful aspect of the iFloor also became apparent when several people were not negotiating the use of the cursor, but just frustrating that they could not gain full control. Then at some point they discovered that other people around the floor were affecting the cursor as well, and then started to compete over control of it. As it is possible to attract more than one 'string' for controlling the cursor by spreading arms

and legs, this then became a digitized tug-of-war and all focus on the messages on the floor was moved to the opponent in the game.

So although the forced collaboration installed a collective by sheer necessity in the interaction, it was not always that we could be certain in achieving the form of interaction that we had designed for. Sometimes the 'rules' embedded in the design afforded instead fun and play. However, presenting people with an opportunity to play can be a valuable way to create an informal meeting and create a collaborative and friendly competitive interaction.

4.3.3 Conversations and emergent collectivity

Our initial hypothesis about the iFloor, that it would be a gate to opening conversations about topics of shared interests did not work to the extent we had hoped. Maybe if the iFloor had stayed in the library for a prolonged period of time, becoming a part of what people expected to find and use at the library, we would have seen more of this kind of connections being made, but since it was installed for a relatively short period we did not find that this happened to any great extent. Although we did see examples of people asking question about topics that were not within a librarian's knowledge-bank or search-ability, but a type of knowledge that is in people rather than in books or databases, we saw very few conversations develop from these subjects. There was for instance a question about where to catch good trout in the vicinity of Århus, and several different answers to that came in with places and streams around the countryside.

But it seemed that there was something we missed in designing for collaboration as a bridge to knowledge sharing and collaboration outside the iFloor. Our idea was that people would meet around the floor reading a question that they both were interested in. Noticing their mutual interest, which is obvious as they have to ask each other to move the cursor around, they would start up a conversation about trout-fishing or role-playing games and fantasy books. The interface in itself was then meant as a point of departure for more in depth conversations. As people met around the interface they would have their attention on the display on the floor and after a while more engaged social contact would be made and the users would forget all about the interface, just talking to each other – an actual disappearing computer (Weiser 1994; Streitz, Magerkurth et al. 2005). Although this did not happen as much as we had hoped, we still had numerous interesting conversations with people about computers and technology in their everyday lives and how they did or did not fit in. Facilitating the emergence of a certain form of collective behavior or type of social interaction is a difficult challenge, and the first step towards the required understanding needed to do this was then to create a conceptual framework defining the relation of different types of social interaction. Based on Goffmans rules of interaction, it was clear that it is the distribution of attention in the social situation or in other words how closely people are engaged in the social situation, which defines and distinguishes one type of social interaction from another.

4.4 The conceptual framework

From the work with designing, developing, testing and implementing the iFloor I developed a conceptual framework for describing the types of social interaction taking place in public spaces. This is developed as a refinement of the designers

stance of just plainly designing for social interaction, as it enables designers to talk about what kind of social interaction is aimed for with a design, based on what type social interaction space is already present in the context or occasion.

As mentioned, the conceptual framework is structured along a scale of engagement into the social situation or the attention given by each participant to the overall situation as opposed to towards their own individual activities. However this does not define the quality or intensity of the social interaction, first of all because this is impossible to decide and since sharing co-presence without conversation can be as satisfying a social experience as the experience of collaborative efforts towards a shared goal. The fact that the four levels of social interaction are placed on top of each other is due to the relationship that one is dependent of the next in order to make sense; dialogue is difficult or meaningless without a shared focus of attention etc. Also the four levels denote and increased level of commitment, availability and engagement by the participants.

4.4.1 Distributed attention

The first level in the conceptual framework is when people are co-present in the same space. If nothing is the apparent centre participants will have different foci around the space and on each other. The shared presence in the space can e.g. be regulated through spatial elements, and the appearance, conduct and posture of participants will be defining interaction in the setting. The social aspect of any given setting is of course only one of many aspects, and the distributed attention simply means that as a social space there is not much direct verbal or active interaction going on. Distributed attention is seen in many contexts both in the physical realm and in the digital. Surfing web pages can be defined as an activity of distributed attention, as the single user never really discovers or acknowledges other users around them, unless it is an actual forum-page or blog with e.g. a comments section. In the physical world we often walk in urban environments where the social situation is based on the fact that we distribute attention around the environment like in a café or in traffic. We are still taking part in a social situation either from necessity – lack of space – or from a desire to be in a crowd at all. In the library this is the traditional level of social interaction, as people move around the library minding their own business while still relating to others by e.g. posture, positioning and gesture.

4.4.2 Shared focus

The social navigation browser by Kristina Höök and colleagues (Dieberger, Dourish et al. 2000) is an example of an application or digital artifact developed for sharing social focus. Here the view of the web-pages is augmented so users can see which pages other users have visited before them. So the point of attention is shared over time and not simultaneously, however still being a social form of interaction. Dieberger et al. compares it to for example an urban environments where we are able to understand tacit recommendations by how many (and what kind of) people are participating in a given event. Based on this communication we can decide whether we want to participate as well or not. Plenty of interactive technologies have been developed to support this form of interaction, among others our own MediaSurfaces system from the iHome project, a host of interactive tables and even older technologies like the TV and before that the radio was used to create social situations for being together in some form of shared activity, namely being co-present with directed attention

towards the same thing. In architecture designing spaces for shared focus is well-known in theaters, churches or any other place organized around a single point. As such the shared focus can introduce a centre and an audience – a potential structuring of power relations. In the library the installation of an object that was public as well as interesting was our way of introducing this level of social interaction. We then designed the interface itself to help persuade users to move from this level to the next with the forced collaboration.

4.4.3 Dialogue

At the dialogue level we sought to get people to talk around the iFloor by making everybody affect the cursor equally and having to relate to each other by sharing an object and influencing one another's interactions. This means that at the dialogue level each participant is engaging in a shared activity that requires some form of situated engagement with a counterpart and accessibility to the counterparts participation. Participants invest themselves and their opinions, materials etc. into the situation. The dialogue-situation is comprised of separate individuals focusing on the situation, the other participants and the activity going on among them. Compared to the shared attention level the dialogue means two-way communication and interaction as opposed to broadcast or one-way communication. Numerous examples of physical, architectural and product designs, as well as digital applications and artifacts exists augmenting and supporting social interactions at this level. Most CSCW projects and prototypes e.g. (Streitz, Geißler et al. 1999; Grønbæk, Kristensen et al. 2003) are aimed at this type of interaction, and instant messaging (IM) applications today support both speech, chat as well as sharing of materials etc.

4.4.4 Collective action

The last level of the framework is that of collective action. It denotes the type of activity that occurs when participants engage together beyond themselves. Or stated otherwise collective action is when participants are working together towards a shared goal engaged in, on the overall level, the same activity. In most cases dialogue and collective action are dynamically intertwined as the alignment of the shared goal and activities is necessary before the collaborative effort makes sense. Collective action can have strong sense of flow (Csikszentmihalyi 1990) as the focus of attention is outside the interaction and situation itself, directed towards a shared third subject matter. Collective action happens when the goals of the participants overlap, not only with each other's goals but with the goal or purpose of the collective or gathering-at-large. This type of social interaction is what we know from a good brainstorm when participants are able to leave individual disagreements aside and lean into the process and creatively engage the subject matter at hand. This notion will be further discussed in chapter 5.

In the iFloor case we saw this type of activity emerge as a playful battle of control of the cursor and the digital tug-of-war. And although this was hardly the type of collective action we had designed for it was in some respect a collective effort as it was beyond each participants own tasks and explorations. We had hoped for a closer engagement with subjects of shared interest where participants would use the rest of the library for exchanging knowledge – the iFloor as ice-breaker towards creating social contact beyond the interface.

This level of collaboration is the goal of many CSCW systems and computer games like Counter Strike and World-of-Warcraft. I have participated in a research project (WorkSPACE 2003) where we developed a collaboration software where reaching this level of social interaction was designed for through a systems perspective instead of a social or interactional perspective (Büscher, Kramp et al. 2003). Presenting tools and materials that collaboration can be directed at in the system is the normal way of designing for collective action; supporting the goal of the social interaction as opposed to supporting the interaction in itself. The conceptual framework here presented is meant as an alternative perspective on designing for this process. Especially when collective action is sought engaged outside the work-sphere this alternative angle on the interaction itself could be a productive perspective in the design process.

Seen as a whole and with examples from work and non-work context the framework looks somewhat like this (table 4.1)

Social interaction	Examples from a work place:	Examples for a playful situation:
Collective action	Collaboration in a team of colleagues brainstorming/ working towards a solution to a design problem.	In the game it self kids will quickly loose track of time and e.g. take on new roles in the interaction
Dialogue	Discussion on e.g. how to frame a design problem or understand a specific parameter.	When kids play a large part of they efforts go into deciding what the rules are for the game and they often return to this dialogue level during play
Shared focus	Presentation. One person in front of the rest of the colleagues.	Bystanders to a game might be observing in order to join the game later or just looking at a friend playing Game Boy
Distributed attention	Awareness of colleagues before the presentation starts or in breaks during the work.	In e.g. a day-care where lots of children are playing different games to themselves or in small groups

Table 4-1: Conceptual framework of social interaction

The internal relationship can also be described with reference to what is shared at each level. As it is a framework of social interaction something is shared and the use and interaction is seen in a context of participating in a gathering of some form. At the first level of distributed attention level what is shared is the co-presence of each participant. One step up co-attention is that which is between the participants and thirdly, at the dialogue level, we could call it co-exchange as here it is opinions, money or whatever that is given from one participant to the other. Lastly co-action can be said to be the shared entity between participants. This is another way of describing the relationship between the individuals at each level of social interaction.

4.4.5 Situational interaction mobility

Lastly in this framework I will introduce the notion of situational interaction mobility. This concept is needed in order to describe the social potential of a product or an

installation like the iFloor. Basically I see three questions that can be inquired in the design process and analysis of ideas, using this framework:

- Regarding the level of social interaction; where are we presently and where do we want to go?
- Regarding the interaction itself; how is interaction at this level supported?
- And finally regarding the openness of the system or service; to what extend is situational interaction mobility supported – that is; can users themselves take their social interaction to a different level if they choose?

Situational interaction mobility describes the change in level of social interaction in the framework, and how well a service, product or installation supports this change in engagement. If the designers want to reach and maintain a certain goal or type of interaction with the designed artifact then this needs to be tightly framed and with a limited sense of mobility, as the users should not take the situation in unanticipated directions. On the other hand if the designers wish to move the participants to a higher level of interaction than what is present in the situation and prescribed by the occasion then a looser framing is needed, or possibly a greater emphasis is needed on the specific direction through e.g. a focus on aesthetic interaction [paper 4] encouraging an explorative curiosity by the users, possibly 'tempting' use in a specific direction if well-designed. As any context a design is introduced into already has a range of interaction rules defined, a design should not only support the specific type of social interaction the designer wants to take place, but also support the shift in type and level of interaction and the way to get there, all according to which occasion, situation and socio-cultural background the users are in and coming from.

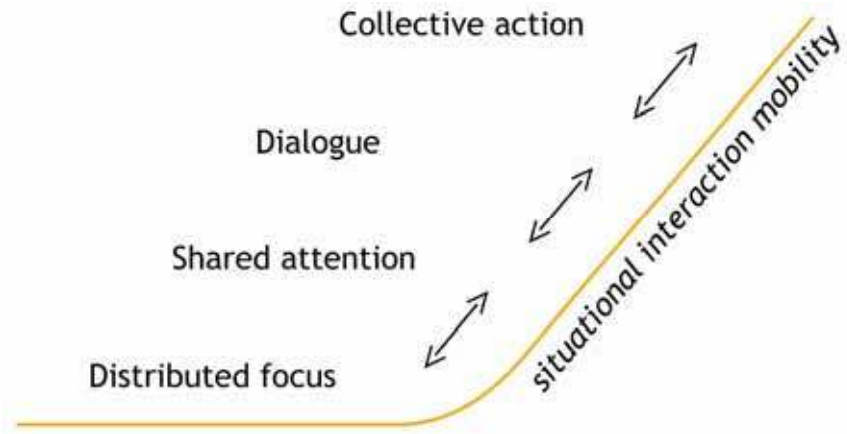

Figure 4-3: A diagrammatic representation of the conceptual framework

4.5 Making social space

Forestalling the discussion in the coming chapters this conceptual framework directs us to the challenge of making social space, or designing for social interaction. A range of work has already been conducted into trying to understand the social context of products and technologies. And several designs have been developed to enhance social connections and awareness of co-workers, friends and even strangers (Paulos and Goodman 2004). The development of the iFloor is an attempt to design for a specific form of social interaction and as such it is following in this line of work. The

intention that a designer can have for a certain type of social behavior can be difficult to manifest in the actual use situation. Andy Crabtree (2004) has explored this as emerging social practices, and reported on an experiment where there were no previous experience at all with the type of interaction that the designers proposed, so Crabtree and colleagues could observe the emergence of practices and negotiations and discussions of rules of conduct. Crabtree sees this as 'breaching experiments' as they create entirely new forms of practice, just like the iFloor. On the same note Paul Dourish states that

> Social computing … recognizes that meaning is something that users create through the ways in which they interact with technology and with each other, and opens up the opportunity to explore and negotiate meaning in the course of interacting with and through software systems
>
> (Dourish 2001)

Thus designing for social interaction is an ungrateful role for a designer since the users will themselves construct meaning of the entire system, regardless of the designer's intentions.

4.6 Summary

This conceptual framework is focusing on how the social interaction is structured into a social space, in an attempt to view social interaction as an entity in itself and not focusing on the single user experiences of participation. According to this structure, the social space then has a distinct character which we can place into a conceptual framework, for a better understanding of a present context and for achieving a better design of a future artifact. Using the conceptual framework in a design process three questions can be asked to confront design ideas. Regarding the level of social interaction; where are we today and where do we want to go? Regarding the interaction; how is interaction at this level supported? And finally regarding the openness of the system or service; to what extend is situational interaction mobility supported – that is; can users themselves take their social interaction to a different level if they choose?

The conceptual framework is meant as a tool for designers to get a better understanding of the social context or social space of a design proposal and in a sense make the social space an active design material.The three levels of occasion, situation and encounter help us to understand, in an observational study, why people act as they do – from which layer the rule to interact in a certain way comes, and, in a design process, to define on which level to position an intended change in social conduct. Furthermore the conceptual framework seeks to recast knowledge from sociological theory and structure it focusing on design processes and design thinking. This probably means loss of detail but this reduction brings simplicity and applicability, in my opinion, to the framework. Designers need to be more aware of the social context they are introducing artifact, products and services into, and a conceptual framework for understanding the context and point to where a future socially interactive service is intended to function, is a tool for better understanding the future impact of a design.

Based on the idea that the framework describes what we share as in co-presence, co-attention, co-exchange, and co-action, it is interesting to take a further look onto what co means – collective and collectivity. In the next chapter I will delve into the concept of addressing the collective user as the focus point in design. Furthering this concept I discuss in chapter 6 then what are the limits to the process of designing for social interaction. As has been debated with e.g. design of user experiences and in interaction design in general (Hallnäs and Redström 2006) there is a gap between what the designer imagines and is able to control and define of the use situation, and then how actual use unfolds.

Designing for the Collective User

Moving from the general exploration of social interaction related to public spaces, I engage the discussion of *who* it is we are designing these social interactions for. This chapter relies on two different strands of argument. Both points towards how designers can further address the social space when designing, and take the notion of collective as a conceptual frame of reference for this social space in the same way as the individual is traditionally taken as point of reference through our understanding of the concept of 'the user'. First then is addressing the evolution of this user concept in interaction design, and how it is affecting the design process. Secondly the concept of collective needs to be further dissected and discussed in order to understand how the idea of the collective user will expand the existing body of user concepts, and expand our design space when designing interactive technologies.

5 The collective user

One of the explorations that came out of the iHome project was an emphasis on the notion of the collective as the user, in this context the family. As an expansion of the individual users and their social interactions we suggest that it makes sense to look at these individual users as part of a collective and furthermore that this collective can be the user to be addressed and inquired into in the design process. This chapter is concerned with discussing this expansion of the individual user model, and open the possibility of a renewed stance in designing for social interaction, especially at the level of 'collective action' as was described in the previous chapter in the framework of levels of social interaction. This conceptual framework is then transferred from only telling us something about interactions in public space to being applied for understanding the levels of social interaction in other contexts, e.g. the domestic.

5.1 The user

The concept of the user is central in interaction design and HCI and has been debated, reframed and expanded a number of times. Outside and before HCI there have been user concepts as well, although they were not formulated in exactly the same terms. With the modern movement in design and architecture the focus was shifted away from symbolic form and detail to the overall lines of society and industrial production. Riding on a massive wave of futuristic optimism (Manzini 1991), the

designers of this time moved this focus to, among other things certainly, the human person, the receiver of the designed, the inhabitant of the building, the *user*. This was also the concept that Le Corbusier(1958) used when he made his 'Modulor'-man from the standard measures of a London policeman, and used this as a measure when designing new buildings as well as furniture. Similarly one of the foundations of the success of 50s and 60s Danish furniture design was Kaare Klint's measuring of almost everything in the everyday activities of domestic life. From how large a folded shirt is and how much space an average stock of socks takes up for a man, he, along with his students who later became the stars of Danish furniture design, defined the sound measures of human activities and used these as the base for designs of furniture that today are classic examples of modern life (Karlsen 1985). In an international context this form of measuring was published by Neufert (1970) and is still used today as reference when it comes to physical ergonomics in designing spaces and artifacts.

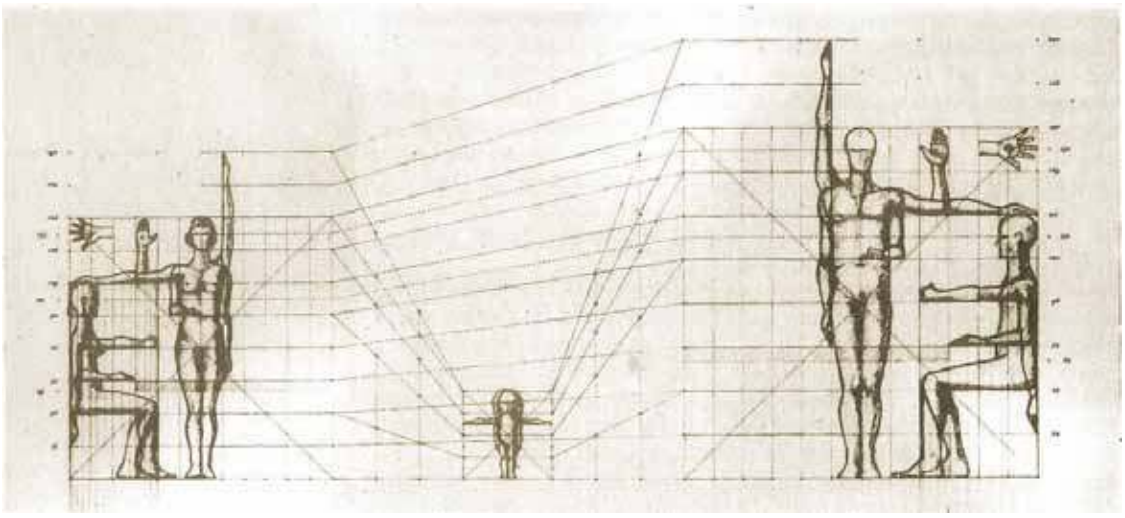

Figure 5-1: Kaare Klint's user studies. Modeling the user on the physical level.

Since the earliest days of HCI there has been a focus on the end user as well, the man in opposition to, in front of, as part of, in relation to the computer. As stated in chapter 2 there have been changes in the understanding of the user from the earliest days of computation when the machine was the most important part of the cycle and thus the user needed to adapt to the machine, learning e.g. commands in prompts, or making punch-cards for executing commands and calculations. Later the human factor became the focus of design and development and the machine was to be adapted to the humans using it. One of the most prominent and often criticized user models is the *Model Human Processor* (Card, Moran et al. 1983). In order to understand the user as seen from the software engineer and the system, this model defines the user as a processor in cognitive terms and as a system component. This model and software engineering in general have been under attack of a too simplified view on human beings in interaction with computers, viewing the user as another system component of a computer for processing the tasks at hand (Bannon 1991).

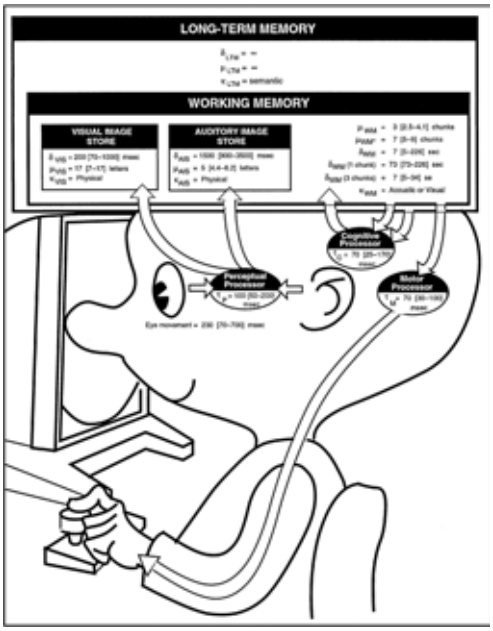

Figure 5-2: The Model Human Processor. A human being seen as a computer with delays, but still able to push the button.

Fact is that the Model Human Processor is able to forecast user behavior in detail related to the expected time to react on a certain type of input. This can be appropriate when evaluating one interface to another. The limits to this are that interfaces evaluated have to be screen-based, and the user has to have the same interest in both of them, and not think of anything else than completing this isolated task. In the eyes of an interaction designer wanting to understand entire contexts of use and address complexities of everyday life in a holistic view, this is an altogether too reductionistic way of perceiving the human being trying to get a computer to do as he wants it to do. To be fair the model human processor has predictive power for explaining strategically isolated events in an assumed undisturbed space, and this can be relevant when conducting evaluations of applications or instances of graphical user interfaces like GOMS and keystroke-level analyses (Newman and Lamming 1995), which are evaluation activities and not directly design activities.

The Model Human Processor and other cognitivistic and reductionistic models for understandings the user in HCI have been heavily debated through the last two decades, since the turn in theory in the 80's, as mentioned in chapter 2. Basically the opposition is coming from an understanding of the user as engaged in context of other people and other physical materials than the computers keyboard and mouse. Andy Crabtree (2003) calls it 'the requirements problem' and unfolds a timeline from the software engineers seeing the user as a system component that needs to be described in order for the design to proceed on one hand, and on the other hand efforts to define the user beyond a processor as a thinking and reflecting individual acting in a context affected and guided by people around him or her. Liam Bannon addressed this in the seminal article "From Human Factors to Human Actors: The Role of Psychology and Human-Computer Interaction Studies in Systems Design"(Bannon 1991). Here he argues for a renewed perspective on the user as not merely a passive system component – a factor that can be predicted and incorporated into the design as a technical element, although lacking in memory capacity and

processor speed, but as an active actor able to contribute to the design process with important knowledge about the context of use. The models that Bannon is opposing are not able to describe use and the users in future work situations where practices and detailed knowledge about contextual procedures, and coordination and corporation in tasks are necessary. The cognitive models basically tries to reduce the user to a component in order not to necessarily test every aspect of the system with live users, but just run it through the model. Bannon, along with many others around the same time, argues that the users themselves are more proficient in providing this knowledge and the best way to elicit this into the design process is through prototyping and users' participation in design. Participatory design, as has been present in Scandinavian context for decades by now, sees *users as collaborators* in exploring the design space and the designers are learning about this through the users' engagement with the design problem.

'The requirements problem' (Crabtree 2003) arises when designers need to make a system or artifact fit with the a particular task or set of tasks. Reducing the complexity of a context can be beneficial in order to make a design at all, but in some contexts where ubiquitous computing is entering, we cannot beforehand know about the user as the user evolves in parallel with the used i.e. the artifact we design and implement, and the practices from which we could deduce 'implications for design' (Dourish 2006) are absent before the designed is engaged in use (Crabtree 2004). This type of design then needs to look at the user in a different way, which is one of the current challenges in the HCI-community. The user becomes an increasingly complex and diverse unit.

5.1.1 The user as aesthetic recipient and creator

The user as an aesthetic recipient, creator of experiences has been propagated primarily by the researchers from RCA in several different projects. The user that is envisioned in e.g. the Drift Table (Gaver, Bowers et al. 2004) or the designs from the 'Placebo'-project (Dunne and Raby 2001) is creatively constructing meaning in her own lives and exploring objects in a iterative, poetic, curious interaction. From the designer's perspective looking at users as not necessarily task-oriented but experience-oriented makes a huge difference. The user becomes separate from the task and the interactive object becomes part of a wider, holistic view on life. The design genre *user experience design* has some of these same connotations, although the user are sometimes closer to what could also be called a consumer of experiences, whereas the user in the aforementioned projects are creative themselves in forming their own experiences. However, as experience design evolves, these different stand-points are refined and reformulated, and focus is shifting towards empowering user rather than merely presenting a buzz of experience[2] (Forlizzi and Battarbee 2004), [paper 4]

5.1.2 Users in social context

Co-experience has been propagated by Katja Battarbee and Jodi Forlizzi (Battarbee 2003; Battarbee 2004; Forlizzi and Battarbee 2004) as a perspective on this issue through the notion of experience design beyond the single user. Battarbee argues that

[2] For a knowledgeable and comprehensive overview of theories of user experience design, read Katja Battarbee's PhD-dissertation (Battarbee 2004).

it is limiting to see the user in the context of interactive products as standing alone and be a passive consumer of whatever the designer has designed for them. Users hack and rearrange their technologies to fit with the activities at hand and especially in order to support social interaction and activities, and the construction of social spaces. Co-experience, or collective experience, is one way of describing what goes on in actual use as we develop technologies for such situations. Furthermore it is an example of how our perspective can be challenged and expanded in the design process as we think of whom we are designing for and what kind of activities we wish to support.

Addressing the user through participatory design methods entails an interesting coupling of the individual user as part of the collective – the workplace. Methods have been developed specifically to have a low entry to the design process so ordinary people can be allowed in not only creating proposals for designs, but discussing them creating a shared understanding of the workplace (Ehn and Kyng 1992). Explicating tacit knowledge into the design process through collaboration with a group of workers is similar to our interviews of the families in the iHome project, as we engaged the domain experts in groups so that they would formulate collective ideas and issues, and present different conflicting issues often independent of personal roles.

The user as social actor is the underlying idea within a range of multi-user technology designs, as already described with regards to CSCW and Bannon's reframing of the user (Bannon 1991). Grudin (1990b) also saw the development of groupware as the natural extension of the role of computers as supporting daily activities of humans. In this view the work-setting and social interaction are of the highest and most complex level to be supported and build on previous levels or foci in the development of computers from the 50's to the 90's. However when going onto discussing and designing the social space the boundary object is most often the interface itself, the user-image tacitly underlying this. Grudin discusses the evolution of the computer and the interface as developing from a highly technical interface to a more user-friendly in terms of how well the computer "understands" the user. He states that the term user-interface "is a technology-centered term: the computer is assumed, the user must be specified" (ibid.) Grudin's call for refocusing the development of computational technologies goes well in accordance with the argument I am trying to wield here pointing towards addressing the collective as the user.

But before going on to unpacking the notion of collective, the role of 'the user' in the design process needs to be explored. What is the effect of how we perceive the user?

5.1.3 The empirical and interactivity fallacies, or using users in design

Design methods like participatory design brings the user into the design process, so that he or she can speak for themselves, and make the design more realistic or fitting the context into which it is meant to be introduced. However, even through participatory design methods, the designer is not able to fully know the user, or more specifically: there are fundamental and conceptual differences between the user we are able to observe and try to understand, the user we use or collaborate with in the

design process and finally the user taking the designed into use on the other side of the design process.

> The notion of a 'user' and that of 'use', as central conceptual components of the interaction design process, are both basically logical notion we define in the process of designing, i.e. it concerns the form of the acts that define intended use
>
> (Hallnäs and Redström 2006)

According to Hallnäs and Redström there are two misunderstandings in talking and thinking about interaction design, and strongly connected to the notion of the user: the empirical fallacy and the interactivity fallacy. Acknowledging both of these misunderstandings is connected to accepting the design process as divided into three basic stages, or modes of thinking in relation to the world, divided by two hermeneutical gaps that the designed is projected across through the process of design. I will briefly unpack these fallacies as they point to the role of 'the user' in the design process.

The empirical fallacy is, in the context of this discussion, the most important. It is "… the idea that use is an activity open for empirical investigations and not something we define" (Hallnäs and Redström 2006) p.63. The user we are able to observe in context today is part of what is 'given' about the design space as we start the design process. But following the notion of 'wicked problems' (Buchanan 1995) we cannot assume that all we need to know about a design space is knowable before the design process starts. This means that the user we see and the problem we observe in the beginning of the design process is not the same user we use during the design process as reference point for the design. We can refer to 'the user' during the design process and the participating users from e.g. a home or library context can refer to their own experience, but in both cases we are working with assumed or projected forecasts of future behavior. So the user that exists in this projected design space is a conceptual construct, in order to fit into the design process itself which is all about projecting across the hermeneutical gap. The third user in the course of a design project is then the person being confronted with the actually designed. This person is not the same as the one observed in the beginning, since the designer is no longer in any kind of control over the designed or in the filtering of understanding the user. As this third user is confronted by the designed, he is changed as he is in a novel situation, and cannot be assumed to react in the same way as before the designed was introduced.

The interactivity fallacy is "… the idea that the objective of interaction design is to design 'interactive' systems where the user is yet another component" (Hallnäs and Redström 2006) p.63. As stated also with Bannon's critique of human factors in design of interactive systems (Bannon 1991) reducing 'the user' to a component who's interaction with the rest of the system needs optimization, is a misunderstanding and a unhealthy reduction of the people impacted by the design. Seeing the user as merely part of the system excludes all the aspects of this person or group of persons that are not directly linked to the functionalities of the system, but affects how the person will go about daily activities nonetheless. This can also be read in relation to Jonathan Grudin's evolutionary view of the computer as reaching out to 'learn' more and more about the people using it (Grudin 1990b). Moving the cognition or 'knowing' and 'learning' away from the computer, this means that the designer's understanding or

conceptual frame for grasping the user and projecting designs, is expanding with notions of the social space and the wider complex context around 'the user'.

Understanding these distinctions in the design process means understanding that what we are able to create, think and perceive in the design process is based on what grounds we choose to define for our own design thinking. The user, being one of these defining components, is a crucial part of the base of the design process. Changing this base or expanding it with new notions of use and users will introduce an enlarged design space and potentially more relevant proposals for future technologies. How we define 'the user', defines how and what we are able to design.

'The user' is thus a reduction of the complexities of real lived life, which is inherently unpredictable and thus impossible to design for unless we use some forms of reduction.

5.2 The collective

It is a somewhat commonsensical effort to arrive at an understanding of what a collective is, as there are no formal definitions to be drawn from HCI or design theory.

As defined by Wikipedia[3]; "a collective is a group of people who share or are motivated by at least one common issue or interest, or work together on (a) specific project(s) to achieve a common objective. Collectives are also characterized by attempts to share and exercise political and social power and to make decisions on a consensus-driven and egalitarian basis." (Wikipedia 2006c)

Kevin Kelly (1994) discusses the term 'Hive minds' as part of a forecasting of the future of computing and society in general. He already saw examples of this phenomenon in different experiments, notably one where a large audience of 5000 people divided in two groups should control and land an airplane in a flight simulator, where after a few trial runs, each individual found his or her role in the greater effort and the airplane was under collective control. The same thing happened with playing a game of 'pong'[4] and having thousands of people negotiating the movement of the paddles. With very short training time, a group of this size was actually able to control and play the game. The 'hive mind' is of course derived from biology and the world of insects where the individual simply plays the role of a little piece of the larger collective acting in the survival of the whole ant- or bee-colony. An example of the same kind of collective activity has been presented in (Strömberg 2002) although dealing with smaller groups of 3-6 people. What happens in both these

[3] Letting the global collective intelligence in form of a global encyclopaedia trying to define itself, or at least one very important feature of itself, is almost recursive in character. The creation of the largest encyclopaedia in the world – wikipedia.org – is entirely based on contributions from volunteers around the world. By way a collective effort the articles on wikipedia are refined and have been found to be as precise and valid as leading officially authored encyclopaedias.

[4] The computer game classic with two paddles placed on each side of the monitor bouncing a ball back and forth. A bit like tennis, but on a TV or computer. One of the first successful games on TV-game consoles.

forms of collective action is that the individual becomes part of an entity that is larger than each participant and acting as one single unit, similar to the definition of 'collective action' in chapter 4.

Although collectives are rarely identified in interaction design or HCI, they are pervasive in our society, from national states to families, to sports clubs to political parties, NGOs, groups of friends where you would not be able to have as much fun on your own as in a group, have as big an impact on the political reality on your own as in a collective, or you would not be able to grow and care as much for yourself and your kin as in the collective of the family. But collectives need not be of such intended nature. Traffic and many aspects of urban life can be defined as collectives by their activities. Here space is limited and thus the individual is required to join the collective field in order to get to move through traffic to where he or she is going. The crowd at a concert, a sports event or in an urban street or plaza can also be said to be a collective where the 'one thing shared' is the presence and orderly social behavior [paper 6].

I propose then a definition of a collective as a group of individuals being together with a shared goal, objective or perspective, for shorter or longer durations. The purpose – an unpleasantly seldom used word in HCI and interaction design – of being part of the collective can be to achieve this focus as well as achieving the shared goal. Adding to (Erickson and Kellogg 2003) I suggest that not only are we social creatures, but part of the purposes humans have in life is to act in collectives towards goals that are greater and thus outside of ourselves as individuals. Being social, and taking part in collectives is as relevant and necessary an activity as individual activities. It is not just something we do when we have dealt with all the individual tasks at hand, and have the surplus to participate in social gatherings, as one would assume by following e.g. Maslow's hierarchy of needs. There have been made several studies of people acting directly opposite of what Maslow's pyramid model would suggest (Nørretranders 2002), acting as part of collectives prior to maintaining basic personal, physical needs. This is an important aspect of human activity, and as such can be addressed in interaction design, as we lay the frames of such actions in the future by the technologies and modes of interaction we design.

The collective is then a group of people seen as a whole; the unit of reference for a social space of interaction. A collective can be joined or it can be forced upon you, it can be temporary or it can be sustaining for a longer period of time. A collective can be stupid or intelligent and it can be structured or chaotic.

When looking for a collective, one looks for the purpose and structure of the collective, that which is beyond the individual participants. The collective is that part of the social gathering that is not the individuals, but that other bit that is the unit of and reason for the individuals being together. This means that one particular interesting focus point about collective is the purpose of the being together: the "at least one issue" that is shared among them.

There are probably many more ways of describing and defining 'the collective', but this will do for a working definition that fits our purpose of reaching an understanding or proposal for how to address this entity-larger-than-the-individual through design. The user beyond the individual.

5.3 The collective user

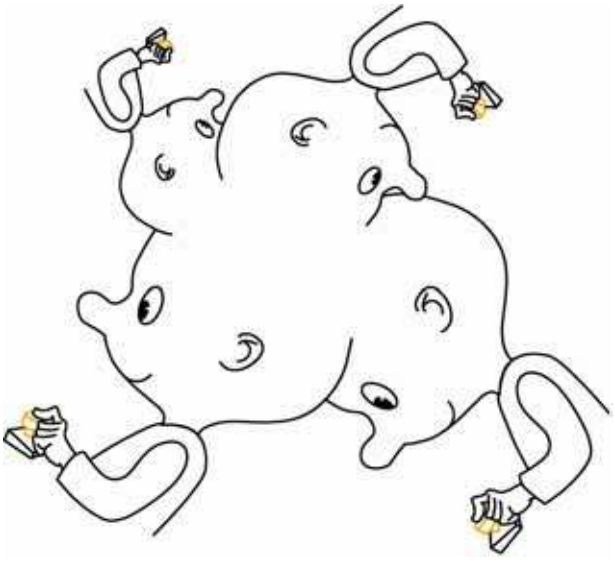

Figure 5-3: Designing for the collective user.

In designing interactive technologies we can then expand our notion of the user with the introduction of the collective user. Here the underlying reference of design can be refocused to the overall social setting; in the same way as the interaction designer normally perceives the individual as the underlying point of reference for the design space. DePaula (2003) has opened up for a similar refocus by introducing community-centered design and "technology as social proxy". With an outset in *distributed cognition* and how reasoning and knowledge not necessarily resides in the individual but is often created in social interaction, DePaula hints at a framework that

> …is to expand the unit of analysis for cognition and human agency, from merely focusing on cognitive processes dwelling in someone's head, toward a systemic view of cognition delimited by functional relationships of the elements that participate in a task situated in a socio-cultural context.
>
> (DePaula 2003)

The theoretical frame for DePaula is distributed cognition as defined by Hutchins et al. (Hollan, Hutchins et al. 2000). This resembles ecological psychology (Gibson 1979; Norman 1988; Gaver 1996) in some ways as human activity is seen in close relationship to the surrounding physical and social environment. William Gaver defines 'social affordances' from this psychological framework as form affecting social behavior and meaning. The affordances can be designed to most extents if the designer knows who is going to use the artifact and what this individual's frame of reference is, on e.g. door-handles or computers. Gaver argues then that this ecological approach is likewise valid when it comes to social behavior since

> Social activities are embedded in and shaped by the material environment… In the end this should challenge researchers to avoid the temptation to ascribe social behaviour to arbitrary customs and practices and focus instead

> on discovering the possibly complex environmental factors shaping social interaction.
>
> (Gaver 1996)

In a psychological context this is a change in focus of study from the mind to the environment. In a design research context this opens up to the possibility for designing these environmental factors, since we cannot design what is already in the heads of the users. The physical and digital context the users are in is then our means for establishing the intended mode of social interaction. At the same time distributed cognition also resembles Bruno Latour's notion of sociology of artifacts (Latour 1992) and how the physical objects play a role in not only the individual activities, but in forming the social interaction that takes place in social gatherings. Distributed cognition is mostly interested in the aspect of cognitive processes in relation to the physical environment and completing different types of tasks seen as cognitive activities.

> [Distributed cognition] extends the reach of what is considered cognitive beyond the individual to encompass interactions between people and with resources and materials in the environment.
>
> (Hollan, Hutchins et al. 2000) p.175

Although the distributed cognition framework is a very interesting framework of thinking about human-computer and human-human interactions, it is first and foremost a psychological and ethnomethodological oriented framework. Implications for design is described to some extend in (ibid.), and it is proposed as an encompassing framework for the entire field of HCI spanning also to interaction design, but it is first and foremost interested in how people think with and in their environments, which is a psychological interest, and in the methods people use to make meaning and sense of complex contexts, which is of basic ethnomethodological interest.

However the notion of distributed cognition and DePaula's community-centered design emphasizes the fact that we can look beyond the individual to find another kind of 'user' or unit of reference for design thinking and doing, since, when the social space is viewed as cognition, "cognitive processes may be distributed across the members of a social group" (ibid.). Social space in my view is not necessarily focused on cognition but can take other forms. The point of interest that I am aiming for with the notion of the collective user is the purpose of the social space or gathering – the reason for the collective user to exist, which the designed must then support. The social gathering in and of itself.

The idea of the collective is not new in HCI literature. Douglas Engelbart e.g. (Engelbart 1995; Bootstrap-institute 2006) envisioned some of the consequences or possibilities that we are facing today in the revolution of social connectivity through the World Wide Web. Engelbart's notion of the collective is focused on the work-place and concerned with establishing efficient relations that will enhance our capacities for whichever kind of work we perform. But as computers and computational capabilities now move, or have done so for some years now, into the domestic and leisure time parts of our lives, efficiency and upgrading of performance is no longer the only point of developing and designing computational systems. But Engelbart's notion of

collective intelligence (ibid.) that can be designed for still holds and is applicable also in e.g. the domestic setting. For what is a home if not a frame around a collective, what is a family if not a collective? Of course families also consist of individuals with their own private life and disagreements with the rest of the collective, but at the same time they are engaged parts of a collective.

Katja Battarbee and Jodi Forlizzi's definition of co-experience (Battarbee 2004; Forlizzi and Battarbee 2004) has the connotation that the collective activity is that which is shared beyond the individual cognition. And again it does not mean that making sense of the experience and creating the situation is first an effort of the individual and after that something that is shared. The construction of meaningful experiences itself is a shared activity and after the collective has reached consensus on what is happening or has happened, is the experience appropriated by the individuals.

In the phenomenological theoretical framework that Dourish lays out intersubjectivity is central to understand communication and collaboration with interactive systems. In broad strokes phenomenological understanding of the world is based on viewing phenomena in the world as subjective experiences and to some extend renounces objective truths. The problem is then how people are able to communicate and share a common ground of understanding in e.g. a conversation. "Social order … arises out of collective action. Collective action … depend on intersubjectivity" (Dourish 2001) p. 111).

Howard Rheingold addresses this notion of collectivity in his book 'Smart Mobs, The Next social Evolution: Transforming cultures and Communities in the Age of Instant Access'(Rheingold 2002). Here he looks for technologies and cultural trends that will enable the further emergence of the phenomenon he dubs as Smart Mobs, which can be compared to collectives assisted by digital and mobile technologies. Rheingold argues that, as people are adapting mobile peer-to-peer technology this will be the beginning of a new social revolution, since people readily can participate in and construct social structures, sometimes for the fun of it and sometimes aimed at goals beyond themselves like the political protests that pushed Philippine President Estrada out of office in 2001. Rheingold is focusing on collectives as very large formations of people taking action in uncontrollable ways and call e.g. peer-to-peer file-sharing and open-source software building for *ad-hocracies*, emphasizing the dynamic and grass-root nature of such emerging collectives: "the power of individuals to use smart mob media to form beneficial ad-hocracies – the power to solve social dilemmas – depends less on computing power or communication bandwidth and more on trust and willingness" (Rheingold 2002) p. 112.

Collectivity can also be addressed from the point of the interface, seen from a technological perspective (Petersen and Krogh forthcoming). This turns the perspective of the designer around and moves it away from the underlying understanding of who the user or receiver of the designed is, and the design process must then be based on an assumed agreement of the people designed for, as engaged in a social context as well as the understanding of what is shared and connecting the social context. Focusing on the interface and the technologies supporting social interaction, collaboration or collective action has been the focus of many multi-user interfaces and prototypes. There are numerous examples from CSCW and social

computing both web-based applications and concepts designed for interaction in physical context, many of which have already been mentioned in previous chapters.

Single Display Groupware (Stewart, Bederson et al. 1999) is one example of how the interface can take front-stage when discussing social interaction. In this view collaboration is co-located as in many of the design cases in this project, and interaction is centered on a single display as output channel and multiple input channels, one for each user. This is then defined as a sub-category of groupware as this field of course has several other ways of supporting group activities. To some extend Single Display Groupware is also an example of how the focus on the interface can make the form or type of interaction more important than what the collective needs for focusing on and working with its purpose. The advantage of focusing on the interface instead of the collective as such is that the type of interface can be tested and results generalized for use in other settings with other purposes. So I am not claiming that focusing on the collective user instead of the shared interface is preferable in every instance of research, but that when this perspective is applied other aspects of the design space is foregrounded for the further design process. In terms of design and HCI research the focus of the particular project can be on either the user model or the interface, depending on which strand the researcher wishes to create generalizable proposals, and in practical design-work both perspectives can be applied and mixed in expanding and defining the design space.

5.3.1 Co-located and distributed interaction

When talking about collective users three dichotomies can be used to discern between types of collectives. I have already hinted at the difference between the family and the traffic system as two very different forms of collectives, and as design space we need to discern between these types with regards to the qualities they possess and present to participants in action.

In CSCW a traditional distinction of presence of co-workers has been between co-located work and distributed work on one axis and synchronous and asynchronous activities on the other. In such a framework activity can then be described and related, and transitions between the different formats of work activities can be spotted and incorporated into design of the new system, e.g. (Moran and Anderson 1990).

The difference between co-located and distributed activities is whether the people interacting share the same physical location. Shared attention and a range of subtle social cues are present in co-located social interaction (Goffman 1963) whereas in interaction where participants are distributed geographically and linked via networked interfaces there are no or very few cues of the same information. These then have to be designed specifically by the designer if they are important for the collective activity (Erickson and Kellogg 2003).

5.3.2 Synchronous and asynchronous interaction

Distribution of communication over time is also well-known from physical, everyday context. We saw examples of this in our user-studies of families' uses of particular places in the home for coordinating activities [paper 3]. In one example the mother would hang notes on a cabinet in the kitchen to remind others in the family of chores or special events that needed to be prepared for. In the same way corners of tables

were used to leave messages as places of social interaction asynchronously distributed in time. And asynchronous social interaction can also extend beyond explicit communication as traces left from the activities of others on the same surfaces or artifacts as you are working on. This is the type of social interaction that is underlying social computing concepts like social navigation (Dieberger, Dourish et al. 2000) where the traces of other peoples activities are left as bookmarks of preferred links.

Synchronized social interaction is supported in most social computing interfaces, as the synchronicity is likened to normal conversation. But synchronizing with friends can be the point itself in some forms of social software. When the kids we asked during user-studies in the *Nomadic Play* project told us that they logged on MSN immediately as they come home [paper 7], (Brynskov, Christensen et al. 2005) this was not necessarily to chat with friends but also just see who was online and be with this group friends – hang out and show that you are online and present.

5.3.3 Ephemerality and persistence of collective users

Similarly a distinction can be made between the persistent collective users existing over a longer period of time and the more ephemeral ones that are assembled and dispersed dynamically in e.g. public spaces. The collective user that can be described as persistent is where participants in the group are familiar with each other and their roles in the collective, and when the collective extends in time. This can be a family, a group of friends in a school class or colleagues in the work-place.

An ephemeral collective user is characterized by its fleetingness and is assembled and dispersed as participants join and leave the interaction. These casual and often public encounters are not depending on participants taking specific roles, but can be focused on creating the social contact at all, like was the case with the iFloor. The ephemeral collective user demands a different form of facilitation and relies to a higher degree on the designed to commit to the collective. This is often in public settings where there are several alternatives to participating in the collective activity.

Combined with the traditional CSCW framework on presence these two concepts construct a framework that tells us something about the quality or type of collective user. The points of interest in this conceptual framework dichotomy are the changes in type. As seen when a social setting e.g. a social encounter in a café moves from distributed to co-located, as two people meet after having arranged the meeting by SMS, or when an ephemeral collective becomes persistent and assembles co-located to make e.g. a smart-mob demonstration as a collective action. How casual encounters in public space become persistent probably relies on *articulation work* as described in (Schmidt and Bannon 1992) and the dynamic formation of consensus and commitment to the collective. A scenario where two friends in a café, who constitute a persistent although often distributed collective, are suddenly confronted by an interactive table linking them to other guests at café tables creates an ephemeral and distributed situation. The collective user can then move along all three dimensions as social interaction evolves, and the intended mode of social interaction can be designed for accordingly.

5.4 Examples of designing for the collective user

The concept of the collective user is a post-experimental reflection based on how we thought during the design process and during the experiments. The concept of the collective user is then a refinement and manifestation or explication of the more tacit notions of use and users we applied during the design processes. The following examples of collective users from the design projects I have participated in represent each of the two categories of ephemeral and persistent respectively.

5.4.1 An ephemeral and co-located collective user in public space

As have already been discussed, the iFloor [papers 2 and 5] interface was designed to facilitate emergent collective behavior in public space through forcing the participants to share the control of the cursor on the floor. The user we then designed for was the entire dynamically assembled group of people standing around the interface at any given time. Looking at the purpose of the interaction we aimed at getting people to talk with each other and share knowledge, with a secondary purpose of changing the social occasion of the library by introducing a new form of social interaction into the setting of a public library. As an interface for collective use and social interaction the iFloor was an experiment in persuading people in public space to participate in a collective by limiting their individual control of a computational artifact. Normally computers in different shapes and sizes are designed for single-user control, and this makes the single-user having to focus attention on individual use. The current technological development is enhancing the individual user, augmenting and empowering the individual with more knowledge, more capabilities and ultimately greater independence from his or her social surroundings.

This aspect of the broad trends in digital technology and consumer products was also the concern in the Bovine Hordes-project from peripheral design case #2 [paper 1]. As developers of technology see a problem somehow it is often concluded that the reason for the problem has occurred is that the user does not personally have enough capacity to solve or bridge the problem – an outcome of looking at the user as a single-standing individual. This problem is then alleviated by presenting the single user with a digital capability that will solve this very problem. But if looking into the wider social context it can also homogenize experience and remove the user form immediate contextual dependence. Using GPS and palm-top computers for way-finding in an unfamiliar place, like when visiting Rome, the single user would be completely independent of the social context of the city, but removing these technological assistive artifacts would place the user directly in the larger collective of the city environment – depending on interactions with other people. Instead of designing nice experiences with technologies we presented ideas of how low-level designs of technological enhanced services would create a platform for social interaction, by recognizing the social context of the user, and the conflict between the tourists 'bovine' collective and the larger urban collective of the Romans (figure 5-4).

Figure 5-4: The tour t-shirt reinstalled the dependence of context for its users. Instead of going independently around an unfamiliar city, the user has to make contact with - and trust strangers – in order to move along her sight-seeing route. The technological empowered independence is removed in favor of actual social contact between human beings.

5.4.2 A persistent collective user at home

The family in the iHome project was definitely a very persistent collective and although the MediaSurfaces system was not installed for more than two weeks it was used both in co-located activities where members of the family sat down and viewed a bunch of digital images together and also in ways that can be characterized as distributed over time and space as files were moved around the different MediaSurfaces for later viewing e.g. from the MediaTable in the kitchen to the MediaDisplay in the living room.

We wanted to design for the family as a whole and began this by looking at how technologies and the use of these affected the home and the family being together [paper 3]. During the design process we often talked about the 'togetherness aspect' of many of our design proposals and concepts. We wanted to create interfaces that would support several people being together mainly co-located in space and time. We had this perspective foregrounded for two particular reasons: firstly we wanted to counter the individualization of personalized ubiquitous computer technology, as was the case in the Bovine Hordes-project, and secondly – as a consequence of this – we wanted to create an interface that would address the whole family as one social entity. Thus we designed the computational media system as a shared space where everyone had to respect and be attentive to others activities. This concern was relevant to address in the home context as the individual technologies and the mode of use that they inscribe were removing, in our perspective, the focus from the family members being together. So we insisted on designing "togetherness technologies" – what have later been called collective interfaces (Petersen and Krogh forthcoming) as they support the collective of the family in interaction and enable collective action [paper 3 and 5].

Another reason we wanted to address the family as the overall user – the collective – was that we had seen in our user studies a range of different conflicts regarding the use of media in the home. These were mainly conflicts of prioritizing between functionality and usability on one hand and aesthetics of the home and the experience of e.g. listening to music on the other hand. The conflicts were not only between

individual members of a family but also present in homes of just one inhabitant. So we defined them as conflicts in the home as a field or collective to be incorporated and dealt with in a proposed design [paper 3].

As we moved to testing our prototype in an actual home context, the father in the family's first responses to us, after the installed prototype had been with them for two weeks, was that he was sorry that there had been none of these "real-together-situations that we had designed the system for" while it had been there. First of all this comment highlights our focus on creating these moments or events, and that such focus can be inlaid in the designed artifact and easily perceived by the user. Secondly the comment also suggests that life in a modern family is not geared towards continuous collective actions and socializing in the co-located sense we had projected. Every member of the family, except the father who works from a clinic in the house, commutes to work or school, and everyone has full calendars to attend to. So in the course of a normal week the family does not sit down to engage consciously in "togetherness-situations" except for the evening dinner. Thirdly, it wasn't true, as will be reported in a moment.

Learning from experiences from CSCW the use of technology and the following patterns of social interaction cannot be said to be stable and knowable in advance. One of the overlaps between the different fields of work and non-work, can be illustrated in the following citation from (Crabtree 2003). This basic reflection is both applicable in a work context, which is where Crabtree uses it, and in a non-work context. It points to the fact that social interaction is inherently difficult to predict and reduce in complexity, and as such must be addressed consciously and cautiously in design:

> In dealing with collectives and with joint (…) action one can easily be trapped in an erroneous position by failing to recognize that the joint action of the collectivity is an interlinkage of the separate acts of the participants. This failure leads one to overlook the fact that a joint action always has to undergo a process of formation; even though it may be well-established and repetitive form of social action, each instance of it has to be formed anew.
>
> (Blumer 1969) cited by (Crabtree 2003)

Although the family is a persistent collective user, the improvisational and informal character of interaction is as present in the home context as in the work-place. Members of the family have shifting schedules and the home is a place where inhabitants evolve and grow and thus change over time. This leads to conflicts and changing patterns of use as roles and identities have to be negotiated and reformulated. The home contains everything that each family member's life contains and as such the home must be a spacious frame for unexpected interaction. Any system supporting domestic life should enable and allow such unexpected uses.

Togetherness around digital photos

In our two-week test there *had* actual been a few of these "together"-events occurring during the test. However, it had not been a planned event in the family, but spur-of-the-moment activities. As one of the daughters of the family came home from boarding school one weekend, she had brought her digital camera and wanted to show images from her life at the school. The family tried to download the images to

the MediaSurfaces system and since it worked they could give us feedback on their experience of the images being too big in the viewer and too small in the organizer etc. Meanwhile they actually had one of those "real-together-situations" improvised since the technologies were present. However, it is important to acknowledge the family's comments that often family life is too busy for this kind of situations to be scheduled, and they also mentioned that the two weeks probably had been too short for especially the parents to get to know the possibilities of the system in context. As an example the mother asked jokingly whether they could keep the system a few extra weeks when she discovered the possibility of setting up images on the screen in the lobby of the house. We had set up a MediaDisplay here for posting images and create an atmosphere or decorate with digital images in the same way one would with physical images. As we were talking about the system at the end of the two-week test period, the mother saw this functionality as a potential to show to visitors where they would go on holiday in the summer vacation. Although formulated as a joke, it points to a potential of meaningful use when the technology becomes an opportunity or functionality instead of merely a technological installation.

A visiting collective user

The difference in types of collective user became very apparent through a few totally unexpected interactions. The son in the family played World-of-Warcraft with some friends from school. So normally when he came home from school he would sit in his room at his personal computer and play in this MMORPG[5] online. As we installed the MediaSurfaces in the home we allowed him to put his game on the machines running the different surfaces. As a result the home was invaded by an increasing group of young boys for the first five days the prototype was installed. These gamers constituted a completely different collective user than the family to such an extend that the mother of the family felt that there was no place left in the house to relax as they were sitting in the kitchen, the son's room and the living room, and running between each post as well. This was an unexpected and not-designed-for social interaction that the setup facilitated in this way, and it shows us what can happen when two different collectives meet with very divergent needs and purposes (Ludvigsen and Petersen forthcoming). Had we been able to foresee this clash of different collectives and uses we might have designed some form of negotiation into the system. As it happened this became an interesting provotype of social forms showing us how very different activities can compete for the same space both digitally and physically.

5.5 Purpose of the collective user

The reason to address the collective user in interaction design is to be able to change the focus of the design effort of designing the acts that define intended use (Hallnäs and Redström 2006). If intended use means activities that are of collective nature, it will be more difficult to design these if thinking about how the individual is participating in the collective and not focusing directly on the collective user. Of course attention needs to given to how the individual can see and interact with a designed technology in the same way as the interaction designer needs to be aware of how the individuals hands fits ergonomically to a set of buttons when designing a

[5] MMORPG is and abbreviation of; massive multi-player online role-playing game

single user artifact. It is a matter of focus and one focus does not replace the other totally, but for a limited section of time in the design process.

What distinguishes the collective from the participating individuals, or rather why it becomes the most applicable point of reference is the overlapping of goals and the shared purpose there is in collective action. As individuals form the collective, supporting the collective's activities, desires and needs becomes the focus of design efforts as opposed to focusing on the total sum of the individuals' ditto. The collective user becomes an entity in itself and thus the unit of reference in design, for the short or extended time it exists and we intend to support it with our designed technology, system, service or artifact. The collective is bound by a purpose. It is what brings people to invest and commit themselves in the collective. This purpose can be high, noble or mundane, tacit or self-evident. It can be political change and overthrowing a president, it can be brainstorming on ideas in design, it can be playing a game, it can be relaxing and having fun with friends, or can simply be to be present with and in a collective like when we go to a café paying four times as much for drinking a cup of coffee in a noisy, crowded place – a nicely and relaxingly crowded and noisy place. The collective exists through purpose and its purpose *can* be itself.

To focus this discussion of the potential of applying a collective user in interaction design the topic can be condensed in design sensibilities, following Ciolfi's example (Ciolfi 2004) and making these sensibilities available in the design process as questions to be asked when designing and addressing a social gathering as a collective user:

- Regarding the social gathering at large, is there a collective to be addressed and is the collective user what the design should be addressing?
- What is the purpose of the collective?
- How can the designed support participation in the collective action?
- How can the designed support the collective user in reaching its overall goals?
- In characterizing the type of collective user and where is it placed in the presence/persistence dichotomies; where is it moving towards and where do we intend it to move? This question is comparable to the concept of situational interaction mobility introduced in the previous chapter.

Question such as these are meant to refocus the designer's perspective on the *given* as the outset of the further design process. Refocusing away from the individual user to the collective user can expand the design space and open up for another range of design proposals.

5.6 Summary

This chapter proposes that looking at the social space as an entity in itself means to address it as a user, giving it the same status as reference point for the design as that which the individual user traditionally has in interaction design. The collective user is thus an expansion of the normal user-model acknowledging that the individual often acts as part of a larger entity and this entity is then that which should be designed for, that which the designed should seek to support the activities of.

We can see the context of a design, and thus the acts we define through our design work, as being part of the life and purpose of collectives rather than of individuals. Thus the collective user has been introduced to establish a unit of reference at the same level of abstraction and importance in the design process as the individual user. The history and impact of the individual user model in interaction design was briefly recapped to make this positioning. This has been exemplified through primarily the design of the SmartHome system MediaSurfaces and to some extend the iFloor that instilled a temporary and public collective and the design proposals form the Bovine Hordes project. The family is a more persistent collective and we addressed this by the design of the MediaSurfaces to support media use in the home and family. For what is a home if not a frame around a collective, what is a family if not a collective?

Facilitating Emergent Social Interaction through Design

A problem occurs. As people, including users, are free minded and most often free to do whatever they please, how then can we design, define and decide what type of social interaction is going to take place in a designed space? How are we to convey our intentions to the collective user? This is of course a basic challenge in interaction design with any individual user, and when it comes to designing for social interaction it is foregrounded even further.

6 Facilitation

This chapter is then a discussion of the role and position of the designer in designing for social interaction. As has been stated about user-experience design (Battarbee 2004; Hornecker 2004), the designer is not in a position to define or prescribe the actual experience the user has, and the same can be said about defining the social interaction that the designer envisions will take place. Referring once again to Hallnäs and Redström this can be seen as a prerequisite of the design process itself (Hallnäs and Redström 2006). In dealing with 'the disappearing user' the designer is unable to predict what is to happen in the proposed design, but he or she is able, also with the aid of the concepts developed in this dissertation, to *project* future reality based on more nuanced notions of what it is possible to support the emergence of.

Creating the space into which people will engage in interaction and create the social situation is what I refer to as *facilitating emergent social interaction*. I posit that it makes sense to see the activity of designing for social interaction as forming the afforded qualities that is to frame the social interaction and carry the intention of the designer, shaping the interaction that will take place. I see this facilitation as a design task coming as close as possible to the creation of social form. Social form relies on participation of individual and collective users, and since, at least for the design space I am concerned with out here, these participants are free to do whatever they please, the design challenge is to facilitate the emergence of the forms of social interaction that the designer and the client is aiming for.

6.1 Experiment: DARE!

As a boundary object for the following discussion I would like to introduce the basic design assumptions and starting points for exploration and development in the Nomadic Play project and in creating the DARE! game

The DARE! game experiment is a radical example of design for social interaction in the sense that we are not only presenting users with a frame to interact in and let social interaction take place, like the two other central design cases. We present users as part of social groups with tools to construct a game by themselves, and thus the social interaction that we envision in the DARE! game use-scenarios are one step further away in facilitating social interaction than in the iFloor or MediaSurfaces cases. We present our users with a possibility to create a whole new social situation – a game – with definable rules and context. We put to their disposal a community tool for creating games and plays and communicating about them in the group they define themselves. So here we provide the frame that provides the frame for social interaction. This is done, as mentioned in chapter 3, since we see that social experimentation is a big part of growing up for the age-group of 7-12 year-olds, the tweens, and we then present a game for creating social experiments among themselves. In this we assume that it is not only designers who wish to create social settings, people engaged in living their lives are too.

Our vision, which at the conclusion of this dissertation only have been 'tested' by asking a few girls in the target-group about the general game/play-idea and showing a preliminary prototype, is to have users build challenges to each other and send them around in the already-established social group of for instance the school class or a smaller group of friends.

Compared to e.g. the iFloor we are designing then for unexpected, although not exactly unintended use, while still designing for the expected social construction that we believe is important for this age-group. The iFloor has in the design a range of uses and while we were setting it up and testing it we saw how a tug-of-war game emerged from how the different technical components of the cursor's strings to users and the video-tracking software overlapped in actual use and created new potentials for play. In the DARE! game we have made a small number of simple components, like time, place, participants and acts, which can be combined to form as of yet unknown social games and playful activities [paper 7] and (Andersen and Brynskov 2006).

6.2 Clash of intentions

How do we make users by their own free will engage in the social interaction we are designing for them? Is this an ethical problem or a technical, disciplinary problem? This is maybe the softest part of the development of the conceptual understanding of designers' position in designing for social interaction, but as a fundamental problem it points to underlying concerns as well as potentials; to design for better and more engaging technologies and interactive products that are respecting and allowing a more social aspect of human life to be foregrounded in everyday use.

6.2.1 Meaning

As mentioned in the previous chapter Dourish unfolds the notion of intersubjectivity as an aspect of social interaction, or more precisely as an aspect of meaning occurring in a social world (Dourish 2001) p. 132. The intersubjective connection between people communicating the meaning of and thus meaningful *use* of a computational system is only one of two main understandings of intersubjectivity. The other form, which is more in line with the discussion in the chapter, is the communication between the designer and the people ending up using the designed.

> The designer must somehow communicate to a user a set of constraints and expectations about how the design should be used. The system can be thought of as the medium through which the designer and the user communicate. The designer's intentions are communicated through the form of the interactive system itself, and through the ways in which its functionalities are offered.
>
> (Dourish 2001) p. 132

So, intersubjectivity also means that there exists a relationship between the designer and the user in which the designer communicates to the user what he or she should do with the designed – how to use it. This relationship is closely related to the idea of affordances from ecological psychology (Gibson 1979; Gaver 1996) where 'affordances' means that which communicates (or doesn't communicate, if poorly designed) the use of a designed artifact. These can be designed and affordances is an active concept in design practice. This then becomes a form of communicative act inlaid in the designed artifact; the physical object or digital interface. Affordances have been criticized for not bridging to design well enough in e.g. the sharply titled paper "But how, Donald – tell us how?" by Djajadiningrat, Overbeeke and Wensveen (2002) where the propagator of the affordance concept into the design community Donald Norman (1988) is used as proxy for renewing and adding to the theory with the concept of feed-forward, making it better fit and more generative in the design process.

This is also closely connected to one of the other aspects of conveying meaning between the designer and the user, as Dourish is unpacking. Ontology is the conceptual frame of understanding the world and the relations between concepts. "Ontology deals with how we can describe the "furniture" of the world" (Dourish 2001). Creating ontological understanding is done through our personal and private experiences in the world and as such it is a philosophical problem how independent individuals can reach shared understandings of e.g. subjectively experienced abstract entities. Disrespectful of this problem designers nonetheless design meaningful objects that are appropriated in the world as meaningful in the way they were intended. There is a communication of intention through the intersubjective link over the designed artifact. But on what level is meaning created, and is the designer's role not merely to suggest rather than define.

There is an interesting discussion here on one hand the subservient role of design as suggestions for appropriation and design as the making of 'acts' that define intended use. Dourish is able to create clarity on this subject matter by presenting principles for design dealing with the emergence of meaning and use;

> Principle: Users, not designers, create and communicate meaning.
> Principle: Users, not designers, manage coupling.
>
> (Dourish 2001) p. 170

Coupling in Dourish's conceptual framework means how the relationship between an action and the outcome at or in the artifact is made effective, and "the intentional connection that arises in interaction, so while a designer might *suggest* a coupling, they cannot actually make one. Only the user can do that, because coupling only happens in use" (ibid.) p. 172. The meaning of an interaction, the couplings that the user makes of theses meanings and how the artifact behaves are the essence of what the user thinks of the designed and how he or she uses it. Dourish' suggestion for a reframing of the designer's stance is that designers must, instead of thinking they control the interaction between the user and the designed artifact, refocus on presenting and providing resources that will enable users to appropriate the designed into their everyday practices. This means that designers have the responsibility for certain aspects of the designed like form and function, and must have some expectations of the use of the artifact they design. But this responsibility does not extend to the actual use, although this is the goal of the designers' intentions.

6.2.2 Intentions

Designers have intentions of uses and most likely these intentions stem from a client's similar or overarching intention of a profitable or engaging artifact, or, in some cases, from a research interest that governs questions and intentions onto a context.

These intentions are then communicated through the designed as affordances and structures of actions. However "Interaction design does not mean staging actual use … What we design is the conceptual context, which gives an act interpretation of intended use of a given thing." (Hallnäs and Redström 2006) p. 24. As designers in this context we need to understand that which we design and our design material is not only physical matter, or the electronic components, but anything that is able to convey these acts of intended use. When design is successful the designer is able to create acts that define the intended use that the user finds meaningful. The user creates the meaning and it is the designer's job to construct uses that fall within this potential for meaning. "Intended use is a concept, not defined by acts of use, but by act definitions." (ibid.) p. 78.

This goes for the collective user as well. As meaning arises out of social interaction as both (Dourish 2001; Hallnäs and Redström 2006) state, the collective user is an important target in design. And designing for social interaction is all about finding what resonates with the meaning already present, while at the same time the designer is in a position to introduce that which has not been present before, and in that way create new social forms and collective users.

6.2.3 Unintended use

Another way to describe the clash of intentions of the designer and the user is the concept of unintended use. This has been a source of interest by both designers and people studying the actual use of technologies and their impact on everyday life. As Erik Stolterman reflects here, this makes particular sense when looking at how technologies are placed and used in social context.

> A community is always changing. People have all the time new needs and [desires]. The technology for supporting such a community must build on the idea of "unintended use". Unintended use is not a threat to the supporting system; instead unintended use has to be understood as the creative driving force. Creative unintended use is a way for users to "take control" of the technology, to make it relevant to them. Unintended use is necessary in a community support system - not a problem.
>
> (Stolterman 2002)

Unintended use happens when people hack and reformat technologies and/or use the technologies in contexts and situations that they were not intended for. Of course there are places where users' creativity is not welcome, like financial transactions on the web, but in most other cases the creative intention and impact of users are refining and developing the designed into unintended relevance and quality.

Battarbee, describing the elements needed when designing for co-experience (Battarbee 2004), discusses how use and the experience evolves over time, past the novelty stages "first five minutes" and "first five days" after this the use of a service or artifact will have settled into what then is more likely to be the prolonged actual use. And with regards to the experience of having used the artifact, people are authoring their own experiences and doing this in collaboration and negotiation of what has happened and what kind of experience it was. Unintended use is then most likely to appear when users have found out how an artifact is useful in the context of their everyday lives, and then remove themselves more and more from the designers' envisioned intended use taking an independent view on the artifact.

Unintended use is then what is emerging, but the designer was not able to see. The unintended use still has intentions behind it, not 'unintentions', the designers are just unable, unwilling or surprised to admit the users the right to define use. Designing for unintended use and usefulness is an approach to design that brings focus to this opening up of uses of the designed artifact and allows users to construct meaningful interactions themselves. This is what is currently evolving as *design for emergence* and is itself an emerging concept in the HCI and interaction design fields (BayCHI 2006; Vogiazou, Raijmakers et al. 2006).

6.3 Emergence

Emergence is that which is on its way to become. Emergence as a quality of a material or a field is that which forms as the material changes or is mixed with other materials. The emergent qualities are sometimes difficult to predict as they are not immediately present and available in that from which they emerge. Like the wetness of water as an emergent quality of hydrogen and oxygen meeting, the emergent quality of a social situation is hidden as a potential before the fact. But we do know that something can happen, and with *designing for emergence* the material of the design becomes that on which the situation is to emerge.

Emergence is itself an emerging concept in the design community these days as especially socially oriented web-applications developed within a perspective of Web 2.0 (Wikipedia 2006b) are seeking to take advantage of the social interactions of users

by creating a live community that attract the attention of a large number of individuals. Here the perspective is to provide the functionalities for this community to arise out of a need or desire, to perform a certain type of activity like selling things, sharing videos or commenting on news – whatever arises as meaningful to the community. In that sense designing for emergence is closely related to community building, which can be seen in relation to computational technologies (DePaula 2003) and interaction design, and it is also a field of research, investigation and practice in itself e.g. (Imagine_Chicago 2006). This need or desire, of the community or collective user as it has now been defined, is only in potential while the designers design, and is first released as the designers release what they have created. Of course participatory design methods are able to tune the design and test whether it is relevant to a focus group of a yet only imaginary user community, but the relevance and value of the platform for facilitating the community is first tested in the actual use.

Designing for emergent behavior is also appearing as a focus of the pervasive gaming genre [paper 7]. Like in the example of the DARE! game, other pervasive computing games are as well concerned with how we design for the playfulness of the game to emerge and new aspects like expertise, roles and unimagined social interactions can evolve from the artifacts we design and present to the people playing the game. An example is the CanYouSeeMeNow game developed by artist group BlastTheory and researchers from Nottingham University. Crabtree has described how players in the game came to a refined understanding of the material aspects of the game controls (Crabtree 2004), e.g. in the case of knowing how GPS-receivers work and how they are affected by the surrounding physical context. This led to new behaviors like communicating in one team about chasing the opposing team's players into a particular spot where they would be easier to catch because coverage of GPS-satellites was good and undisturbed by tall buildings. Crabtree calls this form of design that exposes new social conducts for *breaching experiments*, since the game introduces a new and unknown social space that has no prior practices attached so people engaged in this space define and negotiate the practices as the game evolves. This is likened to provotyping (Mogensen 1994) which are prototypes designed to provoke new insights about an environment, insights that would not otherwise be brought to the surface through normal participatory design methods, since they are tacit parts of the social field.

In the CitiTag game (Vogiazou, Raijmakers et al. 2006) this approach is taken a great deal further as emergence becomes the central aspect of designing. In the example of CanYouSeeMeNow the game was developed as an experiment with pervasive game in urban context, and the absence of practice and the study of how practices emerged was an added perspective in the course of the ethnomethodological research conducted during game-play. In CitiTag the design researchers had the notion of emergent social behaviors in playing games up front when designing and had tested it in a number of other simple online game applications (Vogiazou and Eisenstadt 2005) before venturing into the more complex context of urban space and physical, co-located gaming.

> Our approach to design for emergence in this game can therefore be summarized as follows: simple game interaction rules, providing for interaction with the physical world, simple metaphors that relate to players' past experiences. …[O]ur research focuses on how play, based on very

> simple game rules, can lead to more complex interaction in the physical world, emergent cooperation and collective behavior
>
> (Vogiazou, Raijmakers et al. 2006)

So simplicity of means creates the potential for emerging alternatives to the use imagined by the designers.

The issue of emergence places the designer right on the boundary in the clash of intentions. The designer has intentions for a particular activity, in this CitiTag case gaming taking place in an urban context with PDAs as technical platform. Then users engage in this intention and make it actual use, and in this actual use several practices emerge that are used for winning the game. So in some sense the 'unintended' use in the emergent behaviors are indeed intended – by both users and designers – they have just not been foreseen and modeled in detail beforehand. In both these two pervasive games, CanYouSeeMeNow and CitiTag, the emergent behavior seems to be around users becoming more aware and skilled in playing the game – behavior still within the game-metaphor or 'magic circle' [paper 7]. In the DARE! game, although still not tested in prolonged actual use situations, the idea is to widen this designers' intention to be around the socially constructed plays, and then let the context, rules of e.g. winning and losing be up to the creators of each little game. Furthermore the genre of *mock game*, of which DARE! is an example, is placed between defined games with rules and free play as on a playground. A mock game is continually mocked up and the rules are refitted to fit changing situations [paper 7]. Still, however, the activities of the kids are embedded in our design-idea of intended use, since this sets no or very few limits to the particular activity, but on how it is communicated. The kids in our example could be playing tag or be engaged in criminal acts like "happy-slapping". We make no distinction between these kinds of activities, but in the latter example the dares are kept on record and extended into the community of peers, so any activity has social impact[6].

6.4 Facilitation through design

In this sensitive or unclear position the notion of *facilitation* can be introduced to unfold the perspective of the role of the designer of spaces for social interaction.

Facilitation has been taken up in the HCI and interaction design community by Eva Hornecker as part of her work on describing an encompassing framework for tangible interaction user-interfaces (Hornecker 2005). Here she points out four overall themes for the design of tangible interaction for collaborative use; tangible manipulation, spatial interaction, expressive representation, and lastly, and interesting in this context, embodied facilitation. Inspired by pedagogy and group dynamics Hornecker defines facilitation as follows:

> We can interpret systems as spaces or structures to act and move in, thereby determining options and behavior patterns. They enforce social configurations and direct user behavior by *facilitating* some movements and

[6] Ethical issues of the DARE! game are further discussed in the Mock-Games paper [paper 7] and throughout the project, as we are dealing with sensitive privacy issues as well as pedagogical issues.

> hindering others. Thus, they shape the ways we can collaborate; they induce us to collaborate or make us refrain from it,
>
> (Hornecker 2005) p. 26 (original emphasis)

This means that material and system qualities of the designed shape the social interaction taking place, as previously discussed in relation to e.g. (Gaver 1996). The designed is a communicative object. As design – including interaction design – works with projecting mass-produced products to a certain degree, the product itself must contain these qualities communicating its use. This is facilitation through design of the interaction that is intended to take place.

Physical artifacts play a role in forming our presence and social conduct, as have already been proposed by the range of theoretical frameworks already touched upon; distributed cognition, actor-network theory and ecological psychology. Embodied facilitation in Hornecker's framework means that which is made possible and preferred by the designed artifacts or systems interface. She divides this theme into concepts and guidelines meant as recommendations for actions into this design effort and exemplify these in designed prototypes. In a very concrete way these concepts and guidelines point to challenges in making tangible interaction interfaces and systems for collaborative use:

- Embodied constraints: Physical systems set-up and configuration of space and objects that restricts what people can do and thereby make some behaviors more probable than others. This concept is manifested in the following guidelines for design: Exploit constraints that require groups to distribute the task, help each other out and coordinate action, and provide a shared 'transaction space'.
- Multiple access points: Access is here an issue of power referring to the possibility of actively manipulating relevant artifacts and controls. Communicated to designers through these guidelines: Give multiple points of interaction, allow for simultaneous action, and give equal access – no privileges.
- Tailored representations: Users should be able to quickly explore the basic syntax of interaction, and over time acquire more complex syntaxes of advanced interaction and understand or tailor several layers of representation and legibility depending on expertise. Guidelines here are: Build on the experience of the group and its members, make the interaction intuitive enough for easy access, and allow the semantics to rely on specific knowledge.

  (Hornecker 2005)

Hornecker's framework then revolves around some of the same qualities of the interface as was brought forward in the discussion of designing for emergent behavior and use. The simplicity and adaptability of the interface to the specific situation and user is a stepping stone for further and more engaged collaboration around the designed artifacts. This potential is designed and defined by the designer in the artifact. The guidelines that Hornecker presents are to be brought directly into the design process, and as such aimed at being applicable by practicing designers. She has developed these from a range of analyses of existing designs and applied the theme of embodied facilitation into an ongoing design project where it renewed the base for ideas and refined the work already in progress.

The framework extends beyond this theme with other themes and concepts and guidelines accordingly. Furthermore the framework seems to be object-centric and looking to the designed artifact to create concreteness in the guidelines. This then means that the framework is mostly applicable for tangible interaction, as was also the goal of the research, but is also limiting the impact by referring the complexity of social interaction to discussions of the interface, to things that are manipulable to the hand, and not the social interaction itself. Of course the reference to particular points of the interface and designing them so that social interaction is going to happen is a way of addressing the social space through the design of the interface. These guidelines are then a good example of how the designed artifact can facilitate certain types of behavior like collaboration by using a list of subjects to pay attention to when designing. But collaboration is only a part of what social interaction is, and tangible interaction, although an interesting and potentially impacting strand in interaction design, is a limited segment of interaction design's field of interest.

6.5 Designing for emergent social interaction

The fundamental challenge of referring directly to the social interaction is that any problem dealing with social issues cannot be solidly defined and is then best described as a 'wicked problem' (Rittel and Webber 1973; Buchanan 1995). Is it possible to formulate something in the line of a guideline or tool for thought even though any social problem becomes a wicked problem? As I have previously referred to in this dissertation, what this work aims to do is create awareness of the starting point of thinking and reflection-on and reflection-in-action about the social situation the designer wishes to design. This is in particular relevant when the social design is viewed as a wicked problem and the designer is seen as Rittel and Webber's planner and analyst: "The analyst's "world view" is the strongest determining factor in explaining a discrepancy and, therefore, in resolving a wicked problem" (Ibid).

Facilitation and intention are closely related. When dealing with particularly social space and the social interaction of free minded individuals and collectives, there is a strong conviction that this cannot be defined by a person through intention, standing outside the situation, not being present in either time or physical place. At the same time we know from the history of design that designers are able to affect social space. Particularly in architecture and spatial designs (Gehl 1987) atmosphere can be designed inscribing a certain range of social occasions and affecting the social situation and encounters taking place. In an environment dominated by participatory design thinking, we rarely speak of the intentions that we as designers have for what is going to happen when the designed is in function in the context of use. This has to come from the participating users themselves and the designer should simply be facilitating the process of knowledge acquisition. However, this exaggerated image is rarely if ever true. Designers have intentions from the beginning of any project, and the job in participatory design is to align the constraints and potentials that the designers and the client are contributing to the design space with the constraints and potentials that are elicited from users as these are uncovered in the design process.

Returning to the definition of what interaction design is and the closely related description of the design circle from Hallnäs and Redström (2006) the discussion of facilitation is a problem of handling the second of the two hermeneutical gaps that are

an inherent and inescapable part of the design circle. As interaction design is "designing the acts that define intended use" the designer is to present people – the user – with something to do, a doing that has been intended, laid out, prepared, forecasted, designed. This doing is then manifest through "acts". We then touch upon a discussion of control, responsibility and intention and the dynamic system in which these are negotiated between the designer and the people using the designed. As the technologies and artifact we design are brought from potentiality and design space into the real world of actual use, the designer is handing over the control of the designed, while the user at the same time is leaning into the intentions described by the designer through the designed. The user is in control here and can just choose not to be affected by this, but the designer is communicating to the user through the artifact and persuading and tempting the user to use the 'designed acts' in a certain way, for example through aesthetic qualities as in aesthetic interaction [paper 4].

6.5.1 Experiences from the design case experiments

Through all of the engaged design processes in this research project the notion of social space have been at the forefront of the intended outcome of the designed. For each process we developed a vision for a particular form of social interaction based on user studies and users' participation in design work.

For example in the iHome project we decided on creating a type of social space that would translate qualities from the shared physical space of the home to the shared digital space of the MediaSurfaces. We wanted to emphasize 'togetherness' as it would be expressed in both collaborative uses of the artifacts and through leaving traces of activities and sharing the digital resources that were available in the system. We implemented an experimental system with several users and private spaces for each user, but without password protection or any other locking of resources from each other. We then let the social conventions already present in the home govern also the activities in the digital space.

In the nomadic play project we saw that the experimentation with social forms and 'hanging out' with the friends became much more important to the tweens in our user studies, and frankly the LEGO-values of constructive play were neglected in favor of activities with focus on the social context and negotiating social position. However we still saw a lot of playful activities even if the tweens would not themselves say that they were playing games. We then settled on an intention for the design we were about to develop: It should support playful activity by supplying the users with something that would connect them to their different social contexts even when they move around in nomadic style. This playfulness in the connection should then be about activities like experimentation with social forms, which ended up in the form of making dares to each other in the middle of a group that would follow activities and be a close knit group of friends. Under this intention is a deeper intention about believing that children should still be engaging in playful activities even if they leave their toys behind and see themselves as small adults.

In both cases the underlying intentions have governed the designs and developments of these particular social platforms. In both cases we have been very aware of this base of design and as such it is one of the general design sensibilities that are coming out of these projects; that the designer must be aware of what assumptions and ideals

of social interaction that the design project has at its foundation and how this clashes with the social interaction already at play.

6.5.2 Design sensibilities

Unpacking this understanding uncovers that this is by no measure an easy delimitation to make as the fluctuating boundary between what the collective user decides to create or become and that which the designer intends is not easily described since:

- The user decides what social form is engaged but the designer creates the possibility for a social gathering to occur.
- The designer cannot make a social space emerge since the user creates and communicates meaningful interactions, but the user will go on in undisturbed everyday activity if the designer does not present him or her with alternatives[7].
- Emergent behavior is engaged by design as a potential, but users define actual use, not designers.

Design circles (Hallnäs and Redström 2006) of proposals and potentials, intentions and engagement. The designer's stance as facilitating social interaction is dominated by such paradoxes, and knowing it to be a wicked problem to design in social context the only really big mistake the designer can make is to become paralyzed in the face of these contradictions. Social interaction and the collective user have to be engaged to come into existence.

In the projects I describe here this is seen very concretely as we have engaged the social contexts directly through inviting users to participate in idea generation in all three central cases. We created scenarios from the beginning of all projects, and later also with users and industrial partners, looking at the potential of the context from a number of different perspectives. Lastly we have confronted our ideas, scenarios and sketches directly with the use contexts by building the ideas into working prototypes and seeking the continual refinement of the design proposals through this confrontation. In the Nomadic Play project our first prototype, StarCatcher, was a test of a very simple game of capture-the-flag played on mobile phones with GPS, and it had the function of a proof of concept that the people in out target-group, the tweens, would want to run around in the city and play with a virtual object only on the screen. In addition to this simple proof of concept we got an insight into how to establish a competitive field by using the established social context of the school class as background for the game. The kids were eager to get a rematch after having lost to a team of their classmates. Friendly battle, jousting and teasing can be used as vehicles for increasing the tension of the game and thus the users' willingness to participate. This has been part of forming the further development of the DARE! game concept and place any dare sent and taken in a social context, a group of friends defined by the players. The out-of-game negotiation of the game activity then

[7] This points directly to one of the underlying assumptions of this entire project. Users are confronted with technologies, services, designs that present forms of interaction. To an overly high degree these designs present single user experiences and interactions. As designers we need to be aware of the social potential of people, including users, and design for this to be unfolded in real life and not designed out by a mistake.

becomes an important part of the game concept, but one that we only need to support in broad strokes as most of it will take place and be moderated in the normal social setting that the collective is already framed by.

This means that there are some design sensibilities to derive from this for use in future design projects dealing with social space. These sensibilities are meant as refining reflections-in-action (Schön 1983) and to be applied as the design project is ongoing and unfolding in the hands and heads of the designers and users. They confront the ideas behind the design and they can be applied both in the design team and outside by presenting and confronting ideas into the use-context:

- What is the underlying social interaction ideal behind the envisioned collective user?
- Why are you envisioning this type of social interaction?
- What are individuals gaining from joining the proposed collective user?
- What is hindering this social interaction or collective user to already be present?
- What is a tipping point for the interaction form that you envision to come about?
- What rules and practices are developed and present to support the collective you envision?
- What rules must be developed and how should these be manifested?
- How will the collective regulate behavior itself?
- Examine the purpose of the level of social interaction that exists right now, compared to the one you are envisioning – which purpose is strongest and in what ways must your vision be reformatted to be more thrilling or stronger?

All these nine questions have been addressed in all three design cases of this project in a continual effort in facilitating meaningful social interaction. As mentioned this has been done through a range of methodological approaches like prototyping and participatory design so what I am proposing here is not a new methodology for designing for social interaction. More to the point these design sensibilities enable a refined awareness of the complexity and challenge of designing social space with interactive technologies.

As a concept for encompassing all the different aspects of this discussion I introduce here the idea of *facilitation through design* when designing for social interaction as the designers' task in this type of design, or rather how the designer should think of his or her stance in relation to the designed artifact and the emerging social interactions taking place. 'Taking place' is here related to Harrison and Dourish's discrepancy of space and place, where the place-ness quality of a space evolves as real people fill the space with meaning, practices and interaction (Harrison and Dourish 1996). These specific social interactions cannot be designed, as discussed, but they can be formed and affected by the design, through the understanding of social space that the designer has. This then becomes *making* social space and facilitating the intended and emergent collective user is an *active* yet respectful position in relation to the design space and the people using the designed – the use context.

6.6 Summary

As we have been discussing how to define the limit between what the designers defines and what the users define when new forms of social interaction are being proposed into a use situation, there seems to be no easily defined limit, but more likely concepts that refines awareness and perspectives on the manipulability of the social space. It is difficult to describe an exact border. It is like the man walking on a beach with bare feet in the sand, right where the water stretches up on the sand and retracts to the sea with every incoming wave. Sometimes his feet are under water and sometimes they sink into the sand leaving foot prints. Sometimes the sand is soggy sometimes his feet are moved by the undercurrent of the withdrawing water. He knows what is happening – he has walked here since childhood. But if he stops walking and starts arguing where the water stops and the beach starts, and wants to draw an exact line, then he can never come to an understanding of what is actually going on and he will only come to a non-sense definition of a borderline. We might know tacitly what we are doing since we have been doing it for thousands of years, making social spaces through architecture and designs of furniture and interiors, and what I am trying to do here is to rebuild this knowledge to the complexity of designing digital technologies. There is definitely not a strict line or limit that tells us what is possible and what is not, and thus I have tried to develop meaningful concepts that describe and denote the tensions and potentials of this design space.

In this design space there are intentions and there are meanings. Meaning is decided by the user and intentions are carried by both users and designers. Seeing design of social interaction as facilitating emergent behavior is presented as a way of framing a designer's stance in relation to this design space, and a list of design sensibilities is presented to aid designers' reflection-in-action of this process. Compared to other frameworks on this issue these design sensibilities are not concrete in referring to the designed artifact, but is aimed at the design process itself as tools for thought, and aimed at bringing focus to the social space, the collective user as an entity in itself, not by proxy of the designed artifact.

Extending the result of a piece of research in such a form then presents a challenge in it self. Is that a valid scientific result and what is a result in the science of design? I have proved nothing, but only proposed ways of thinking that have only been tried in few occasions. Fundamentally I have not proven anything in these projects or in the reflection, but through a design-based inquiry I have come across a range of concepts that can refine our understanding of designing for social interaction. These are presented as proposals for new knowledge in accordance with the definition of scientific results that the following chapter will unpack.

What are scientific results in a science like design research studied in a research-through-design methodology – a scientific direction still in its formation process? As I have now presented the reflections and contributions from the project-based design work I have been involved in, it is relevant to present an argument of why and how such reflections can be understood as scientific results. This discussion of the workings of a science of design is also engaged hoping that this will make a meta-reflection on the entire process of this research project, again based on the concrete experiences from the multidisciplinary design experiments.

Part III - Chapter 7

Reflections on Interaction Design Research

> Design Research is alive and well, and living in an increasing number of places
>
> (Cross 1999)

This chapter is intended to deepen the reflection on what I have done and how I find that this work qualifies as a scientific study. The dissertation so far has summarized the work I have done in the PhD-project and much of the project work has already been peer-reviewed and accepted into conferences. So in a pragmatic sense it is science since it is accepted by my peers as such. However the methodological and philosophical discussion of how this work constitutes a scientific study has not yet been that thoroughly investigated, which is why I will do that here.

The aim here is to look into design research, through the eyes of interaction design research, as a scientific discipline in itself, and potentially establish clarity on what it means to hold design as a scientific genre or method, and not merely a subject matter. 'Design' itself is a heavily debated word. As the community is not thoroughly able to define design and its connotations design research is probably as difficult to define. Fundamental to design is the disciplined thinking that designer engage in when solving problems and making innovative designs.

7 Design research

Design in a research perspective can be seen as either something distinctly different than other types of inquiry and traditions, or we can look at it as that which can bring together a range of different scientific disciplines and traditions into a shared move forward in creation: the part of research where knowledge from various places is put into action in context and an actual product. The first perspective will point us to looking at what then is specific and exclusive for design as an activity. We see today that several research disciplines are involved in designing, but there are some that use the term "design" to define themselves as a disciplinary category. The second

perspective could point towards what has been known as "action research", or towards another similar term "the constructing sciences". In other words, one can look at the current state of interaction design research either as in conflict with the surrounding disciplines in HCI, or as interaction design as the term denoting the confluence of disciplines in the same field. Both perspectives are correct and can be seen in the field today, and both are interesting and could yield insights as we go into them a little later in this text.

In a Latourian (Latour 2004) perspective (a framework I shall return to) the aim of this chapter is not to make a tough and rigid, undeniable and unfalsifiable definition of design research, but rather it should be seen as one way of describing design research and place it into a current discussion of science and design research. My goal is to make a wide *proposition* of a foundation as opposed to a narrower but deeper definition of design research. I will draw on a number of very different sources in order to get to a description of what can be said to be design research. Using multiple angles like that will hopefully construct an open and engaging description and base for a discussion of design research.

This chapter on the foundations and distinctions of design research is an exploration of the perspective on science that I have worked from in the project and a relation and explanation of this perspective in relation to a general discussion of science and scientific inquiries. The easiest way of defining the work I have done as a scientific study, is in the pragmatic sense that since I have received money in form of this PhD-project as a design research project, and it is furthermore undertaking by a person educated as a designer and dealing with designerly issues, then it *is* design research. However, this institutional argument does not engage in the qualitative or structural discussion of the work or field. What is design research and what is not? And what is quality in design research?

The topic of design research has been debated widely in more than 40 years since Herbert Simon made his famous statement about a 'science of design' in his series of lectures 'Science of the Artificial' in 1969 at MIT (Simon 1996). Right now there is a renewed interest into the subject mainly since design research has engaged in interaction with the technological and sociological sciences in the bustling area of Human Computer Interaction (HCI) research, but also because there seems to be a general trend towards a 'scientification' of a range of disciplines, design being just one of these. This has extended the idea of design research from the traditionally more technical disciplines to the more aesthetically oriented design disciplines, where a research tradition is not as strong, and where the process of design is viewed as a less structured process, described by such terms as working with "wicked problems" (Buchanan 1995) and design circles (Hallnäs and Redström 2006).

In the following I will go a little deeper into this discussion by first describing the state of affairs as I see it within the branch of design research that I have been engaged in the project at hand, namely interaction design research in the field of HCI. Being a varied field of diverse disciplines, HCI draws on various standards for scientific valor, validity and quality between the disciplines. After that I will describe from a designer's viewpoint in that context what design research is as a scientific discipline based on design thinking, and consequently how it differentiates itself from the other disciplines taking part in HCI. This is the conflict-perspective.

Many other participants in HCI make designs, innovate and get new ideas for technologies and applications for technologies, however they do not necessarily apply design thinking to this process. HCI is filled with constructive sciences and the following discussion of design research is not an attempt to state designers of one background as superior to another, but rather an attempt to focus on what the differences are between designers from technical backgrounds and designers from aesthetic backgrounds. This distinction is applied even though it often can be hard to see in the results of design and even though disciplines are merging and mingling in a continual process to define and educate interaction designers. This is the confluence perspective.

Lastly it should also be mentioned on a note that in the following design science and design research is and have already been used to cover the same activity. I am aware that especially in the US there is a distinction between the two as the latter can be external to the academic discipline and simply mean a designer investigating something in the course of a design project (for further exploration of this notion of design research, reminiscent of pre-design, see for example the preface by Peter Lunenfeld and the introduction of Brenda Laurel to the book *Design Research* (Laurel 2003)). The first then becomes a very serious activity which to some extend excludes the practical design work. Using the two concepts as one and the same in the work de-emphasize the difference between practice and academia, since I think the same kind of activity and reflection can take place in both domains and a strong connection of the two is crucial to a vital science of design. The first main difference between industrial oriented design work and design research oriented into the academic arena might simply be found in the communication and product or outcome of the activity, not necessarily in the process itself. The second difference is that scientific research must be leaning into the unknown, not as a personal or isolated endeavor, but on behalf of the entire field. Otherwise the innovation bar would not be raised high enough.

7.1 The conflict of design research in HCI

The science of design is in turmoil these days. Within design research we have not reached what Thomas Kuhn in his description of the shifting of paradigms (Kuhn 1962) called the state of puzzle-solving normal science. This is when a scientific community knows what its foundation is, it knows how to look at problems and even what the next problems to be solved is. There is a sense of coherence and achievement. As design institutions are becoming aware of the potential of doing research, both in financial, educational and a wider disciplinary perspectives, there is an emerging need to understand what design research is and how we distinguish good from bad research. Pragmatically this is due to the distribution of funding and the upholding of scientific value in the broader field of interdisciplinary discussions of subject matters. None or very few subject matters are isolated to the scrutiny of only designers doing research. There will always be a discussion between varying researchers and their concepts of quality in research. In the conflicting perspective design research is engaged by both types of designers, engineering and creative, but they disagree on who works correctly with design.

So design research is a form of science still in its formation and integration state. It has not reached the consensus of normal science and there is still a great deal of debate on what constitutes the base of the discipline, what could be called the dominating disciplinary paradigm that defines the field. Paradigms can be seen as overall concepts that define the world and how science act in it, concepts on such a high level that they are integral part and parcel of researchers worldview, and therefore almost invisible to those working within this paradigm. However shifts in paradigms also take place on smaller levels in less dramatic ways. And especially when looking outside the laboratories of the natural sciences paradigms become a multiplicity of traditions of one field or "schools" of inquiry within a field like the ethno-methodological tradition within ethnography (Dourish 2001; Crabtree 2003). It makes sense to claim that one branch of science can be in discussion of its paradigm while the neighboring sciences are not in this same sort of existential crisis, but simply discussing nuances of the agreed-upon ideal. So in order to describe what the current conflict or dynamic is within the science of design, this seems to be a valuable concept. The conflict that design research is facing as a part of HCI-research seems at first to be a conflict of solidity of paradigms.

This is part of the current frustration of design research. As I will return to later, creative design is at its foundation a fundamentally different way of thinking than that of the dominating notion of scientific inquiry, thus the results of design research are often unable to fulfill, or uninterested in fulfilling the characteristics of good science as it is defined by these dominating perspectives in HCI. Since design research is in its own formation process there are no solid criteria for discerning good from bad or lacking science. But in HCI there are plenty older and more respectable types of scientists (Card, Moran et al. 1983) participating from fields where the standards are more solidly defined. These types of research have a better foundation for defining the criteria on which the good and valid results are judged and thus also defining how research is to be undertaken if one wishes to be successful – and in this field-of-science perspective that means to be accepted into the best conferences, appreciated and quoted by ones peers.

Thus peers from psychology, computer science, the humanities and aesthetics, different genres of sociology and engineering can, since they have a much stronger position being grounded in (closer-to-)normal-science paradigms, define how design research is accepted into the HCI field, how the research is taking place and is approached, validated and communicated by designers. So what we see are cross-disciplinary conferences extending the same value-sets across all participating disciplines. And often this is not even seen as a problematic situation since the notion of design is that it is not of type of scientific inquiry in itself, but more of a certain way of presenting the same knowledge:

> We have been slow to recognize the peculiar indeterminacy of subject matters in design and its impact on the nature of design thinking. As a consequence, each of the sciences that have come into contact with design has tended to regard design as an "applied" version of its own knowledge, methods, and principles.
>
> (Buchanan 1995)

Consequently the role or challenge for design research is to make this distinction ourselves and state what constitutes a good scientific study in design research. Thus, in the current struggle of defining design research, there are natural opposing forces of such statements, namely those that have been working with design activities in their own practices or fields of scientific studies. These are within HCI e.g. the field of psychology where focus is mainly on usability, and social science disciplines where focus is on appropriation and use of technology in the everyday context of the users. Similarly engineering and computer science have a strong interest in design from the methodological level in e.g. participatory design, which was developed with computer system development in mind, and on the product, prototype or what one might call the manifestional level, where many of the important and influential innovations of the last decades have come from these technological and natural science based disciplines.

Defining these activities as design spreads the notion of design into many disciplines, potentially either devaluating design as an activity or linking multidisciplinary efforts towards creating the new.

7.2 The convergence of design research in HCI

In the confluence perspective, design is seen as applied by a wide range of scientific disciplines within HCI. One way of defining these is as the constructive sciences (Hevner, March et al. 2004). This is where design is engaged beyond the creative design disciplines (the disciplines that traditionally took their names from the process itself), and "design" becomes equivalent to or the same as developing and experimenting with e.g. software programs, technical or organizational installations. Design and construction is used in a range of research disciplines to create artifacts and test hypotheses of the new. This definitely lives up to Simons "devising actions for changing existing situation into preferred ones". HCI can be said to be a constructively oriented field in general. Most participants are interested in improving the quality of future technological applications and thus improving the lives we are able to lead with these technologies. For some participants in the field this manifests itself as theoretical contributions, or observational studies, and in such cases we often see the article ending with the section "impact for design" (Dourish 2006).

7.2.1 Constructive sciences

The idea of the constructive approach originates in management accountant research, where it seems there are two schools of inquiry in research. One models organizational development and decisions by developing and testing mathematical abstractions of the problems, and innovations and proposals are proved to be right mathematically. The other school of inquiry is base on making hypotheses and implement them in actual systems, to be used by decision makers in industry (Kasanen, Lukka et al. 1993; Hevner, March et al. 2004). This approach is applied in order to overcome the problem of relevance to the industrial community that the research wanted to talk to. Also the construction and implementation of models into actual context of decision makers refocused the research questions continually in stead of the artificial situation where "typically the academic literature has merely analyzed and interpreted the innovations constructed elsewhere after the fact" (Kasanen, Lukka et al. 1993). Constructions are defined by Kasanen et al. as "entities which produce solutions to explicit problems. By developing a construction,

something that is different profoundly from anything that existed before, is created: constructions tend to create new reality".

This approach is recognizable in a vast range of other scientific disciplines like engineering, biology, nano-technology and basically every discipline of reflection where we cannot be totally certain of a result or a theory before it has been tested in the context, or a similar context to where it is envisioned to function. When (Hevner, March et al. 2004) state that "in the design science paradigm, knowledge and understanding of a problem domain and its solution are achieved in the building and application of the designed artifact", they describe the constructive approach and in conceptually point to it counterpart in HCI, namely prototyping.

7.2.2 Prototyping

Based on Andy Crabtree's definition of prototyping (Crabtree 2003) it is a "methodology that introduces a foundational element of communicating with and feedback from the use practice into the design process (…) concerned with analyzing the design space from various points of view". So this strongly relates to the constructive approach in developing a placeholder for a hypothesis and let this hypothesis be examined, tested and reflected upon in the actual context of its use and by the people it is aimed at for this use.

The design efforts that Crabtree is focused on are within the field of CSCW and the designers are basically computer scientists and software engineers. However, the prototyping approach is, like the constructive approach, an effective way of recognizing and leaping across what Hallnäs and Redström (Hallnäs and Redström 2006) has called the hermeneutical gap, where the designer is unable to go further based on the logical knowledge of the context and problem space. He or she then progresses by envisioning the solution and then cognitively backtracks to find out how to proceed from the present. The prototype is a test of this envisioning and the feedback from it generates not only a better described path from the present to the realization of the full working artifact, but might even elicit new aspects of the problem space to be addressed. Preben Mogensen (Mogensen 1994) states the concept of 'provotyping' as a way of calling forth the 'taken-for-granted' in the context of inquiry and, in relation to CSCW, tacit knowledge in both the work practice studied and the design endeavor.

Design can certainly be seen as a subgenre of the constructing sciences but I claim that at the foundation of design there is a different approach to problem solving than in these related disciplines. Design in positivistic terms was defined as a logical construction process of solving problems, what has been characterized as going through the waterfall model. Basically design was thought of as something "tame"-able and applicable through logical steps. Later we have realized that design and innovation is inherently pointing towards "wicked" problems and situations (Buchanan 1995) where there is no one optimal solution. In the prototyping approach this is recognized as it is not the optimal solution being made and tested, but simply the solution that has the greatest evolutionary potential in testing the designer's hypothesis.

7.2.3 Design research as action research

As mentioned in chapter 2 another way of placing design as a scientific activity into a broader and acknowledged scientific genre, researchers have defined it as a form of action research (Argyris, Putnam et al. 1985). This field is a large and frequently used perspective on doing research that definitely has some of the strong qualities of design research. Action research is focused on change and intervention into contexts, and seeks to find its results through the same kind of building of theses and testing theses in real life contexts as some forms of design research – "to criticize what is from the perspective of what might be" (ibid). However I find it lacking to define interaction design research simply as a sub-genre of action research. Like the social and natural scientists action researchers are interested in the observation of phenomena in the world, but with the added effects of some kind of change that the researchers have themselves developed. Action research is a strong way at looking at e.g. methods for development and interaction and a range of social of processes, and "is commonly referred to as applied behavioral science" (ibid). To some extend action research can be said to be a 'social prototyping science'.

However, fundamental to the way I wish to define design research is the innovative character – based on an aesthetic position that works in parallel to logic thinking – as well as its intervention aspect, dealing with real context. Action research is then in my view a fine and valid stance to make for scientific study, but the goal of this chapter is to characterize some of what I hold to be unique aspects of design research, specifically in a research-through-design perspective.

7.2.4 Conflict or confluence – potential in discretion

I hold that at the core of design as an activity there is a distinctly difference in approach to the world as engaged material, different from the logical progressing process of engineering problem solving. This might be in support of the perspective of conflict, and as such limiting the potential of the width of the discussion of design research. On the other hand investigating this difference deeper could provide interaction design research with a theoretical base that would strengthen its position and applicability in HCI.

7.3 Design thinking

As the bi-polar view on the dynamics of design research in HCI has been outlined, next step is to try to understand the roots of the conflict which will shed light on the limits to - or the touch-points of - the confluence. In the following section I wish to unpack how design thinking can be viewed as a distinct form of epistemological endeavor. What I aim to do is not close the black box around design, but point to a qualitative distinction of design thinking that is necessary to maintain, as the boundaries of design is challenged in the new disciplinary context of HCI.

Herbert Simon defines design with "everyone designs who devises courses of action aimed at changing existing situations into preferred ones" With this definition he pin-points the nature of designing as something that everyone is doing from time to time, some probably more than others. However tying my shoelace before walking out the door is not a design activity although it is still changing a situation into a more preferred one. Innovation is central in understanding design. As soon as we feel that something has the potential to break the barrier from normality to innovation and

release unexpected potential, we seem to think of it as design. Klaus Krippendorf (2006) has extended Simons definition in order to distinguish a discipline from a mundane activity:

- Design brings forward what does not come natural
- Design proposes realizable artifacts to others
- Design must support the lives of ideally large communities
- Design cannot avoid ethical questions
- [Designed] artifacts must make sense to most, ideally all of those who have a stake in them

(Krippendorff 2006)

As Krippendorf further argues Herbert Simon saw design as progressing from analysis to synthesis, and was then not able to address some of the intrinsic complexity that Krippendorfs additions address. Simon, being a software engineer and coming from a modernist positivistic ideal, had the idea that a problem faced by design could be described in full before being solved through a design process where the best proposal for a solution could be selected and implemented. This logical progressing understanding of design is or has been well-established and dominating in many design oriented disciplines. It is connected to an engineering tradition but is difficult to extend into traditional design disciplines like architecture, industrial and possibly also interaction design. Contrary to this engineering approach is the notion of "wicked problems". A problem becomes wicked when the designer is not able to describe the problem to a complete extend before making the solution. The concept was developed by Horst Rittel in 1973 (Rittel and Webber 1973) in order to define the nature of the problems often faced in city planning and other contexts where social systems, as is the case in this dissertation, were part of the problem. "Coming to a consensus of what a wicked problem is, is the problem" (Krippendorff 2006). Richard Buchanan further explains wicked problems as "a class of social systems problems which are ill-formulated, where the information is confusing, where there are many clients and decision-makers with conflicting values, and where the ramifications of the whole system is thoroughly confusing" (Buchanan 1995). When defining design one also has to define the background of the design of which one is talking. Either the type of design one is approaching is based on natural science thinking like Simon and others; where problems can be structured and understood fully and a solution can be found that fulfils the problem definition. Alternatively design thinking can be based on what has been called a creative, artistic, holistic or humanistic approach. This other line of thought have had increasing momentum in the HCI research community as designers from institutions based on artistic or aesthetic traditions have engaged in the research community and discourse. Previously the design discussions were dominated by engineering and computer scientists approaches (Simon 1996; Lawson 1997) and in the last 10 years the focus has shifted or been contrasted by especially the work done by researchers from the RCA in London (Gaver and Martin 2000; Dunne and Raby 2001), who got involved in larger interdisciplinary research projects in the HCI community. From this angle has grown an alternative approach to HCI, where inspiration, provocation and thoughtfulness (Löwgren and Stolterman 2005) are essential and as important as usefulness, applicability, appropriateness and implementability.

This alternative type of thinking is essentially what Löwgren (Löwgren 1995) calls creative design thinking. It has been widely accepted in the research community that through this type of thinking novel, innovative and interesting ideas about e.g. use of technology can be developed. However design thinking still has a validity problem of rigidity and reliability in the HCI community. Fundamentally it is difficult to accept design thinking as valid because of the intrinsic lack of logics and, when we delve deeper into it, the lack of scientific rigor with regards to reproducibility, falsification, objectivity etc. This will lead me to discuss design thinking as a scientific approach in a moment, but first I wish to travel back to what I see as the foundation for design thinking and its relation to the foundation of scientific thinking. Back a few hundred years and into charged and occupied territory to look for the roots of the aesthetic reasoning and judgment that is central to design and thus to interaction design research.

7.3.1 Aesthetic as an alternative to logic

Löwgren and Stolterman (Löwgren and Stolterman 2005) talks about the aesthetic sensibility that the designer must apply in order to grasp and tackle the whole of an interactive system when doing interaction design, to balance the focus on functionality and efficiency. They use the concept of *gestalt* to encompass this whole:

> The artifact gradually reveals its dynamic gestalt (…) Gestalt can be understood as the overall image, the emergent dynamic whole, something changing over time. (…) An alternative approach might be to think of this as the total aesthetic dimension of a digital artifact
>
> (Löwgren and Stolterman 2005)

So thinking aesthetically about an interactive artifact is to be conscious about its entire composition over time and the effect it has on the context and users. And this aesthetical thinking is central to the way designers think and make judgments and design decisions. My claim in the following is that we can track the idea of aesthetic *thinking* back into epistemological tradition and find that it is as well and early described and understood as its logic counterpart.

From the age of western enlightenment in the 18th and 19th centuries a scientific way of thinking was developed based on logical progression of discoveries. Many of these discoveries had to do with mapping new territories, discovering the fundamental law of nature and its building blocks, and thus making objective definitions of how the world is. Essentially what had to come from darkness to enlightenment were these conceptual definitions of the world. Going back to this place in history gives us an opportunity to look at how the concepts we use today about epistemology and the epistemological evolution came to be. And with regards to design thinking, the goal is to justify this alternative to logic thinking – originated as an aesthetic thinking.

The term 'aesthetics' has been used in many ways since its inception in 1735 by the young German philosopher Alexander Gottlieb Baumgarten (1714-62), and has developed into an analytical discipline all by it self involved in and looking at the arts and areas of our society where 'beauty' is important. So using this term can be hazardous, as it has a mountain of connotation attached. Some of these connotations can be a bit stifling to the people I whish to communicate with, and others are even directly counterproductive. However, I believe that the implications of including

aesthetics in design thinking are important in order to make a firm foundation for 'research-through-design'. The main counterproductive aspect of using the word aesthetic is that there are thousands of people in the world who know more about traditional aesthetics than I do, since they have studied it for lifetimes at different institutions of Arts and Aesthetics. This means that there is an enormous amount of theory on this field and very likely some of it that I would not be able to argue with or defend against. As mentioned aesthetic is today a perspective of analysis. It is something connected to art and to what is beautiful. Kant's disinterested judgments and other theoretical frameworks have all been focused on defining what art is and what its effect is on us, which is understandable since this was the discussion that Baumgarten's argument was part of. But what Baumgarten saw can also be read in a different way.

The following is based on Søren Kjørup's (1999) knowledgeable description of Baumgarten's introduction of aesthetic theory in the enlightenment era's philosophical discussion of what to make of art. This summary of Kjørups text is given here to come to the conclusion or insight that aesthetics, in exactly the same way as logics, are meant to shed light on unknown concepts and aspects of life. Furthermore, this paragraph might seem lengthy, but I do not know of any English translation of Kjørups text, so I find it necessary to summarize along with the reflection.

In the period of western enlightenment Man was able to create wonderful things. The new scientists were able to deduce and describe many aspects of nature, and the engineers were able to build and construct machines, engines and other kinds of improvements. The new defined quality of mankind was its ability to utilize logic. Logic could solve problems and this became the ideal for enlightenment. The scientist was king. Art was then the problem. Art still moved us, and not only did it move us emotionally but also at an epistemological level – we discovered new aspects of life, religion, society, beauty and ourselves by the assistance of art, and this was a problem. If logic is the ideal way to enhance our view of he world, what was art doing there having the same, or similar effect.

In Kjørup's view Baumgarten basically stated the problem as line. If logic is at one end together with enlightenment and intelligence, progress etc. then naturally unenlightenment or stupidity is at the other end. Art being not stupid and still possessing qualities of insight needed somewhere else to go. Kjørup argues that Baumgarten turned the line around and made what diagrammatically is a horseshoe – two lines joined together at the end where no quality was present – the stupid end. Then logics would still be at the pinnacle of enlightenment and epistemological progress, but so would 'Aesthetics' and here Baumgarten makes a new word from the Greek word aistheta, making the conceptual pair *logics* and *aesthetics*.

The argument lays in the fact that conceptual discovery or epistemological evolution is a continual shedding light on new concepts. Actually the aim of the enlightenment was not to shed light on people or humanity, but on the concepts themselves. A concept can be seen as either 'unclear', 'clear', 'distinct' or 'complete' and it is a basic epistemological analytical endeavor to climb each concept towards the top. An example is how one would observe an object, say a golden ring. If one has absolutely no idea of what this object is or any aspect of it, then the concept of golden ring would

be obscure or unclear. Then the observer can have a clear concept of what a ring is and if he or she then even have clear concepts of what gold and fingers are and how to wear the ring, the concept of the golden ring becomes distinct. If the observer then even have distinct ideas of what gold is with relation to quality, carat and resistance to acid etc. then the concept of the golden ring would become complete. This is the classic continuum or hierarchy of concepts. However the notion of art was a paradox in this perspective. Baumgarten clears this paradox by defining poetry, which was what he was working with, as the 'complete sensitive talking'. The sensitive concepts are then those that were defined otherwise as unclear or obscure, but which the poet can speak of through metaphors, comparisons etc. to give a wide description of the characteristics of the concept. In this approach he introduces an alternative epistemological ability or path. We not only have one path of discovery or enlightenment where concepts are divided into the lower obscure and the higher complete concepts in a logic or philosophic clarity, but we have also this other path from the obscure concept toward clarity in a sensitive discovery. So where the traditional continuum takes the obscure concept towards a higher degree of intensive clarity and completeness, Baumgarten introduces the notion of extensive clarity. "Whereas the increasing intensive clarity can be said to go in depth, and thus become increasingly abstract, the extensive clarity can be said to go in horizontal width and thus become more and more concrete" (Kjørup 1999) p.51.

Figure 7-1: Enlightenment of concepts through logic thinking or aesthetic sensitivity. (With due respect to Søren Kjørup.)

So the continuum seen as a line going from obscure to complete is, diagrammatically extended and bent at the lower end. Taking an outset from the obscure concepts the path towards clarity can either be through the philosophical or the sensitive branch, but they are connected and part of the same endeavor towards enlightenment. The sensitive and the philosophical/logical are not two separate worlds but aspects of the same effort. This interconnectedness between logic and sensitive enlightenment was later removed by aesthetic theorists forcing the one and the other into two separate worlds.

I believe that the introduction of Baumgarten and the root of aesthetics will contribute fruitfully to the discussion of design thinking. The point of doing it is to make a link back into history, and show some of the origin of our understanding of this alternative aspect of thinking. This brings the argument more depth than simply stating that design thinking is something special since it is not based on logic and linear progression. In more recent design theory there is this increasing awareness that designing is not just simply following a logic rule book and a step-by-step manuscript, but has to do with an altogether different approach to the world. Introducing Baumgarten takes this argument as far back as possible to when this alternative path in the human cognitive capacity was first acknowledged, and argues

that aesthetic and designerly thinking is not a substandard thought-model, but an alternative route to clarity of the world and an equal alternative approach in the big discussion of the world that science is – as a way of thinking, and a way of covering conceptual ground and discover new. I am not able, based on this, to take on an in-depth discussion of the differences between Kantian, Hegelian (etc.) and Baumgartian aesthetic theory, but I bring this piece of information into this argument on order to show yet another piece of evidence or basis for taking designerly thinking serious in a research context, simply because it is a part of epistemological evolutionary progress. This is done in an effort to make what Bruno Latour (2004) calls a broad articulation of the problem of defining interaction design research on its own terms as a valuable path to insights. The overall goal of this is of course to contribute to the building of self-confidence in the design community in relation to the scientific community.

7.3.2 From past to present

Since the 18th century Baumgarten's term has been used to talk mainly about the effect that aesthetic expression in art has in a person and what the person does with the effect – judging or engaging. But for the argument I am trying to wield here, I want to look at the other side of the coin Baumgarten made, namely the way of thinking that the artists engage in when creating their artifacts of epistemological effect. The designer's way of going about a problem or design space in a heuristic and iterative way is, in this line of argument, basically an aesthetic way of thinking – like an artist creating an extensive clarity of a concept by way of using metaphors, emotional descriptions etc. It means that the designer engages the context in creation, based on what might be described as an intuitive stance, or bridging the hermeneutical gap, as Hallnäs and Redström (Hallnäs and Redström 2006) calls it. This gap is where there is no logical way of progressing and there is no one single correct answer to the challenge. The designer needs to envision the full solution before the design process can be engaged, which can be said to be turning the progression of time upside down in the process (Jones 1992). When the solution is perceived afterwards it makes perfect sense, but before the gap is traversed there could have been multiple different solutions. Making the link to the field of interaction design and HCI-research one might argue that both intensive and extensive clarity are needed in this field and none of them can exclude the other. If either defines innovation in the field disregarding the other we would end up with a poorer not richer understanding of the relationships and potentials of people and their technologies.

An example of such a process is the creation of the iFloor prototype, where we gathered lots of data and made excursion and interviews in the library, and we could have reached a number of different solutions, but when we started exploring the idea of a floor, almost the full range of problems and potentials we wished to engage at the library could be addressed in the experimental prototype. Making a wall or another type of environment might have presented a just as challenging prototype, but we made the leap to the floor, which afterwards showed itself to shed light on a number of very interesting issues, as I showed in chapter 4 and [papers 2, 5, 6].

This redefinition of the scope of the concept of aesthetic is a branch of the work that I have been part of engaging previously with the Aesthetic Interaction paper [paper 4] where we used Dewey (1980) and Shusterman (1992) to stir up the fundamental

assumptions of what the aesthetic experience means in designing interaction. In the section at hand I try and use the same kind of expansion of the known concept of aesthetic to point towards the tradition of thinking and the fact that aesthetic thinking as in discovery and epistemological evolution has been known and recognized for hundreds of years. Going all the way back to Baumgarten (Kjørup 1999) is beneficial in order to show that aesthetic discovery and epistemological evolution through other paths than the pure logic is possible, has been discussed before in history and is recognized as true or valid or possible as part of our world. The aesthetic 'track' in the human mind is active. This should be read as a proposal for a foundation for being able to talk about design thinking as equal - not subordinate to - logic and traditional scientific thinking. Normally in discussing design thinking one just simply points to the fact that we all agree that design thinking is different. Design thinking is often described in relation to engineering thinking (Löwgren 1995) as being creative, innovative and unpredictable and taking "leaps" (Gaver 2000). These aesthetic qualities of design seen as process have also recently been approached by Hallnäs and Redström:

> We have to look for foundation in the opposite direction so to speak… The logic of expression, i.e. aesthetics, plays a basic role here as we go from the abstract to the concrete, from ideas about functionality to the expression of function, from requirements to suggestions
>
> (Hallnäs and Redström 2006)

Here the notion of aesthetics is at the foundation of the "logic" of design just as I have tried to deduce by bringing in Baumgarten to the discussion of the process of epistemology in design.

Types of design

Jonas Löwgren (1995) describes the conflict of understanding design thinking as the difference between two forms of design thinking which he calls 'creative design' and 'engineering design'. The basic distinction here is in how the design process is conceptually understood. In the engineering design framework the process of designing and making things are held to accord on a logical frame where the problem can be described completely in the analytical phase, and then the solution is developed based on this in the synthesizing phase. In creative design the problem is defined along side with the solution as the designer builds more and more knowledge about the problem and its context as the process unfolds it, as in the definition of wicked problems. This means that the logic models of step-by-step progress cannot be followed, and even though time is a factor in both types of design process, the creative design process is more heuristically oriented and iterative in the fact that each part of the process must be repeated when needed, revisiting the analytical phase as new insights occur and projecting ideas for the future in order to find out whether the basis for analysis is well-defined. Jonas Löwgren's focus in this has been on professionally working designers and developers of software, but this perspective can be expanded to describe two distinctively different understandings of design at work today in HCI-research with interaction design research as the creative type of design. Daniel Fällman (2003) makes the distinction between three types or accounts of what design is: the conservative, the romantic and the pragmatic. The first of these accounts correlate to some extend with Löwgren's engineering design, and creative design spans the romantic and pragmatic account, with the distinction that the in romantic

account sees the designer as a creative genius operating in a mystical and undiscoverable "black box" when designing, whereas, in the pragmatic account the designer is in the centre of the design process incorporating and collaborating with multiple interests and handling large amounts of knowledge in an iterative and reflective process. Donald Schön (1983) talks about design as being a process of reflection-in-action and a reflection-on-action. Being able to see e.g. which of Fällman's three kinds of design one is engaged in would be a reflection on the current actions taken by the designer herself. The reflection-in-action is being aware what consequences an action or line of actions has on the context one is designing in and on the knowledge one has about the context. Schön describes this kind of reflection as a continual process of professional practice and extends it far beyond the design disciplines. However, the type of thinking is very close to what could be defined as design being a practice of research in itself, if the creative and exploratory process of design is reflected upon while doing and the results are treated with scrutiny, and articulated into the research community, this constitute in many respects a scientific workflow.

7.4 Design as science

Usually there is an agreement that the natural sciences are better and more valid than other types of science, since the scientist can claim something to be the truth and others then can prove him wrong or right by looking at nature or numbers. This is not possible with other types of science like sociology, economics, psychology etc. What then is a good result? The French sociologist and philosopher Bruno Latour (Latour 2004) has presented a new way of looking at these questions. Instead of going into the institutional perspective of some sciences being better than other simply because they are better able to attain, and have tradition for attaining, mathematical truth, he sets up a range of normative qualities that each scientific result should adhere to in order to have value.

With a rhetorical starting point in what it means to have a body and thereby understand and discover the world around you Bruno Latour talks about the normative qualities of science in trying to come to reach understandings and condense knowledge of the world. Science can be seen either as trying to eliminate aspects of reality in order to reduce it to workable facts, or as formulating a range of parallel articulations that add to our understanding of our world. Latour sees the first as bad or old fashioned science since it tries to give a false impression of reality and solid truth. Latour's normative definitions of science are aimed at defining the qualities and thus qualitative parameters of research and research communication. In his article "How to Talk About the Body? The Normative Dimension of Science Studies" (ibid.) he defines this new way of looking at science. Instead of the traditional paradigm of Popperian falsification (Popper 1963) and the rigorousness that has stemmed from this approach, he argues for an alternative perspective on science, based on Belgian philosophers Stenger's and Despret's eight aspects of good science pointing towards the difference between making statements and defining the truth on one hand, and on the other making propositions and adding to what he calls the multiverse; the entire universe of human knowledge, but far more diversified and multithreaded than *uni*fied, therefore a *multi*verse. This perspective is, in my opinion, a strong background for discussing and making a stance for design research. Primarily because it questions the very foundation of all science, so as a newcomer to

the academic arena, experimental interaction design research need not be too respectful and subordinate to other disciplines and approaches, but simply focus on the cross-disciplinary normative qualitative principles that Latour states. In this respect the perspective Latour constructs is a rather concrete yet difficult touchstone for science. It does not exclude any discipline of inquiry prematurely but rather excludes specific results and approaches to studies as fallible if they are uninteresting. To go a little deeper into the distinctions made by Latour in the text and subtract some of the points that are most relevant in the discussion of design research as well as other types of scientific inquiries, there are some basic distinctions to be made:

Firstly Latour argues that science needs to progress in propositions as opposed to statements. Statements can only be true or false and since the objective of especially the natural sciences has been to claim truths, we mistakenly assume that this is the main goal of all scientific activity. Contrary to the statement the proposition can be articulate or inarticulate. The advantage of the articulate proposition over the true statement is that the proposition is an open and debatable act of communication. The truth can only be proven or rejected; the proposition can take place in an ongoing communication: "The word 'proposition' conjugates three crucial elements: (a) it denotes obstinacy (position), that (b) has no definitive authority (it is a *pro*-position only) and (c) it may accept negotiating itself into a *com*-position without losing its solidity". Here Latour is in line with design research philosophers like Klaus Krippendorf arguing for a stronger design discourse (Krippendorff 2006), and Nigel Cross defining design research as a disciplined conversation (Cross 1999). Latour states "The decisive advantage of articulation over accuracy of reference is that there is no end to articulation whereas there is and end to accuracy." And further "Controversies among scientists destroy statements that try, hopelessly, to mimic fact, but they feed articulations, and they feed them well" (Latour 2004).

Secondly we need to eradicate the distinction between primary and secondary knowledge about the world. If natural science is set in a privileged position where it is able to make the background for all other aspects or discoveries of the world, then all other sciences are uninteresting layers on top of those truths. "We will end up with a world made up of a substrate of *primary qualities* – what science sees but the average human being misses – on top of which subjects have simply added mere *secondary qualities* that exist only in our minds, imaginations and cultural accounts" (Latour 2004). There is, in Latour's account, no need to reconcile these physical and phenomenological world views, but simply the scientist need to take a stance in a dynamic definition of being as 'learning to be affected'. This means that both the natural scientist examining something with high-tech equipment and the social scientist observing and participating are in a position to become articulate about something; "an articulate subject is someone who learns to be affected by others – not by itself." This goes for designer researchers as well, using the designed as the 'equipment' with which he or she learns about the use-context.

In these distinctions we might see Latour as a counter agent of natural science per se and in favor of 'softer' (e.g. social) sciences. However this is not quite true. He is the more precisely countering all sciences that have a traditional base for being scientific, and thus can proceed unreflected in uninteresting fashion. The natural sciences have had this privileged position and other disciplines often look to them to find rigidity and validity in existential search for meaning and foundation. Instead any scientific

activity should focus on making articulated propositions. In order to make the distinction between articulate and inarticulate propositions, and consequently between good and bad scientific activity, Latour, based on Stenger and Despret, lists eight principles that is to articulate such a normative stance.

The Stenger-Despret Fasification Principle:
In order to discuss science and the quality of results of science we need to acknowledge that the 1)scientific is a rare ingredient of science, 2)scientific means interesting and 3)scientific means risky. When engaged in the inquiry the scientist needs to 4)look for recalcitrance in the humans and non-humans that he investigates and 5)provide these with occasion to differ at the very base of the inquiry. 6)Neither distance nor empathy to the subject matter guarantees relevant results, and the results need to be articulated in 7)good generalizations the allows for a multiverse of understandings and for the 8)insights to exist in a common world.

The scientific is a rare ingredient of science: As mentioned there is no way of presuppose that a specific kind of scientific activity (e.g. astrophysics) will always be scientific, and others (e.g. design research) always will fail, whatever they do. The previous success' of a science is not equivalent to the continued validity of it.

Scientific means interesting: science gains knowledge and this knowledge has to be interesting. Too often research results can be extremely rigid and validated in every aspect, but simply be boring or redundant. This implies that scientific results has an audience in a community and takes part in the ongoing discussion of this community. And it also implies that the scientist must lean towards and beyond the edge of current knowledge.

Scientific means risky: In order for science to be interesting it also has to be risky. This corresponds to Poppers notion that scientists need to look for those experimental instances that jeopardizes their theories the most. However, in this framework it means that "(t)he real risk to betaken is to have the questions you were raising requalified by the entities put to the test". Whereas Popper asks scientists to design their experiments and inquiries so that their hypothesis can be found to be false, Latour asks us to venture the risk of having our entire hypothesis reformulated and the experimental set-up redesigned by the context we are engaging. To Bruno Latour this of course can means by both human objects and non-human objects (Latour 1992). Looking at the difference that defines experimental design research as something else than mere design practice, this principle is important. Some experimental instances are more interesting than others for jeopardizing theories, whereas commercial design practice probably is based on theories of e.g. methods but they rarely redefines the theories and the foundations for the theories themselves.

Look for recalcitrance in humans and non-humans: This means that experiments should be designed to maximize the friction, hesitation and resistance of those (again things or humans) that are interrogated. Latour claims that contrary to ordinary beliefs human objects are more hesitant to show resistance to the experiment. Humans are generally impressed by what he calls white-coat scientists and behave politely according to what they think is the correct way to

be in the experiment. In-animate objects, on the other hand, are more obstinate as they are not easily impressed.

Provide occasion to differ: "'(s)cientific' means rendering talkative what was until then mute". By this phrase Latour point towards the dominating ideal for the scientist defined as the "disinterested scientist", as he or she is not to interfere with the context, and therefore is as little engaged with a context that is to behave as natural (uninterfered) as possible. On the contrary this framework calls for "a passionately interested scientist who provides his or her objects of study as many occasions to show interest and to counter his or her questioning through the use of *its* own categories". This is another way of saying that the context studied and results achieved cannot be untainted and strictly objective, but are defined and affected by the observer. The observer then needs to be reflective of this interconnection of context and observer and not lock the context in a particular frame, but provide it with opportunity to point to what is the most interesting. In my opinion this closely resembles an intervention-oriented science of design. This principle leads to what he calls the three minimal conditions for science: is the scientist interested? Are the elements under study interested? Are the articulations interesting? It might be difficult to know whether an object is interested in a study, but one might set-up an experiment that will bring to the foreground the most interesting aspects of the object of study.

Neither distance nor empathy: The previous principle does not necessarily mean that the scientist throws him- or herself into a very close and emphatic relationship with the objects under study. Empathy might or might not be relevant, but with the prerogative that both empathy and distance must maximize the occasions to differ, and both the closeness as well as the distance might make the investigator unable to pay attention to that friction. Part of this principle is to keep in mind that "(t)he distance to be examined is not that of the observer and the observed (…) but that between the contents of the world before and after the inquiry (…): is there now a distance between the new repertoire of actions and the repertoire with which we started?". This means that the scientist must be conscious and explicit about what the starting point is of the investigation so the audience is able to see whether the inquiry achieved such distance or progress. This aspect of the sixth principle is then that "abstaining for biases and prejudices is a very poor way of handling a protocol. To the contrary, one must have as many prejudices, biases as possible, to put them to risk in the setting and provide occasion of manipulation for the entities to show their mettle". In the dissertation at hand I have tried to be explicit about this as I address the projects in reflections of the work afterwards and explicate the theses that formed the projects, and how the projects changed those theses.

Good and bad generalizations: Where the traditional idea of science is that it provides an accurate picture of the world this framework sees science as a creative activity that makes more and more articulate propositions about the world. Traditionally we think that science should generalize and make an account that will encompass many different phenomena into one sentence and thereby making them instances of the same phenomenon, but this runs the risk of eliminating differences that would have otherwise been interesting. Good

propositions "allow for connections of widely different phenomena and thus generate recognition of even more unexpected differences by engaging a few entities in the life and fate of many others". On the other hand the bad proposition makes generalizations "not through connection to new differences, but by the discounting of all remaining differences as irrelevant". This seems like an extremely difficult principle to adhere to, since a normal way to position one self in an academic community is by pointing to a group of people and claim that their idea of the world is false or flawed and your own is much better. And then work hard to prove that other group wrong by making better and more interesting results. The scientific community or field is, as I mentioned earlier, inherently a battleground for different ideas and concepts, and thus of the scientists that support either one.

Allowing for a common world: Latour, through Stenger and Despret, encourages us to open the pandemonium of sciences and think of all science as equal and of none as a priori better or more scientific than any other. If all the different scientific activities are talking into a commonly shared world – the multiverse – then they all contribute to our knowledge of the world. The contributions will then need to be well-articulated and interesting as opposed to redundant even if they are rigid.

What does this then bring of insights into how to think about design research? Taking the Stenger-Despret Falsification Principle seriously means that design research like any other scientific activity needs to lean forward and be affected by the world in an articulate fashion and deliver articulate propositions as a result. There in nothing inherently unscientific in design research and there is nothing inherently unscientific in using design thinking in the scientific inquiry, even if it does not provide and use sequential and solid logic thinking but might also apply pragmatic and aesthetic, sensitive thinking in its evolution of conceptual insight. So design research, like any other type of research, needs to be at the edge – of what we know and how we know it, separating it completely, at this level, from the wider design practice. It might even be easier for a relatively newly founded scientific discipline to live up to the principle, as opposed to disciplines with hundreds of years of tradition, since they have built shared understandings of ways-to-always-do-things that makes a valid result. This 'always' removes the risky aspect of such a study, and potentially locks the results or subject matter in 'already-knowing' without the occasion to differ.

I find this principle especially intriguing in the fact that it opens up to, or does not prematurely exclude, aesthetic epistemological endeavors, meaning that knowledge of concepts can be acquired and defined using designerly thinking and approaches to contexts, doing interventions, implementing designs and seeing what happens, restating hypotheses. The entire design process can in fact become a scientific process if the design/scientist is able to engage it from the edge of his or her – and the entire community's – knowledge and lean into the unknown in an articulate stance and producing articulate propositions back into the research community.

Design research need not do controlled lab-studies and worry about reproducibility and falsifiability. The Stenger-Despret falsification principle knows that we cannot step into the same river twice, but we can tell someone how the water feels.

Herbert Simon states that design can be viewed as a type of academic and scientific endeavor in itself. Due to the conflicts in HCI mentioned above and a general desire to make design education academic and scientifically founded, there is now a general pursuit in the design community to define design in terms of a scientific discipline. Drawing on the Stenger-Despret Falsification principles it is not necessary for a science of design to imitate other disciplines of science. Some tradition or disciplines might be internally in conflict with regards to their foundations, methodologies and rigidity of communication and this might leave opening for design to be drawn in either as the applied version of its knowledge or as a new methodology of inquiry. However design research in itself should be more concerned with establishing its own confidence as a scientific discipline while still be deeply engaged in interdisciplinary scientific fields like HCI.

William Gaver (Gaver 2000; Wolf, Rode et al. 2006) addressed this at the conference for Design Interactive Systems (DIS) in 2000. In a plenary talk, of which there is only an abstract available, he distinguished the kinds of accountability that design demand of practitioners as opposed to the one that is demanded of science. Design demands an 'aesthetic accountability' where the foundational question is "does it work?" Not on a mechanical level, but more in the line of an aesthetic judgment or design judgment as defined by Wolf et al. "informed by a combination of knowledge, reflection, practice and action". I interpret "does it work" to mean "does the design have the desired or any other effect on me as a viewer/participant". Science, on the other hand demands an 'epistemological accountability' where the basic question is "how do you know that what you claim is true?" Firstly this notion of aesthetic accountability can be seen in extension of the concept of aesthetic thinking, since the aesthetic accountability draws on the same kind of approach to an artifact, aiming for the extensive and in some way holistic aspects of the artifact, as opposed to the intensive and internal logic aspects of the artifact. Secondly the notion of truth in HCI and design is still a recurring question. At the DIS 2006 doctoral consortium, which I attended to present my PhD-project, the projects presented were nearly all more focused on solidity of statement than on contributing to a discourse with articulated propositions with interesting novelty. This could be seen in a pervasive dominance of methods for quantifiable results. Statistics based on quantitative user studies were part of 10 of 12 projects. As the principles above propose, this is not in anyway equivalent to having attained a scientific result. In my limited experience from the world of HCI this seems to be a point of conflict between a US engineering dominated stance and then that of a Scandinavian and Northern European stance, where the investigation and validation can take several other forms than simply the most rigid of statistical validity. Using statistics can be a very strong and beneficial method, and be a channel for insights, but when it is done in order to claim a truthful finding, it often becomes a way to either not reach a discussion on the subject matter at hand, or to reduce the discussion to positions of disagreement. It is knowledge sharing but not much knowledge development. In that respect what Latour calls "the collective body of a science discipline" seems to be distributed around the globe and not live fully when confronted in face to face interactions. This then limits the pace of possible progress, in my humble opinion.

Next is trying to come to a definition of the differences that exists in perspective in design research and which defines and differentiates core issues as methodology and evaluation of results. In the last ten years there has been a growing use of three terms

in mainly a North European and Scandinavian context: Research-on-design, research-in-design and research-through-design as was introduced in chapter 2 and now will be unfolded a bit more. These concepts are based on Christopher Frayling's definitions (Frayling 1993) of research "into", "for", and "through" art and design. Of these three types of research mainly the last one, and to some extent the second, uses actual design thinking as an integral part of its methodology. The three types each denote a group of people and institutions as well as an approach to design research. They work with different subject matters and they call upon the same conferences and fight for the same funding, so they constitute a form of community of practice in an institutional respect.

Frayling's goal was to establish research thinking at all as not only connected to art and design, but an integral part of the thinking in design. As I have tried to show this discussion is still ongoing and the idea of aesthetic thinking is meant as a proposal in this frame.

7.4.1 Research-on-design

The first, oldest and most respected type of design research is research on design. It is an art-historian view of design as the manifestations of culture and it is the sociological interest in what happens around the designed artifacts whenever they are in use in their actual contexts as investigated by e.g. a scholar of visual culture looking at the differences in expression and use of the rice spoon in rural Japan (Daniels 2005). The focus is on the object of design and the effect of this object in use. In the research community of HCI there is a strong contingent of professionals working with design from this perspective, doing usability research and user studies and ethnographies. It is very seldom that the scientists doing this kind of research are educated as designers themselves. Mostly designers are aimed at the creation of artifacts, and not only the study of other designer's artifacts. Very often there is a strong link *to* designers from this perspective and it is here that the sociologist or psychologist can think of design as "the applied version of their knowledge"(Buchanan 1995) while the designers often think of the work being done by them as "pre-design". Communication over this barrier often bears the title "implication for design", and the distinction between the two is often more of importance with regards to disciplinary identity than actual interest in design and development of technology. As long as participants in design teams are aware of the difference in languaging design issues etc. teams comprising of both professionals with a research-on-design and a research-through-design angle are very efficient at innovation.

7.4.2 Research-in-design

Research-in-design is concerned with the process of creation. This has a high value with respect to relevance to the design community in general as it looks at and reflects on design praxis. It is a basic scientific endeavor where something can be formalized and tested and reproduced, and this series of trials can be reflected upon into a community of interest and expand the possibilities for action. This type of research in design has been around for at number of years and has been undertaken by both scientists from within the design community and e.g. cognitive scientists from the outside looking for the inner workings of the creative process. Often, as the object of study has been the process of design, the goal has been to formalize the process into a model that could then be exchanged and picked up by others, or even formalized to

such an extend that it could be done by computational artificial intelligences. This last perspective has, as far as I know, died out in the realization that the creative process is not tameable to such extend. That aside there is today a focus on formulating the methodologies of design and experimentation with new ways of doing design, often in new settings and disciplinary contexts. Research-in-design is the innovative edge of design methodology and can be engaged both as observatory studies and in testing methods in actual design processes. (Büscher, Kramp et al. 2003; Westerlund, Lindqvist et al. 2003). In relation to Frayling's research *for* art and design the main difference is that the results of research-in-design are aimed at communication inside and outside the design community, whereas research for art and design seems to more akin to what has been known as artistic developments, within the frame of design and architecture research in Danish context. This is closely related to research, but doesn't really qualify, as the communicative and innovative parts of such projects are unclear and closer related to the developers personal interest than to that of the larger community of practice and inquiry. This is where this framework diverts the strongest from what Frayling proposed.

7.4.3 Research-through-design

Lastly, in this framework, there is the perspective of research-through-design. This is basically where design thinking comes into as a scientific approach in itself. Design thinking is, as mentioned, characterized by non-linearity, aesthetic judgments and accountability as opposed to e.g. the natural sciences, even though these can also be creating things. This making-of-things is found within HCI, but limited to what Hevner et al. has called the construction sciences (Hevner, March et al. 2004) e.g. design, engineering and parts of computer science. In research-through-design we utilize this special way if thinking-with-material-and-context to investigate into contexts, technologies and aspects of human life that we find interesting, and the design researcher is not only observer or participant observer, but the interventionist and change factor creating space for discoveries as artifacts are introduced. The subject matter of research-trough-design can be more or less the same as in research-in-design on the higher levels of reflection, as mentioned earlier. Research-through-design has an interest in something other than itself and investigates this through interventions with e.g. technological prototypes. Daniel Fällman (2003) calls this research-oriented-design as opposed to design-oriented-research and his main point is that design is to be used as a tool to achieve insights. Buchanan (1995) finds that design is hard to narrow down to a scientific endeavor since design is "inherently interested in the particular, and there is no science of the particular", but as is the case with ethno-methodological findings the interesting aspect of the investigation is where finding are generalizable and of interest to a wider community as new knowledge that gives us a wider range of action in the future than what we had in the past. Examples of this kind of work are found widely in the HCI and design community, including the investigations in this dissertation.

Research-through-design is where Schön's reflective practitioner becomes a reflective researcher, and the talking-back (and forth) with the context in an iterative heuristic spiral of prototyping and reflection, is the process of gathering empirical base for the following articulate propositions to be made into the research community.

7.5 Design as an experimental research approach

I have a preference for this framework that incorporates research-through-design since it opens the possibility for designers to formulate and participate in research of important subject matters in our artificial world, outside the field of design itself, e.g. developing technologies that fit better with the human body, notion of space, experience and social interaction. There is at least a handful of other frameworks that seek to explain the variety of the design research community (Cross 1999; Krippendorff 2006), and the pivot of these definitions seem to be who is concerned with design research and which aspects of design they are concerned with. Generalizing the discussion rather crudely the positions seems to be that of whether design research is people looking from the outside-in on design, or designers looking at themselves or looking outside themselves. Designers doing research for designers or "science for design – a systematic collection of accounts of successful design practices, design methods and their lessons" is Krippendorf's suggestion for a category for strengthening of an internal discourse in the design community as a whole (Krippendorff 2006).

Richard Buchanan (2001) proposes to see design research in the frame of clinical, applied, and basic research. Clinical research deals with individual cases and resembles the closest what designers in commercial practice call research. Attaining knowledge with one goal to influence and qualify the solution of the problem at hand. Applied research in design links several cases and "attempt to gather from many individual cases a hypothesis or several hypotheses that may explain how the design of a class of products takes place, the kind of reasoning that is effective in design for that class, and so forth". This category resembles to some extend the case-driven research that has been undertaken in this PhD-study. However, the reflection of the findings is tried formulated in what is the last of Buchanan's categories; basic research, since I focus on the basic relationship between users, designers and technology. Basic research is then the kind of design research "directed towards fundamental problems in understanding the principles (…) which govern and explain phenomena". Basic research then reaches the highest level of abstraction on design. In a Latourian perspective it seems like Buchanan argues that clinical research not very often reaches high enough scientific standards, but when it does it is because it is interesting to the design community at large. Buchanan uses the term "*first* principles" about the subject matter of basic research as if these are somehow principles that are closer to truths. Since both applied and basic design research is concerned with generalizing knowledge and proposing it to the community, the difference between the results – the propositions – of applied and basic research respectively must be that one assumes that the propositions of basic research will stand as interesting and important for a longer time in the community than the propositions of applied design research. However, applied science links to both the theoretical aspect of the design disciplines, as well as to practice, which I think is a very important aspect of building a viable design research community – it needs to be founded within an interested, broader community.

Within HCI and interaction design research the most recent and most interesting article about this topic was presented at the CHI conference in 2006. Wolf et al. from the social computing lab at IBM Watson lists four qualities that are part and parcel of design thinking in their view and which should be wider recognized in the HCI

arena. They use Löwgren (1995) and Fällman (2003) to make the distinctions within design in HCI between engineering design, user-centered design and creative design. Then in communicating especially the results from the creative design branch they propose these four qualities as the manifestation of design rigor comparable and usable in the same way as scientific rigor. The four qualities that are to be introduced in HCI design thinking in order to (re)connect it to the design community's core values are: "design praxis as comprised of 1) a non-linear process of intent and discovery, 2) design judgment, which is informed by a combination of knowledge, reflection, practice and action, 3) the making of artifacts, and 4) the design critique ('crit')." (Wolf, Rode et al. 2006). These four qualities of creative design is a proposal for how to appreciate this kind of design in HCI. I hold that it is similar to introducing aesthetic thinking, and as the Stenger-Despret principles it adds concrete ways to look and judge the value of a proposal in the scientific community. The arguments of presenting these qualities is that the traditional designer's way of thinking/reflecting in process and communicate about knowledge, discovery etc. is of value to mainstream HCI, if not for anything else then in order to know how designers and architects work within HCI. As HCI has grown from a psychological, social, and natural science background, the introduction of design thinking constitutes a distinctively alternative approach, which is continually expanding the traditional HCI disciplines. Or another way of looking at it is that it formulates and solidifies design engagement in the constructive scientific discipline of developing and exploring potentials in technological innovations.

Possibly aesthetic thinking is not the best or most progressive concept for describing the particular type of thinking applied within design research as well as in the general design process, since it has an enormous burden of connotations. However, the basic epistemological history and meaning of the concept of aesthetic indicates its meaning somehow as "that which is not part of logic, but still has meaning and relevance". Whether this is based on an intuitive judgment or experience the result is that aesthetic can encompass these "tracks" in our experience and thinking. As we move closer into an understanding of what is specifically going on in design thinking, the notion of aesthetic thinking might become obsolete, but it is a workable concept for rediscovering its foundation. Today we are also able to use words like holistic and intuitive, but these hardly bring more clarity in describing the approach. As we move deeper into the understanding of the design approach, especially regarding it as scientific inquiry, we might be able to reach concepts that at the same time bring more precision in this understanding as well as maintain the ephemeral, transitory and transformative quality of design.

7.6 Taking part in the big discussion

So the conclusion of this argument is that we potentially have a non-logic science at our hands. This has been stated as based on "creative design" thinking or as basically aesthetic thinking in order to distance it from other types of design like engineering design, and (Wolf, Rode et al. 2006) even suggests it as distant from a user-centered approach to design where the personal impact of the designer is twice removed by the users and by the context in which it is used. This line of argument started with the question "can design from at creative stance work as a scientific approach?" And it is this stance that this chapter has tried to explain why should be approached, applied and appreciated as a scientific approach – a modus of inquiry. This modus does

qualify as scientific to the same extend as any other as long as the activities are framed and measured to the Stenger–Despret falsification principles. These are high demands for any science and design research is not in the groove automatically. It is up to each scientist in each scientific study to attain this high standard and produce articulate propositions that will be of interest to the rest of his or her community if not the rest of world. Both Cross and Krippendorf (Cross 1999; Krippendorff 2006) argue for a perspective on design research as respectively a disciplined conversation and a design discourse, both looking towards design research as taking part in the ongoing larger discussion of subject matters beyond design itself.

Furthermore there is an underlying discussion of whether design research is to be perceived as the avant-garde of design or design research is documenting of design. Both are probably relevant to engage in design, and documenting methods and trends in product use and link it to cultural and historical phenomena does not only document our shared history but provides reflection for new designs. In research-through-design and the type scientific inquiries this dissertation is part of, we engage more in a type of avant-garde activity, as we seek to be the first to question and explore certain aspects of use and developing technologies in interactive spaces.

Design is seen here as in itself a radically different way of thinking compared to engineering problem solving, as well as a possible entry to scientific thinking, maintaining the hermeneutical gap and the notion of creative and aesthetic thinking and reflection-in-practice. Possibly this is able to renew the scientific stance by adding the design approach to it. A science of design needs to be based on this creative thinking in every aspect of its process in order to be integrated in the professional design community and be a science relevant to designers.

It might be observed that establishing distinctions between types of design and use emphasis when describing the aesthetically founded design approach in scientific studies, is contributing to the conflict of design in HCI. Alternatively I could have made links to other disciplines notions of design and added to or reaffirmed the confluence of design and the fact that so many people from a variety of disciplines state that they design. However this confluence has the potential to devaluate design and aesthetic design thinking, and thus contribute to a further prolonging of the conflict. In stead it is my goal to describe what I believe is the base of design and what is at the base of a design research based on a design discipline. What I am concerned about is first and foremost the scientific activity conducted by designers, i.e. by people coming from a background of aesthetic and creative design as opposed to people from engineering-, social sciences- or computer science-based design traditions. The shared understanding and acknowledgement of the different stand-points and foundations that designers come from, is important to the successful interdisciplinary discussion and progress of e.g. the HCI community and its subject matters and hand.

Although this subject of describing and defining design research still is far from completely and comprehensible extended, and far more theorists could be drawn into the discussion, I think the concepts I have applied in this discussion have extended a higher clarity on the notion of experimental interaction design research or research-through-design. I further claim that this clarity is applicable for discussing design research in general, in further context than merely technological innovation.

7.7 Rigor vs. relevance

The discussion of rigor versus relevance in a scientific community and regarding a particular result is the balancing act of maintaining solidity while still breaking the boundary of the known. In research-through-design, as is also the case in practice-oriented designing, the designer investigates a context and defines the problem as the context is uncovered – starting out with a very limited understanding and moving towards increasing knowledge that can at some point be put to the test with a manifest designed experiment – a prototype. This whole investigation can be seen as an ongoing "conversation with the material" or context at hand, as is described by Donald Schön (1983). Doing a scientific investigation from a research-through-design point of departure thus means to change the thesis as one engages the subject-matter context and possibly only have a general notion of direction instead of a solid research question or hypothesis before entering the context of investigation. In some scientific traditions, like ethno-methodology, this is the acknowledged way of conducting a scientific study, as the researcher instead enters with a field of interest and a basic curiosity (Dourish 2001; Crabtree 2003). In other scientific disciplines, like most natural sciences, going into the experimental phase of investigation without a clearly defined and isolated hypothesis is basically the definition of a study bound to fail.

The methodology applied to a research question and the extent to which these methods are strictly followed during the process and recognized in the general scientific community as valid, is what constitutes the rigor of the research. The relevance is defined by the wide community of researchers looking at the same or similar subject matter and even beyond this in the general professional or societal community engaged in related matters. As seen from the practice community design research can have two different roles: Either it is the historical notaries of what has happened in our shared past and this knowledge is usable by the community today for inspiration, in order to ultimately produce better products. Or design research can attain the role of the avant-garde of the design community. Whereas the historical aspect can be seen as research-on-design, the avant-garde aspect is present in both the methodological concerned research-in-design and the innovation- or product-centric research-through-design (Frayling 1993). As an avant-garde design research is testing potentials of new technologies and social trends and developing the language for describing how these potentials can be approached by the general community and possibly even how they relate to other fields of knowledge. In both cases the researcher is reflecting and experimenting with novel aspects of design, aspects that are likely to become important to the broader design community in a while.

In this project the balance of relevance and rigor has been engaged in the multidisciplinary and thus multi-methodological field of HCI. None of the papers that have been presented at conferences have presented findings based on statistical material, so rigor has been maintained through wide and deep descriptions of the project, processes and proposed results. Relevance has been maintained through relating to the most current results from other researchers and by presenting e.g. prototypes in both the scientific community as well as outside. The latter is best exemplified by the 2004 Danish Design Award which we won in the Vision Prize category for the iFloor concept and prototype. This is the first and only time a research project has won a Danish Design Award and as such a positive step in

minimizing the gap between practice and academic research in at least the Danish design community. Developing and demonstrating *exemplars* such as this has been extremely important throughout this project and in Interactive Spaces' research activities.

On the general level research-through-design must, like Argyris et al. explains about action research, seek to attain theory that "identify patterns that, suitably combined, will be useful in many situations"(Argyris, Putnam et al. 1985). On the same note Flyvbjerg states that "[g]ood social science is problem driven and not methodology driven in the sense that it employs those methods that for a given problematic, best help answer the research questions at hand", which can be transferred to research-through-design as well. Thus the context is more important than the method itself, and adapting the methods used as the process or context changes or unfolds instead of rigorously sticking with a method, is preferable in what can be best described as 'wicked problem' research situations (Rittel and Webber 1973; Buchanan 1995). As research-through-design is based on a wide base of design methodology, adapting the methods used to the situation at hand is as pertinent here as in design practice.

7.7.1 Discussion

Latour argues for a redefinition of the hierarchy of sciences to a free floating structure where individual results speak for themselves and are held to accord on the Stenger-Despret falsification principles. In this perspective relevance is achieved by making good generalizations and letting the subject matter under study "differ" or reformulate the hypothesis at the very ground of the inquiry. In a technology development context is it relevant only to make proposals of technologies that are not tested in detail and described intensively? Design proposals could be scientific results by simply opening discussions of different application of technology in specific contexts as well. Prominent examples of such research are articles and projects delivered by researchers at RCA e.g. (Gaver and Martin 2000). However design research can also test, evaluate and iterate on the same concept and deliver a more extended account for reflections in that way e.g. (Hallnäs and Redström 2006).

Based on Baumgarten we are able to talk about enlightening concepts in intensive or extensive descriptions, both able to bring an obscured concept into clarity, the first pertaining to the logic thinking and the other to aesthetic thinking. Flyvbjerg (Flyvbjerg 2006) talks about how single case study research has been under fire for being fundamentally irrelevant, and he seeks to describe a format and foundation for accepting this type of narrow study – wide description as a relevant mode of inquiry and communication of results into the community. This is seen in opposition to making several checks and repetitions of the experiment and thereby making certain that the results attained are closer to factual truth than reflections on single shot events. Whether the deep and rigorous inquiry is preferred to the wider description related to several other instances of related cases or issues, is fundamentally up the community into which the results are sought published. But as Latour advices scientific findings should be proposed into the multiverse of theory and allow for a common world. Design, with is holistic and aesthetic stance towards facts and futures, is a qualified scientific method inquiry for exactly this.

7.7.2 On science

What could be confusing to a standard notion of science is that science is not *about knowing*. We have an image of that which is scientific to be about *having* knowledge, and to some extend this is true – science produces knowledge and basis for interesting discussions and explorations. But science is the process of *not-knowing*. Being scientific is taking a stance in not-knowing and go engaged, personally into finding-out. If this is approached from *already-knowing* the scientific, in Latourian terms, is no longer present. I hold that I see this in many places in HCI, and if I had a clear enough mirror, I might even see it in my own work. Already-knowing is difficult since we enter any context and any framework from a position, tradition or attitude – a bias. When already-knowing is strongest we might frown a bit at the result and call it delta-research – results achieved in too small increments on top of already known concepts. This is comparable with Kuhn's state of normal science and puzzle solving (Kuhn 1962). We know what we want to get to; we just need to prove what we already know in a few more contexts. As good science – i.e. relevant science – is closely linked to innovation as well, the conscious scientist needs to be the first to not-know something and possibly also the first to get closer to knowing a little bit more – which will again point to even further aspects still in the unknown.

Is what I present here this type of research? It might not be as seen from a sociologists perspective since what I show here probably can be explained somewhere deep in the corner of theoretical frameworks I am not aware of. But it is important to stress that this work first and foremost is contributing to design knowledge within a frame of *what can we do when designing for this type of contexts?* So the concepts introduced and discussed in this thesis are not directed towards analytical processes where the goal is to dissect other people's designs. The repertoire of action that is aimed to expand is that of design action – the projection of ideas of future use, the definition of acts that define intended uses. And with the concepts developed it will be possible to define other types of uses than if the use-context was viewed in terms of single users and individual activities.

Conclusions on how to design for social interaction

The conclusion of this dissertation will sum up the contributions presented in the dissertation and the published papers, and relate them to the overall research focus of the project.

8 Contribution statement

A contribution statement has to encompass the relevance of a presented scientific work in 30 words or less, when handing in a scientific paper for review for a conference. This is an exercise in precision and economy of words. And here is the overall contribution statement framing 3 year of research work in collaborative projects and the reflections presented in this dissertation:

Presenting concepts and frameworks for design thinking and action, enabling designers' ability to construct social spaces through widening conceptual understanding of social interactions, the collective user and design as facilitation.

This means that my goal in this project has been to create a better understanding for the structure and workings of the social space that exist between people, and by this get to a more tangible or applicable understanding for the designer faced with the challenge of designing social interaction. As the social space is inherently emerging in the present, and very difficult to foresee let alone define before they actually happen, the designers position in projecting design proposals of future social spaces is difficult. I have sought to make discernments of some of these challenges and hopefully create a clearer image of potentiality (Stolterman 2005) of social space and interaction in connection with interaction design's current material of computational technologies.

8.1 Words, abilities and repertoire of action

I have not presented methods to be followed as I do not believe in the vitality of strict methods. I have not presented guidelines as check-marks for benchmarking design

solutions. The concepts I have presented are instead sometimes diagrammatically related and sometimes presented as standing alone, as is the case with the collective user. These concepts are defined, explored and reflected on the basis of design projects I have participated in with colleagues from the research centre and have been evolved primarily after the projects finished as reflections on the design process itself and the knowledge that I could draw from it in a generalizable way.

8.1.1 Words and abilities

The contributions that are presented here through this dissertation are formulated as design sensibilities, proposals for refinement and renewals of the effort of designing social space with interactive technologies. In accordance with the perspective on science that is unfolded in the previous chapter these contributions are not proved in an old-school scientific view, but related to specific experiences from design projects. Are these concepts generalizable and true? Divided in two the answer is definitely yes and definitely no. Truth itself is not really relevant for this type of results, as design research is – in the methodological frame that I work in (research-through-design) – fundamentally about the making of the future, then the goal of presenting concepts for refinement of our understanding of the subject matter must be to make and convey viable, generalizable insights into this subject matter.

Designing for social interaction is a complicated matter where much is based on tacit intentions of what and why a particular form or level of social interaction is preferable. Furthermore defining this design space leads into at least two more layers of issues firstly of who we are designing for and secondly what we are able to do when defining intended use, when that which we design is as incontrollable as a social gathering. These are the questions I have sought to answer as they have developed during the course of this project. Admittedly I did not have a clear notion of exactly what to answer when I started this project. The hypotheses of this project was not clearly stated in a isolated problem but directed towards a field of interest, which is how design research must be undertaken if dealing with wicked problems. The design-based form of scientific inquiry that has been applied here does exactly this. As actual living contexts are studied through design and prototypes are developed to test hypothetical concepts, the understandings of the field of interest have evolved and refined. As mentioned in the introduction this dissertation proposes and summarizes these understandings and reflects on the design cases with the knowledge and understanding that I have now.

The overall subject of social interaction could have been approached differently and the results might have been different, but seeing that design research is not an exact natural science the quality of a result in the form of a proposal for new knowledge, must rely on the quality of the relations of this knowledge to what Latour calls the multiverse of existing knowledge. This have been attempted through design projects relating directly to the use context, with peer-reviewed papers published as the projects evolved, by presenting the work to a multitude of different people from other disciplines and professions, and finally with a thorough discussion of these underlying concepts that have formed the design projects in this dissertation – relating the proposed knowledge to existing theories within interaction design research and human-computer interaction research.

Levels of social interaction

To sum up what is presented in this dissertation first there is describing the social interaction taking place and intended to take place in a given setting. For this I propose a conceptual framework of types of social interaction structured through levels of commitment and engagement towards the overall situation.

- Distributed attention: If nothing is the apparent centre of attention, participants will have different foci around the space and on each other. This is still a social situation as participants are maintaining availability towards the gathering at large.
- Shared focus: this happens when a gathering is structured around an object or subject by all participants. In the shared focus situation participants can see that they are part of a social grouping.
- Dialogue: At this level participants exchange opinions, money and share attention to each other. The dialogue-situation is comprised of separate individuals focusing on the situation, the other participants and the activity going on among them. Compared to the shared attention level the dialogue means two-way communication and interaction as opposed to broadcast or one-way communication.
- Collective action: Occurs when participants engage together beyond themselves. Collective action is when participants are working together towards a shared goal engaged in, on the overall level, the same activity.

There is no normative difference in quality of the levels, as they are all relevant social situations. The difference is simply in how engaged people are into the social exchange and what demands there are on the individual participant when participating.

As a designer is confronted by a given context for design, he or she needs to figure out at what level the current situation can be described as, and to what level the future envisioned interaction will be at. In connection to this conceptual framework is then introduced the notion of situational interaction mobility pointing towards what is needed to move or facilitate the type of interaction to change into the more preferred type. Situational interaction mobility also emphasizes that any social situation is a dynamic field that can change over time. This change can be unexpected or intended by the designers.

Purpose of this conceptual framework

The purpose of introducing these concepts and relate them to each other in the framework is to create a greater awareness of the differences in interaction and types of social behavior that can occur and can be designed for. Furthermore this framework emphasizes the focus on the social situation in itself as a point of reference in design as opposed to an attribute or quality of use of a designed artifact. Lastly unpacking several different understandings of what 'social interaction' can mean refines the notion that being social is always 'collaboration' or 'really having fun together'. Being present in the same space or share a point of focus as an ephemeral grouping are also social activities.

The collective user

Furthering the effort of making the social gathering a point of reference in itself in design thinking it is then introduced as the collective user, as a unit comparable to the individual user. The individual user has been thoroughly described, analyzed and applied in the last decades in design of interactive technologies, and, although this is a valuable building of knowledge, it is also creating a blind spot for how individuals take part in collectives. These collectives are entities where the individual is able to pursue goals of higher complexity and effort than alone, and making the collective user the unit of reference for design in certain cases strengthens the focus on collective activities as being *as* meaningful, *as* important and *as* real as individual activities.

Applying this concept can be facilitated by these following design sensibilities that will make the concept more concrete and implement it as a tool for thought and action, following Ciolfi's example (Ciolfi 2004):

- Regarding the social gathering at large, is there a collective to be addressed and is the collective user what the design should be addressing?
- What is the purpose of the collective?
- How can the designed support participation in the collective action?
- How can the designed support the collective user in reaching its overall goals?
- In characterizing the type of collective user and where is it placed in the presence/persistence dichotomies, and where is it moving towards and where do we intend it to move?

Purpose of the concept of collective user

The collective is bound by a purpose. It is what brings people to invest and commit themselves in the collective. This purpose can be high, noble or mundane, tacit or self-evident. It can be political change, it can be brainstorming on ideas in design, it can be playing a game, it can be relaxing and having fun with friends, or can simply be to be present with and in a collective like when we go to a café, being social by being available in a social space.

The idea is not to argue that the individual user is a mistaken view of the use-situation, but merely that in some respects there are more to human activities than what can be framed by individual actions, and here the notion of the collective user becomes relevant. Instead of looking for – and designing for – how each participant relate to the group the design effort can be focused on supporting the purpose, needs and evolution of the collective. These are important issues as we often engage collective activities to reach higher purposes than what we are able to as individuals.

Facilitation of emergent social interaction

Lastly I have discussed the issue of control, intentions and emergence through a discussion of the concept of facilitation of social interaction through design. An overarching problem in interaction design, and even more so when designing for social interaction, is how designers get people to use the designed in the way they have envisioned and how designers design that which is actually needed by the people designed for. This clash or negotiation of intentions is a fundamental issue in the interaction design process. Facilitation means to have intention and listen and

change as the process unfolds. Both designer and the designed artifacts can facilitate the social interaction: The designer by changing and paying attention to the users and use context during the design process, and the artifact can facilitate interactions by being open to interpretations and emergent uses through simplicity as was pointed out by (Hornecker 2005) and (Vogiazou and Eisenstadt 2005) in tangible interaction and pervasive gaming respectively.

To convey this stance and make it applicable in design projects by practicing designers, a list of questions for inquiring into the design space is presented.

- What is the underlying social interaction ideal behind the envisioned collective user?
- Why are you envisioning this type of social interaction?
- What are individuals gaining from joining the proposed collective user?
- What is hindering this social interaction or collective user to already be present?
- What is a tipping point for the interaction form that you envision to come about?
- What rules and practices are developed and present to support the collective you envision?
- What rules must be developed and how should these be manifested?
- How will the collective regulate behavior itself?
- Examine the purpose of the level of social interaction that exists right now, compared to the one you are envisioning – which purpose is strongest and in what ways must your vision be reformatted to be more thrilling or stronger?

Purpose of the concept of design as facilitation

The notion of facilitation is then proposed as a stance for the designer as a way to understand and respect the fluctuating and evolving use of the designed artifacts as they are introduced into the use context. Viewing design challenges of social interaction as fundamental 'wicked problems' (Rittel and Webber 1973; Buchanan 1995) the above questions are not meant to be easily answered but to increase awareness of the complexity facing designers of social spaces.

Conceptual framework

Together all these design sensibilities can be seen as a conceptual framework that is to enlarge the perspective and capabilities of how designers are able to approach designing social spaces and facilitating different kinds of social interaction. It can be either viewed as a linear list of sensibilities and concepts, as above, or the different concepts themselves can be positioned diagrammatically in a visual framework related to the designer and the design space.

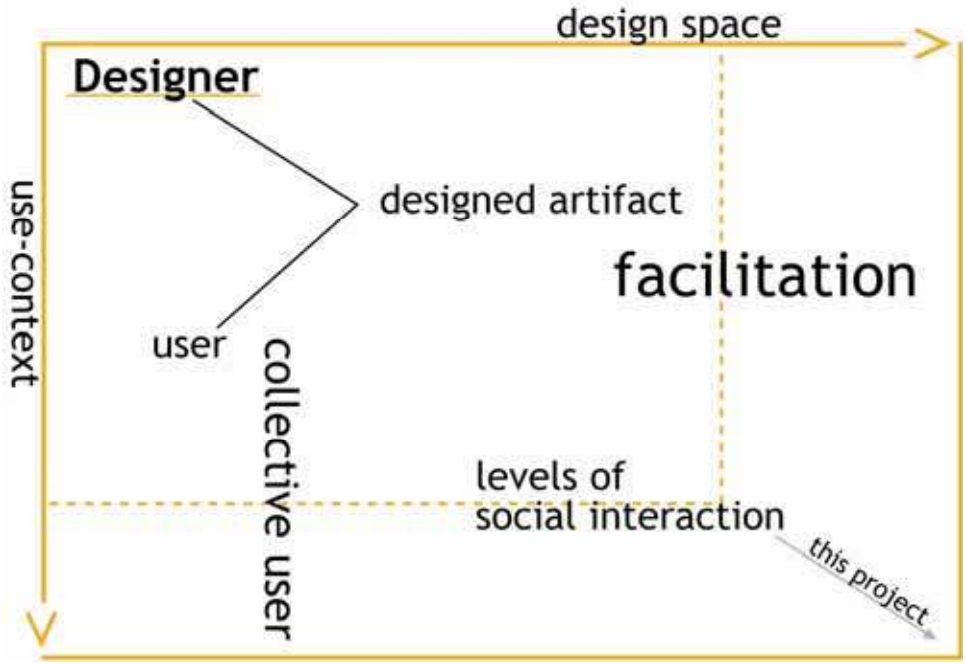

Figure 8-1: The concepts proposed in this project seen in relation to the designer's perspective.

8.1.2 Repertoire of action

Latour writes that the relevant measure of distance travelled by a scientific inquiry is the expansion in potential actions a community is able to take (Latour 2004) based on the knowledge presented. Distance translates into relevance and impact – how much a certain study moves the edge of the knowledge we have. This is then related to an active stance where knowledge is not simply something we attain and then have, but something that is actively usable in some context. A good proposal of new knowledge expands our collective repertoire of actions when faced with the subject matter, since we have more knowledge about the subject matter and thus are able to act in more informed and refined ways.

This project is concerned with refining our knowledge of the design space of social interaction, in order for designers to act more consciously in this setting. I have not provided direct methods in this dissertation, although I have been part of creating new methods within existing frameworks of participatory design and user studies; [paper 3] and [paper 11]. To me the knowledge and perspective that is applied to any context is more important than any specific method. Recipes for certain actions can be formulated to make it easier to approach a complex context, but the methodological freedom is also important to retain and adapt the design process in the particular situation. So the most important component of an expanded repertoire of action is a renewal of the mindset that governs how a context is approached, understood, analyzed and facilitated in change. This means that the repertoire of possible actions is expanded by providing a perspective that is offset a little from how we would normally look at a design space. The concepts provided in each of the three chapters sets focus on aspects of the design space that were before not explicitly inquired into, namely the social setting in itself, not as comprised of a number of individuals engaged in a particular activity, but as a collective with a purpose of its own and a reason to exist and act that is stemming form the collective. This perspective then

presents the designers with issues to explore as well as reflections to conduct with users and internally in the design team.

8.2 Contributing to the design community

This project has been carried through in a research-through-design methodology and as such is much related to design practicing by its applied form. This means that the results in the shape of prototypes and experimental design cases can function as communication between research and practice by themselves. This is best shown in the success of the iFloor prototype being awarded the Danish Design Award in the Vision Prize category in 2004. This is the first and until today the only time a research project has received such credit. The iFloor was furthermore nominated to the Prix Moebius Nordica and the International German Design Award. In the design community these awards are extremely important in stepping forward and announcing new trends, attitudes, products etc. By positioning the work of a research project in such context we make the community pay attention to what is happening in the adjacent research and we strongly argue for the relevance of design research to the wider design community.

On the particular level of this research and the proposals in this thesis, there is currently a momentum for social technologies in the marketplace, especially regarding web-applications and communities, but most likely the popularization of ubiquitous computing will see more products in the borderland between physical and physical products where the social interaction with and around them will be an important part of their relevance and market value. Often the basic design intention of these services and applications is to get people to act in a social field and ascribing meaning to the provided service, thus making it valuable, also is monetary terms.

Following Thackara (2006) design is developing in this phase where designers should pay as much attention to the social practices and relevance around the designed artifacts as to their physical shape and interfaces, and need to focus on supporting communities and collective activities. Engaging this knowledge in relation to products/service systems (Morelli 2002) in interaction design offers potential for successful and relevant products in the marketplace as well as relevant and meaningful collective activities to engage in. As a renewed perspective on the user we design for, the idea of collective user and the importance of participating in social interactions and looking at the social space as the point of reference in design are important issues as we then can develop technologies, artifact, services etc. that fit with both our individual lives and how we participate in gatherings that are larger than ourselves.

Furthermore I posit that this work can participate in the ongoing definition of design research as this field is reshaping itself over the next years. As described design research is receiving intensified focus and design thinking is being used in more and more disciplines, and therefore it is important to discuss a more solid foundation for the dissemination of knowledge in this emerging community and to the communities in which design research is only one of many participating scientific disciplines, like HCI.

8.3 Future work

The work I am finishing with this dissertation is opening more than closing. As what I present are proposals of new knowledge it needs to be discussed in the design community and tried for its relevance, even though I have discussed it as best I could myself. Emergence, facilitation, collectivity are all concepts that are becoming increasingly important and relevant to bring to the design processes of interactive technologies.

Connecting this work with the future *multi*verse of design knowledge and HCI points in many directions. Firstly the discussion of the science of design and the particularities of research-through-design as a form of scientific inquiry are only just about to unfold. Buchanan sees the future of design as a new type of learning that will spread to most academic and professional disciplines (Buchanan 2001) and in this case the design discipline's approach to conducting science is important to negotiate and define.

On the far future node, this work inscribes itself in what I believe will become a major field of investigation in the next two-three years. When we look at designing for a larger unit of reference than the individual user and turn our attention towards the collective, there is the emergent notion of collective intelligence that is rapidly becoming an important new perspective on human capability in relation to technology and in relation to the very large and pressing problems we face as inhabitants on this planet. Following Douglas Engelbart I hope that this work can help in refocusing design if interaction and technology to enable us to better address these issues in a as near as possible future. MIT (Malone 2006) has just launched a centre for collective intelligence, but without much design-orientation and sadly with an underlying agenda leaning against old ideas of artificial intelligence. I believe there is a huge potential for addressing this issue from what could be called a Scandinavian tradition – a holistic perspective of human-human interaction supported by our best technologies, but the intelligence is inherently in these humans and not their machines, as intelligence is, in my very personal opinion, closely linked to spirituality and consciousness. And that is never going to emerge in any chess-machine.

Thus this work is pointing to a new area of design of systems aimed not at the pleasure of leisure-time life, nor or work systems developed for the commercial sector, but for work and activity with in what has been called the NGO or 'citizen' sector (Mau and Leonard 2004), as opposed to the corporate and governmental sectors. This means that a big challenge in future work is to design support for collective action and support for democratic movements working beyond the individual towards goals larger than each participant. The director of MIT's new Center for Collective Intelligence Thomas Malone states: "With new communication technologies – especially the Internet – huge numbers of people all over the planet can now work together in ways that were never before possible in the history of humanity. It is thus more important than ever for us to understand collective intelligence at a deep level so we can create and take advantage of these new possibilities." The perspectives presented in this work is a fertile starting ground for developing technologies that empower and add to this, enabling technologies and tools supporting organizations and other collectives to get more out of their shared collective intelligences.

This highly evolutionary and idealistic perspective is where I take off from this project, into an unknown future. In my future practice I will continue to practice science, unrelated to whether I work for a research and teaching institution, in industry or independently as a design consultant. Working with knowledge at the edge of what is known and presenting and sharing this knowledge with the community is a research endeavor. And I think we will see a redefinition of the notion of science of design and the ways the community handles it in years to come.

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Part IV:

The Papers

Paper 1

From Bovine Horde to Urban Players: Multidisciplinary Interaction Design for Alternative City Tourisms

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Published:
Workshop position paper for MUM 2003
10-12 December, 2003, Norrköping, Sweden.

From Bovine Horde to Urban Players: Multidisciplinary Interaction Design for Alternative City Tourisms

1 Abstract

This paper tells a story of an international and multidisciplinary atelier-based design experiment. For ten days in Rome, the 'White Group' explored a cyclical process of informal fieldwork and intervention, critical reflection, design concept generation, and prototyping to generate two novel, if highly-situated forms of technologically-mediated city tourism. We wanted to 'redesign' our experiences of city tourism - both as visitors to Rome and as people who live there. Inspired by
Situationist-like explorations of the absurd and sociological 'breaching' experiments, we played in and with the city in order to design something playful for the people in it. In doing so, we begin to contribute to existing research on technology and tourism, as well as offering creative ways to approach other design projects.

2 Introduction

In September 2003, over thirty international graduate students and designers came together for two weeks in Rome to participate in the EU CONVIVIO Network for People Centred Design of Interactive Systems' Summer School on Mixed Realities. The organisers, lecturers, design atelier leaders and participants represented diverse public and private sector interests, industrial and visual design, cognitive and behavioural sciences, social sciences and humanities, art and architecture, economics and business, computer science and engineering – as well as over a dozen cultural backgrounds and languages. In addition to attending morning lectures by international scholars and practitioners, each person was assigned to one of three design ateliers (named for the three colours of the Italian flag). Each atelier group had ten days to prototype a 'mixed reality' technology. This paper tells the story of the experience and design process of one atelier: the 'White Group'[1] led by Alan Munro (University of Strathclyde). In keeping with the workshop's focus on exploring methods for the design of mobile and ubiquitous services, we begin the paper with

[1] The White Group was Elena Ferrara, Anne Galloway, Magnus Ingmarsson, Simon Larsen, Martin Ludvigsen, Valentina Novello, Erik Sandelin, Johan Sandsjö, Luke Skrebowski, Hillevi Sundholm, Joerg Traub, and Alan Munro.

our inspirations, and continue with our explorations and development of design themes. We then describe our two prototypes, and provide use scenarios for each. Finally, we critically reflect upon our design themes and process and offer what we call a "mindand-feet" approach to interaction design which also probes our social condition in the tradition of design noir (Dunne and Raby 2001). Although a discussion of the complexities of local and global tourism (see Urry 2001) is beyond the scope of this paper, our work can also be seen to begin to contribute to the existing literature on experimental tourism (see Henry 1997) as well as research on tourism and technology.

3 Inspirations

The original inspiration of the theme of the atelier, 'the Invisible City' came from Italo Calvino's *Invisible Cities*, which discusses the transition between the traveller's first intense experiences of a city to those when they become familiar with the city. This, Calvino says, allows parts of it to eventually 'disappear'. *"When you arrive in [the city], you rejoice in observing … At every point the city offers surprises to your view … But it so happens that you must stay in [the city] and spend the rest of your days there. Soon the city fades before your eyes…" (Calvino 1997: 90).*

We agreed to begin our task by exploring the city and looking for Rome's 'invisible cities'.

4 Explorations & concept design

The group consisted of a number of different skill-sets and disciplines, and this was reflected in the varied and different types of inspiration which they were able to garner from the city. A number of differing approaches were taken, often based on ethnographic methods, but also taking inspiration from more non-traditional approaches. Some participants used various algorithmic and 'gamelike' elements in order to help them see aspects of the city that they might otherwise not see. For example, they used activities and 'rules' which meant that they had some kind of randomised or formalised method of choosing just what parts or aspects of the city to explore. Though this is not the subject of the paper in itself, it is more than worthy of another more methodologically focussed paper, and the group is in the process of doing this. Particularly interesting is the heuristic usefulness of Situationist-inspired 'methodologies' in this area. Venturing out in smaller groups, our explorations consisted of algorithmic walks, 'pseudo-stalking,' observations and 'interventions'. Although some approaches as said before were Situationist-inspired, other approaches took more of a sociological 'breaching' approach. One group chose to

explore the city by coding a simple algorithm that would govern their walking (c.f. the '.walk' algorithmic framework of the *generative psychogeography project*[2]).

Another group chose to follow particular Romans around the city, occasionally taking pictures. Each approach involved arbitrary 'rules of engagement' and while each allowed us to witness different parts of the city – as well as to produce wonderful anecdotal evidence - the algorithm was considered to be too restrictive and repetitive, and the 'stalking' approach of following people was considered unethical and potentially dangerous. Two groups chose to do types of situational observation. By visiting famous tourist destinations, as well as residential neighbourhoods, hectic public transportation hubs, quiet gardens, suburban and industrial areas, both groups watched and recorded interactions between people, objects and environments. One focussed on the margins of the city, while the other focussed on non-tourist areas and tourist-local interactions in public spaces. Both groups were able to gather a sense of what it may be like to live in Rome, and while the approach worked well for preliminary investigations, more formal ethnographic methods would be appropriate later in the design process. Another group chose to conduct 'cultural probes' and interventions into Roman life. The first probe involved two hand-drawn paper maps taped on the back of a sweater and a jacket. The maps had routes with schematic symbols connected by arrows showing the direction to follow. Each of the signs showed famous tourist destinations or different places of interest in the neighbourhood. Two people wore the maps without having seen them, and walked around asking local people where to go. Two other people were following and taking pictures from a distance, observing the scene and the reactions. Most of the locals couldn't speak any English but, as soon as they saw the map, all of them understood the problem and did their best to point us in the right direction – and everybody seemed really amused. We had reservations about whether this concept might work if there were hundreds of tourists wearing maps on their backs, asking locals where to go, but in this case the concept seemed promising, and we decided to work on it further.



The second intervention was 'Rent-a-Tourist' - a way to have locals and tourists interact, and allow the tourist to experience everyday Roman life by helping out with daily chores. This method played with tourist vulnerabilities and dependencies by placing the tourist directly at the service of locals. However, this set-up appeared to be too unusual in this particular cultural context and no one wanted to participate. Together with the t-shirt experience, this concept explored the balance of power between the tourist and the local and focused our attention on the notion *of codependency* that is explored in the later prototypes. These activities took the entire

[2] http://www.socialfiction.org/psychogeography/index.html

first week. After our daily interactions in a wide variety of city contexts, we reconvened as a group and reported on our experiences.

Thus there was a cyclical process of fieldwork and intervention, critical reflection, and early design concept generation. After returning from a weekend away, the group came together to discuss our recent experiences. From these discussions and reflections upon the previous week's explorations, the group articulated a list of desirable qualities for design. At this point, we had still made no decisions regarding the technological form and function of our design.

5 Design themes

We believed that the 'conventional' city tourism we observed all around us offered a predictable, mass-produced and strangely *isolating* experience. It seemed heritage-heavy and neglected the living diversity of the city. Interactions between a city's residents and its visitors seemed to be reduced to routine commercial transactions. Tourists appeared to 'graze' through the prescribed sights and get in the way of locals, while parts of the city became no-go zones for its residents, as 'bovine hordes' of tourists blocked the streets in slow-moving masses. Tourists seemed to have few other options - they are offered only tacky souvenirs or the chance to gape at prearranged spectacles. For their part, residents of Rome appear to have no choice but to endure constant tourism. We asked how we could turn these bovine hordes into *urban players*.

From the above list of desirable qualities for design, we articulated our design objective: "We will attempt to re-design the experience of city tourism, both for visitors to a city and for the people who live there. The new product or service would ensure that:

1. City tours become better experiences for tourists.
2. Locals and tourists have more fun and engaging interactions.
3. Local inhabitants of the city also experience their city in new ways.

The final design should offer direct physical engagement between tourists and locals and should be intimate, warm, and fun for all concerned. It should create a shared, tangible experience that promotes diverse views of the city. The user experience should unfold unpredictably over time, start new conversations and elicit new and unexpected information." At this point, we broke up into smaller groups and brainstormed possible applications. After critically discussing each design as a group, we combined ideas from each and agreed on two designs to prototype. This process itself took a few days, and was a very intensive phase involving a number of iterations. This was because of a need to fit with time restrictions - which are always present in such atelier-based projects but just as much in the 'real' world - by having only two surviving prototypes to fully work with, and also the competing perceived need in the group to save some of the richness of the various ideas and concepts. Therefore there was a constant trawling of the rich materials which had been generated, and which adorned every surface, in order to see if there were any ways in which they might add to the surviving concepts, and so prototypes.

6 Prototype 1: The Tour-shirt

Our first prototype took a 'low-tech' approach to interaction design by simply refining the t-shirt probe used earlier, and creating the Tour-Shirt. The Tour-Shirt lets you explore the city in an entirely new way: you can meet people as well as see new sights. A use scenario might go as follows:

Hillevi, a 25-year-old Swede visiting Rome for the second time, wants to try out this new Tour-Shirt concept, so she goes to a store to buy one. In the store she spends 10 minutes at a computer designing her personal tour. At the computer she enters her wishes for the tour, which in this case are quite open. She does want to see Piazza di Spagna, and she would like her tour to end at her hotel in the evening, but otherwise, she chooses to let the computer (and locals) surprise her. When she has finished her designing, the T-shirt is printed in the backroom of the store. The storekeeper helps her put on the shirt without her seeing the motifs printed on the back of the shirt. She leaves the store and heads out into Rome. Wanting to start the tour right away, Hillevi stops a local man to ask where to start her tour. "Do you speak English?" she asks. "Non capisco…" responds the man. Gesturing at the map on her back, the local eventually recognises the picture of Piazza di Spagna, and explains the way to Hillevi. Shortly afterwards she arrives at her destination. The next picture on the shirt shows a more generic item, in which case the tourist and locals have to decide what it means. The following picture is empty, which means that locals can design the tour on the spot. Hillevi continues to tour Rome in this way, and finally she uses the T-shirt to find her hotel and get some well-earned rest.

7 Prototype 2: The Cube

Our second prototype - The Cube – took a more 'hi-tech' approach to interaction design, but still focussed on simplicity of form and function. Simply rolling or throwing The Cube causes it to display an image from the city. The images are all slightly ambiguous and users will almost certainly need to ask other people to find out what it might be. Each time The Cube is rolled a new image is generated for users to track down, either on their own or with friends. Because The Cube draws on a huge variety of images it is suitable for both tourists and locals alike. The Cube is for those who want to explore the many facets of the city, whether they have just arrived or lived there all their lives.

Furthermore, once the user finishes their tour, they can take The Cube home with them as a souvenir. As they travel through the city it acts as their outboard memory, saving all of the images of the city that they have experienced en route. When back at home, they can re-live their trip by watching The Cube cycle through a unique, personalised photo album of the city. They also become part of a growing global

community of Cubers, individuals committed to new ways of experiencing the urban environment and sharing their insights with other urban adventurers.

In our first scenario we find Johann, a 24-year-old from Berlin visiting Rome for the first time. He has been in the city for three days now and has already tired of following tourists round the standard attractions. We find Johann at a tabaccheria where he has stopped to buy a metro ticket. As he hands over his change a display of Cubes on the counter catches his eye. He is intrigued and after looking briefly at the point of sale copy, hands over some money to give it a try.

He reads quickly through the instructions:

Find a friendly-looking person and ask them to roll your Cube for you.

Pick up the Cube and look for the picture that will have appeared.

Ask the other person to help you try and work out just what the picture is and how you could find what it shows (or something similarly interesting).

Set off and find it, asking for further help along the way if necessary.

Once you have found it, enjoy and learn about what you have discovered and roll again.

He also notes two important features:

1. *The Cube is active for 24 hours after you first throw it.*
2. *Once the 24 hours are up the Cube changes modes and becomes a souvenir of your trip, cycling through all the places you visited and allowing you to re-experience the city in all its diversity.*

Johann sets off to find someone friendly-looking. In our second scenario we encounter Valentina, Eleanor and Riccardo, three middle-aged Romans who have heard about The Cube craze sweeping Europe and have decided to give it a go. They have lived in Rome all their lives but are bored of visiting the same old places and are eager to experience their city with new eyes. We find them in Trastevere. They have already successfully tracked down two different pictures from The Cube (a small ice cream store and a little-known gallery). Riccardo throws The Cube to Eleanor who catches it. All three gather round The Cube to see the picture and try and work out what this one is all about. They discuss it for a minute or two but really don't have a clue what it might be and decide to ask someone else. They find a passer by and get him involved in the interpretation. They come to a consensus as to roughly where they might find this thing (although they're still not sure exactly what it is) and set off in the general direction.

8 Reflections on the design themes & process

As mentioned above, it is beyond the scope of this paper to address the social, economic and political complexities of global tourism, and given the limitations of our design experiment, we did not attempt to evaluate local tourism according to the vast literature on the subject. Our decision to design for tourism emerged directly from, and only from, our personal and group experiences as tourists and residents in Rome – our group comprised ten visiting foreigners and two Italian residents of Rome. By drawing on our immediate contexts, we positioned ourselves – from the beginning - as both designers and 'users'. In this way, our designs must be understood as highly situational and subjective.

Despite these limitations, more broadly applicable practices include focussing on mundane or everyday experiences, which allowed us to experiment with design that augments or adds to an existing experience, rather than replacing it with a new one. Similarly, we worked with observable practices and expectations surrounding city life and tourism, rather than creating a new set of user behaviours and expectations (c.f. Mynatt 2000). In general, we may refer to our design approach as a process requiring "mind-and-feet." In other words, we used our intellects and our imaginations as much as we 'got out there in the wild,' exploring and experimenting. Each activity inspired the next, and informal observations and interventions in public places were the primary means by which we explored aspects of the user experience and contextual design (see also Beyer and Holtzblatt 1999; Jääskö and Mattelmäki 2003). Yet integral to our process were group discussions, de-briefings, brainstorming sessions, and deciding how to proceed after each – in the spirit of Bellotti and Smith's (2000) "intimate relationship between iterative fieldwork and design thinking". Designing technology for tourism is not new (see for example Yang et al. 1999) and more recently, Brown and Chalmers (2003) completed ethnographic studies of tourists, and describe three types of tourist technologies: "systems that explicitly support how tourists co-ordinate, electronic guidebooks and maps, and electronic tour guide applications." Our work can be seen to fall within this broader tradition of research, however, as in design noir (Dunne and Raby 2001) our practices sought to probe our social condition and following Gaver et al. (1999:25) we also sought to "provide opportunities to discover new pleasures, new forms of sociability, and new cultural forms … [to] shift current perceptions of technology functionally, esthetically, culturally, and even politically."

The way a user of our conceptual system would become part of a city is fundamentally different from that which is normally offered to a tourist in Rome. Being dependent on locals to guide you around the city not only lets you interact with them outside of formalised settings, but also exposes you to a broader range of human interaction – like lying about the locations of sites or simply telling a different story than the one you were asking for. In our design, the tourist experience is not just of the official stories and sites, and it shifts from a goal-oriented and efficiency-oriented endeavour to a more subtle interaction with the city where the user is open to surprises and strange experiences. Accordingly, our design sought to create new kinds of 'mixed reality' experiences and technologies. If we were to design for tourism, we wanted to also play with the notion of tourist, and see if local residents of an area might be able to temporarily 'see with a tourist's eyes'. By encouraging particular types of local-tourist interaction, our designs subtly interrogated the status-quo of tourism. Both designs played with traditional power relations between locals and tourists, as well as among locals in their own city. We wanted to 'defamiliarise' the city, and in the process, 'familiarise' the people. Our prototypes encouraged personal vulnerability in so far as users were required to trust strangers'

interpretations, directions and advice – fostering more intimate collective actions and experiences than normally afforded in mainstream tourism.

In sum, we acknowledge that our designs are highly situational and speculative, remaining in the paperprototype phase. The design challenge itself was unusual, and working intensely for two weeks with a dozen strangers of diverse backgrounds presented its own host of obstacles and limitations. We are not certain how our context compares to others, but we believe that our experiences can serve as example and inspiration for more radically convivial, multidisciplinary and critical interaction design.

9 Acknowledgement

This paper would not be possible without the exemplary work of the 'White Group' Design Atelier: Elena Ferrara, Anne Galloway, Magnus Ingmarsson, Simon Larsen, Martin Ludvigsen, Valentina Novello, Erik Sandelin, Johan Sandsjö, Luke Skrebowski, Hillevi Sundholm, Joerg Traub, and Alan Munro. Special thanks to our hosts and sponsors, the EU CONVIVIO Network for People-Centred Design of Interactive Systems, the Istituto Europeo di Design and each participant's home institution.

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Paper 2

"Help Me Pull That Cursor" - A Collaborative Interactive Floor Enhancing Community Interaction

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Published:

Proceedings of OZCHI 2004, 22-24 November, 2004 at the University of Wollongong, Australia. CD-ROM. ISBN:1 74128 079.

“Help Me Pull That Cursor” - A Collaborative Interactive Floor Enhancing Community Interaction

1 Abstract

In this paper we describe the development, experiments and evaluation of the iFloor, an interactive floor prototype installed at the local central municipality library. The primary purpose of the iFloor prototype is to support and stimulate community interaction between collocated people. The context of the library demands that any user can walk up and use the prototype without any devices or prior introduction. To achieve this, the iFloor proposes innovative interaction (modes/paradigms/patterns) for floor surfaces through the means of video tracking. Browsing and selecting content is done in a collaborative process and mobile phones are used for posting messages onto the floor. The iFloor highlights topics on social issues of ubiquitous computing environments in public spaces, and provides an example of how to exploit human spatial movements, positions and arrangements in interaction with computers.

2 Keywords

Interactive floor, library, ubiquitous computing environments, spaces as interface, social computing, interaction design, designing for community interaction, video tracking.

3 Introduction / motivation

Much design and research effort within HCI have been put into supporting distributed communities e.g. family members being away or living apart from one another (Hutchinson 2003), geographically distributed fellow, or systems supporting the establishment of contact and formation of groups and communities between people not knowing one another on beforehand (Nielsen 2002). There is a growing interest in how to support and encourage social interaction between collocated people and how the physical surroundings e.g. (Wilde 2003) can be exploited in this regard. However, little work addresses how ubiquitous computing environments will go beyond spatially arranged devices as in e.g. (Streitz 1999) and take into account and exploit spatial qualities of physical rooms, spaces and places. The work and the

prototype presented here are a step towards realising the concept of interactive spaces.
The user population addressed in the work presented here are the visitors of a central public library; people that do not necessarily know one another on beforehand, but might be interested in informal conversations and contact with other citizens. As one of the most profound institutions of a democratic society the public library primarily serves as a place giving every citizen unrestricted access to catalogued information and providing facilities for self-initiated life-long learning. But in doing so it also indirectly serves as a social space enabling awareness of fellow citizens and the pluralism that is equally important in maintaining a vivid democratic society.

In the research project denoted "The Future Hybrid Library", which is an initiative in the multidisciplinary research centre for "Interactive Spaces" mixing competences within architecture, engineering and computer science, we've been exploring how ubiquitous computing environments that take into account specific spatial qualities could support and enhance the social aspects of the library. As we would like to have as many potential users as possible to be exposed to the developed system the entrance hall of the local central public library was picked as framework for the design of the system as well as location for a later three week period of evaluation. On the basis of the spatial qualities and functions of the room we chose to explore this by means of an interactive display on the floor.

4 Background (and challenges)

In his book, e-topia (Mitchell 2000), William J Mitchell starts out with a tale of the well and its importance in cities in the early days of civilisation. Beyond being water reserve the well also had a strong social attraction, as people would go there just to meet up, exchange goods, arrange marriages etc. To enable the cities to physically expand and to minimize the risk of diseases, water was put into pipes suffusing the whole city. Having direct access to water in each household made the practical role of the well obsolete, whereas the social needs remained the same. In response to these new social places e.g. cafes emerged. By means of the tale Mitchell asks the polemic question: "What will happen when information by means of broadband access to the Internet is "piped" into our households?" Will this be the death of e.g. the library? Which services and installations in the physical library will support the institution in maintaining its attractiveness and social role?

In recent years libraries throughout the world have focused on delivering web-based services for its users. Along with the web-based services there has been a growing focus in the physical library on meeting the needs of the individual user, and her ability to find relevant material. Activities and approaches as these have resulted in a starvation of the attractions of the physical library beyond erecting evermore-impressive buildings and architectural statements of the importance of the physical library.

Through user studies, interviews with librarians and statistics on numbers of visitors (Magistratens 4. Afdeling, 2004, only in Danish) at the local municipality library, we've learned that the by-product of these activities among others has been a decreasing number of visitors at the physical library. Many needs of the user in regard of finding relevant material can be met through advanced search and reservation facilities on libraries web sites. In addition to this the general facilities on the Internet: search engines, user groups, etc. also seemingly meet the users' needs for finding information. Furthermore, the social space in the physical library has taken a swing towards being more focused on the individual. Independently, some users and

librarians in our user studies even talked about the local library as having developed a supermarket-like atmosphere where people are indifferent to the whereabouts of others. Probably this can be traced back to the increased focus of the library on serving the individual user supporting individual learning rather than providing a space for social gathering, activities and public awareness.

To summarize, the experienced social value of the public library shows tendencies to decrease. Visitors and librarians are becoming more and more focused on serving individual needs, efforts and tasks that obscure the view and attention to support and develop the social role of the library. To regain and strengthen the democratic role of the library it is necessary to devote more effort into the social aspects and activities of the library. New architectural monuments of the library and enhanced ways of efficiently organising the collection of materials are not enough to ensure the continued community-integrating role of the library. The design of computer systems also has to address the social challenges that the library is expected to meet.

5 Related work

In order to address the challenges mentioned above the work presented here draws upon work in three areas: architectural design, ubiquitous computing and designing for community interaction. Furthermore, the interrelations of the three areas are explored in order to pursue the realisation of interactive spaces.

From a perspective of architectural design, the design of physical spaces, most of the work within ubiquitous computing has either worked on furniture-sized installations (Grønbæk 2001) following the concept of roomware (Streitz 1999) or generally applying the scheme of "tabs, pads and boards" initially described in (Weiser 1999). The only architectural element in these prototype environments that aims to transgress the affordances of furniture to become actual room-sized elements and interfaces are walls embedded with display facilities e.g. (Johanson 2002). The vertical orientation of large displays positioned to be touch by hand, makes it fairly easy to adopt many of the well-established ideals within HCI e.g. direct manipulation (Schniederman 1987) whereas interfaces that are hard to touch directly by hand e.g. ceilings and floors are less explored as interactive surfaces.

Interactive floor surfaces are typically experimented on in dance and performances like set-ups e.g. the prototype Magic Carpet (Paradiso 1997) and Litefoot (Fernstrom 1998). The prototypes are sensor intensive environments for the tracking of people's movements of feet and in the case of the Magic Carpet the sensor floor has been supplemented with sensor technologies for tracking the movements of the upper body and arms. To serve different shaping and sizes of an interactive floor the Z-tiles concept (McElliot, et al. 2002) was developed. As the above-mentioned systems the Z-tiles interactive floor is based on sensor technologies. Input from the interaction technologies is used to control and manipulate sound providing the idea of playing an instrument with your body movements. Another system exploring multi-user spatial interaction by means of an interactive sensor-based floor is the Virtual Space project (Leikas et al. 2001). The sensor technologies are in this case used to enable spatial interaction and control of a computer game projected on a vertical positioned display. Another approach to enable spatial interaction is the use of video tracking e.g. the commercially available eyetoy game. http://au.playstation.com/ps2/hardware/eyetoy.jhtml.

Most of the work with designing for community interaction uses computer interfaces to mediate distributed activities enabling awareness of distributed people's interests

and whereabouts e.g. (Büscher et al.). Increasing effort has been directed towards enabling community interaction among collocated users (Churchil 2004). As computers and computer interfaces for community interaction become an increasingly influential part of our everyday lives (Grinter 2002) we see a need for addressing issues related to the experience of the social qualities related to the experience of collocated users. These concerns are intensified as computer interfaces transgress traditional interfaces and become embedded in the physical surroundings and spaces enabling groups of collocated people (Huang 2004) to simultaneously interact with the systems accessible or as experienced in awareness facilities in office spaces. From our point of view this body of work lacks to take the spatial qualities of the physical environment sufficiently into account in regard to of how systems might be operated and appropriated in use.

The new Seattle Central Library (Koolhaas 2004) is, a part from being an impressive architectural statement of the library as institution, also a refreshing example of how the need for social spaces and their nature can have just as strong impact on the design of the building as ensuring efficient organisation of the collection of media typically has when designing libraries. Though the use of computer systems and their physical materialisation in the new Seattle Central Library is fairly traditional with huge amounts of personal computers, floor spaces as "the living room" on 3rd floor and "the mixing chamber" on 5th floor, indicate an increased awareness of the social role of the library. But how would these floor spaces have materialised architecturally if they from the early design stages were thought of as ubiquitous computing environments, encouraging social interaction.

We see a need for including spatial concerns in the design of systems and interfaces for community interaction that goes beyond the mediation of distributed activities to include the experience of the collocated user. Furthermore, there is an unexplored potential in including more playful aesthetic ways for interacting with these systems. From our point of view experiments taking on this challenge could be informed by approaches to aesthetic interaction as promoted by (Petersen et al. 2004).

6 Design rationale and aims

In the following we will present our rationales and aims of the prototype design. The development of this prototype has two basic aims. The first is to facilitate a space for communication and collaboration, based on the exploitation of user knowledge and curiosity. The system should not announce itself as a community supporting system. It should merely be a trigger for collocated people to start talking and engaging with one another. The second aim is experimenting with collaboration on interactive floor surfaces with no need of special input devices apart from being present in the physical library. This is done in order to design an interactive system that can be appropriated by most of the broad range of people visiting the public library every day. These users include all ages, genders, races and professions e.g. children, disabled, students, mothers with bags full of books etc. For more advanced interactions we will experiment with mobile phones as 90% of all Danish families have minimum one mobile phone (Statistics Denmark 2004)

The prototype is to be located in the entry area of the local central library, a transit space that is approached by the users from all directions. To keep the spatial qualities of this transit area it is important to ensure visual overview of the adjacent spaces. In addition to this public spaces are characterized by people with many different doings and different attitudes towards disruptions in the public realm (Gehl 1987). To

comply with this we will experiment with floor interaction that in many aspects will not alter the physical space.

Designing for public space requires certain considerations regarding the robustness of the system, which should result in an interactive system without any direct contact with the hardware.

By introducing the prototype we want to inspire to the change of the communication style of the library. Today most library users have interpersonal interactions with only the librarians, asking them for advice or references to books. The local central library is fairly visionary with respect to introducing technologies to make the daily handling of books and other materials more efficient. Thus they have introduced self-service check in- and out of materials, and recently also self-service check-out of reserved items. This means that the interactions between users and librarians have been minimized, and the library is decreasing its need for interpersonal interaction. In the design process library staff and mangers expressed the need to counter this trend by creating facilities and a space for informal exchange of knowledge among users, and encourage the transformation of the library into a more vivid social space. Addressing this became one of the key design issues of the developed prototype.

7 The prototype

On the basis of the above identified challenges and needs a prototype was developed: an interactive floor for communication between users of the library named iFloor. We will describe the iFloor by looking at separate elements of the design: the general setup, the technology, the graphic user interface, bodily interaction and interaction by adding content. Basically the iFloor is an interactive floor that affords users individually or in collaboration to browse and discuss projected questions and answers produced by the users themselves, through the movement and position of their body. By the use of a mobile phone or an email client questions and answers can be posted on the floor.

Figure 1: the iFloor in use. Several users discussing and interacting with the floor and the man on the opposite side of the floor is writing a message to the iFloor using a mobile phone

7.1 Technical setup

The system consists of a remote server for receiving and handling sms' and emails and administering questions and answers. Furthermore, a projector mounted on the ceiling is connected to a local computer for the display on the floor. Due to the requirement for system robustness, tracking technologies like e.g. interactive tiles (e.g. Richardson) were rejected because this would require the installation of a technology-intensive floor that would be vulnerable in the public space. Instead the floor interaction works on the basis of a video tracking system software (Valli 2004) analysing the rim of the interface based on a video feed from a web-cam mounted on the ceiling. The tracking of people's position and movement are sent from Retina to Macromedia Flash and translated into magnetic forces attracting the cursor. This solution has the advantage that all fragile parts are mounted on the ceiling and thereby removed from direct access. Using projections in bright daylight caused problems regarding the visibility of the display and the tracking. This was solved by using a powerful projector to project the graphic interface onto thin white PVC boards on the floor creating a clear projection image and giving a good sufficient contrast in the video feed for the blob analysis and threshold tracking done in Retina.

7.2 Bodily interaction and the interface

Due to the novel interaction explored in the prototype and the unprecedented facilities offered by the prototype the graphic user interface had to be very simple and clear.

Technical tests showed that the precision in tracking we got from a simple web cam was enough to keep track of at least 15 people at one time in a 5 meters by 4 meters rectangle. Diminishing the possibility of users entering the projection and thereby casting shadows on the content we only used data from the tracked persons in a one meter band surrounding the display. By using a visual feedback in form of a projected string connecting the cursor and the user while being in the tracked area, people could see that they were taking part in the interaction. As soon as they entered the projection on the floor the string would disappear and they would have no influence on the system. We used the coordinates from the tracked persons to calculate the movement of a graphical element representing a shared cursor. The cursor had its initial position in the centre of the floor but as soon as the camera detected a person in the tracked area, the string would connect user and cursor and the cursor would start moving towards the user. Stepping out of the tracked area would instantly make the cursor move towards the centre. In this way the system got very responsive supporting various playful ways of interacting with the cursor both as an individual and in collaboration e. g. by spreading out hands and feet one can obtain up to five strings giving five times the power of a user standing straight.

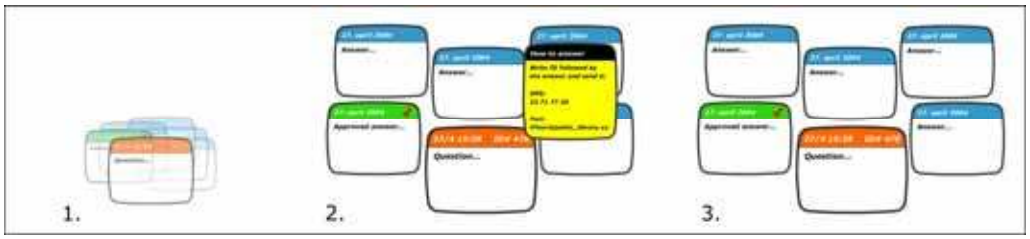

Figure 2: The unfolding of a question. A tool-tip provides the relevant instructions for replying. The green answer-box is an approved answer from a librarian.

The maximum number of questions on the floor was set to 15 due to screen space and text readability. Each question carried a time stamp that was used to exchange new questions with the oldest time stamp on the floor. We designed colour coded graphic elements as containers for the questions and answers. The fact that the floor was approached from all directions challenged the common layout of interfaces traditionally approached from one direction. To comply to that the questions were arranged in a circular array around the centre of the floor to provide equal access and readability of the display from all directions along the rim. Intentionally, this encouraged users to walk around the floor in order to read all questions or ask others about questions on the other side of the floor. In experimenting with an alternative to double click on the floor we used the event where the cursor entered a question to trigger an animation unfolding the question and revealing its specific ID number. If the question had been responded to earlier, these would fold out from behind the question enabling the user to read up to five different suggestions. The questions could be read at all times but users had to move and negotiate the cursor around to read the answers related to the questions. This was deliberately chosen to encourage users to communicate and negotiate on the movement of the cursor.

By designing the cursor to slow down when entering a question we gave users time to read the question and related answers and get the ID number. When leaving the unfolded question the cursor speed raised and an animation contracting the question and answers was triggered.

During the evaluation period in the library we made ongoing improvements and changes to respond to interviews and user observations. The changes were made both to respond to expressed user needs as well as to try out new features. Two changes are mentioned in particular here. In order to make the prototype more self-explanatory tool tips-like would evolve from the questions when the cursor would enter a question. The tool tips described exactly in three bullets how to answer the specific question either by mobile text messaging (SMS) or e-mail. Another change was made to encourage the librarians to take ownership of the prototype and to give their answers more integrity by developing an approved answer – colour coded in green - that could be posted through the same web interface that was used to clean up the floor for offensive questions and answers.

To experiment with different ways of having users interact with the system we tried making the cursor respond to movement instead of position. This resulted in a dance-like performance to get the attention of the cursor but making precise interaction very difficult.

Finally, we tested the implementation of cursor-speed adjusting facilities mediated by icons. By adding small symbols in the corners of the display representing two speed up and two speed down facilities, users could move the cursor to an icon and through feedback from a counter see the change in cursor speed. This was tried out to add a higher degree of interaction but the feature also had a tendency to create chaos on the floor by unfolding all questions in seconds because of the speed.

7.3 Adding content

To compose new questions users were requested to use either an email client or their mobile phone as input device. By using mobile phones and SMS we could enable people to interact with the system without any specially designed gadgets supported by the library or the prototype itself. Questions could be posed by sending a SMS containing a question on max 120 characters to the iFloor phone number. About ten

seconds after sending the question the user would get feedback in form of a SMS saying "thank you for your question, you will receive answers as soon as they arrive, regards iFloor". After that the oldest question and related answers disappear from the graphic interface making room for the new question to emerge on the floor during an animation clearly showing that new content has entered. Responding to a question is done by entering the ID number revealed from an unfolded question in a SMS or e-mail followed by the answer. This creates a new answer that is nested to the question. In order to give visual feedback to users around the floor on changes in content and to promote curiosity in exploring the floor animations were implemented.

Figure 3: As the cursor enters the questions they unfold and reveal the ID-number and related answers. Too high cursor speed will activate neighbouring questions and responses creating a confusing overlapping pool of messages.

8 Evaluation

The evaluation with users in the library context was conducted with emphasis on qualitative interviews and observations of users. In our observations we focused on relevance of the prototype and on learning what users experienced when interacting with the system, on the expense of statistics. During the three weeks of evaluating the prototype, we had several users experimenting with the installation. Sometimes we stayed in the background to leave the users to figure out the interaction by themselves, and at other occasions we introduced the prototype to the users in order to engage in dialogue about how the installation was perceived. This way we had both informal talks with users and formal interviews conducted after users had worked or played with the prototype. In the course of the three weeks we also made observational videos of the space where the prototype was installed in order to see how people reacted to it, and how it affected people moving through the space.

Another source in the evaluation was the feedback from the library staff on how they experienced the support of users interacting with the floor and their reflections on how it contributed to the traditional library context. Along with the feedback from the user interviews, the librarians' feedback was the starting point of redesigning and altering aspects of the floor during the three weeks and in order to enhance a walk-up-and-use experience and make the prototype more self-explanatory, as explained in the prototype section.

As a part of the qualitative evaluation we also invited a 7th grade school class for a one hour quiz game. We posed the questions and they were supposed to find the answers by using the traditional search facilities provided by the library. With 25 pupils in the class it was a good way of seeing how the system would react to a maximum load of input. The experiences from this test emphasized the fact that even though the technology in theory could support an unlimited number of participants, the social and physical space set a certain limits to that number. The negotiation part of interacting with the prototype and trying to figure out how the tracking worked could not surpass the competitive element of the quiz game, so the prototype was often blocked by too many inputs. If the video tracking software can see users

diagonally across from each other or, as in this case, all the way around the periphery of the floor, the cursor simply stops in a dead zone of equally balanced pull.

The kids in the class were especially fast at adopting the system, and quickly used the floor beyond its intended use, as they started to post teasing remarks and other messages to the school mates. This way the floor expanded into a different kind of communication surface of graffiti-like tagging and personal exhibition.

9 Reflection

The iFloor challenges several interaction paradigms (Svanæs 2000) as they are difficult to translate these into interacting with a floor.

In the three week period of evaluation and redesign of the prototype at the local central library we learned that the questions posed typically would be in the category of seeking advice or tips and tricks on every day things as, how to un-lock ones mobile phone, or where to find the best and cheapest printer. It came to work at bit like the notice board found in local supermarkets; however, in this case the communication was not about runaway cats and baby carriages for sale but knowledge exchange between users at the library. Furthermore, as the floor was residing in the entrance and exit part of the library it came to work like a "sleeping policeman", causing people to stop and to start chatting about the questions and answers on display, and taking the opportunity to participate in the process by posing new questions and responding to the ones in the display. Furthermore, the playful way of navigating the interface was found very intriguing by the visitors and definitely also facilitated the process of making people talk to one another.

Figure 4: The iFloor in the library.

After having discovered the interaction mode and the idea of the system, most people are enthusiastic about the technology and idea of use. When asked, most users were capable of thinking of many other places where a physical/digital bulletin board-like functionality could be helpful or interesting. E.g. a group of student teachers had an idea for using it as a means of teaching because of its synergetic effect between play and serious content.

10 Spatial interaction

10.1 Proximity

Using the body as the means for interaction is to many people a very provocative and challenging idea. It seems the single-user-in-front-of-a-desktop paradigm has been thoroughly accepted by the general public. Through the iFloor prototype we are experimenting with new principles for interacting with augmented floor surfaces. Walls and all kinds of furniture (e.g. Dunne 2001) have been used as interactive artefacts or displays, but using the floor surface as a collaborative multi-user surface sets design challenges as to how to point click and select content on the floor. Being

out of reach in most situations, the floor is not a surface for direct manipulation (Schneiderman 1987). On the other hand, a potential input that is always available is if a user is able to view the floor he will be in the physical vicinity of it, so by using video tracking we can relate the floor to the user and afford interaction.

This physical proximity is translated and used to orient the interface to the user. The question boxes are rotated in relation to the centre of the floor to ensure readability no matter from where the user will approach the display. At the same time this rotation encourages the user to walk around the floor to read the other questions, thereby discovering that the cursor is attached to her by a string and responding in real-time to movements. This sets of an exploration of the interaction and in several cases we saw users in the library trying out different ways of enhancing their ability to attract the cursor by e.g. joining other users or spreading out arms and legs.

10.2 From private to public displays

Sending questions and answers to the iFloor are done by SMS or via emails. This causes an interesting flow from using a public display in collaboration to using your private mobile phone or walking away to a computer, sometimes while still discussing the answer with a friend around the floor. The mobile phone becomes a remote control or a wireless keyboard for the shared display on the floor, causing a mix of private and public space.

Utilizing the mobile phone in the iFloor concept also means that the library extends its sphere of influence into the city, as you can pose questions or receive answers anywhere. The knowledge sharing that we try to establish in the library goes beyond the physical constraints of the library. However, the core of the community is still the collocated people at the library, since it is only the people present round the floor that can read and get access to the ID-numbers and thereby answer the question.

11 Social issues

11.1 Social Navigation

During the first days of setting up in the library, we walked around the floor to ensure it was running properly. This attracted many users who interestedly started using the system. But when we stepped away from the floor the interest decreased. Not for the individual users currently engaged in interaction but as a general trend for people arriving at the library. The floor, we decided, did not convey its potential use strongly enough. It looked attractive and interesting at first glance but potential users rapidly lost interest as they were unable to figure out how to use it and what the point of the interaction was. We changed the set-up by placing A3 sized posters on the three sides of the floor where people would approach it. Thereby we allowed an opportunity to observe and learn what the system was about before stepping onto the floor and interacting. Even with this stepping stone approach, users were still hesitative to jump onto the floor and we sometimes had to jumpstart interaction simply by being present on the floor conveying a use pattern and the fact that the system was safe (and even fun) to use. When on its own, it seemed to us, the prototype was too unfamiliar for most people and the rate of how many walked up and experimented with the floor more than halved.

As described in (Höök et al. 2003) it is very important for a physical place as well as for a digital to convey it use context through the social interaction taking place. When designing a place that is both physical and digital and unfamiliar to the potential

users, it is important somehow to provide the users with a possibility to gradually approach the system in a socially safe way. From observing how many people are using the floor and especially what they are doing, one can decide whether or not to participate. As a general rule when people are having fun or are deeply engaged in interacting it seems far more interesting for outsiders to try for themselves.

11.2 Negotiation and collaboration

When users were experimenting with the prototype, we often saw problems with sharing the cursor. In most cases when the users did not know each other, the negotiation that had to take place in order to move the cursor to the desired location was limited. If a user finds a question interesting he will have to ask the other users around the floor to work with him to move the cursor to the question or tell them to get off the floor, which happened almost as often as the first approach. Contrary to this, users were quite helpful explaining how to interact with the system to other users approaching the floor. In one case an elderly man had experimented with the floor and read the poster beside it, and was able to introduce the conceptual idea and use of the floor to a family of three. After this introduction they explored both what could be done with the video tracking and when using the SMS-service. The single-user perspective is so deeply imbedded into users when it comes to using digital technology, that it seems surprising that a display and a cursor is addressing several users in 360 degrees. When approaching the iFloor a user discovers her influence on the system as a string is "attached" to her and follows her around as she walks round the floor to read the questions. When entering the floor, users will inadvertently disturb anyone else who might be doing something purposeful with the cursor. In this way the interaction with iFloor invites or even demands users to collaborate in order to control the interface. By setting up such "forced" collaboration, we wanted to create a hidden opportunity for library users to establish contact with each other, however transitory these contact might be.

Finally, we observed several users, who did not know each other beforehand, discussing possible answers to questions. As with a dinner table, it is seemed socially acceptable to be talking with the people you are sharing a point of attention with, and collaboratively solve the problem.

11.3 Play

As users become more familiar with the interaction and figure out how the system is controlled, they can use the iFloor in a more playful manner. The iFloor can be manipulated to give more pull to a single user if he or she discovers that spreading out arms and legs will give more pull, as the video tracker sees more blobs and therefore "attracts" more strings to the cursor. This can give two or three users an opportunity to play with the floor and compete on who has the power to control the cursor. This game was often initiated when users were walking around the floor and noticed e.g. that they had strings "attached" to both their feet. The game became almost sport-like as it is your agility and stamina that will decide who can attract the most strings and win the cursor over. Often these games appeared almost like dance performances as users really got captivated and expressive in their effort to attract the cursor. Making teams could also be a way of competing. Sometimes users would also insist on the efficiency of something that did not have any effect on the system, like stomping or dragging the feet backwards as if the strings were physically attached to them. This, of course, makes sense in a direct translating of a physical string's affordances, and this was often how users experimentally appropriated the prototype.

12 Future Work

In continuation of the "Future Hybrid Library" project a related project has been launched called "The Children's Interactive Library". In this work we will advance the exploration of spatial interaction paradigms in relation to the social spheres in the children's library. In further development in the library context we will address the following issues for improving the iFloor prototype:

- Visual aging of questions to create a fast overview of new and old questions.
- The relation to the physical surroundings e.g. using the floor for directing users to bookshelves related to their questions.
- Explore the use of the third dimension down in floor.
- Using gestures to improve the bodily interaction.

As the technical solution proved to be fairly robust we believe that similar installations could be applied in other domains of the public space with a projectable floor material and the proper light conditions to do the video tracking e.g. as an interactive informative city map in transportation transit spaces supporting newcomers to get the latest information on events and happenings.

13 Conclusion

The iFloor prototype, as we have presented in this paper, experiments with new interaction modes for using floors as collaborative display and interaction surfaces. Novel interaction was achieved through the use of video tracking to extract the positions of the users around the iFloor, and thereby placing a shared cursor to navigate the posted messages. Questions and responses were posted onto the floor by using a mobile phone as remote keyboards. In order to support community and informal interpersonal interactions in the library the iFloor encourages users to collaborate and negotiate when interacting with the cursor and browsing questions. The installation of the iFloor contributed to the library's desire to change the library into a more social and communicative space. Through user studies we evaluated and improved the prototype and found that in addition to fulfilling the design aims from the library, the iFloor also supported users' curiosity through playful and spatial interaction.

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15 Acknowledgements

We would like to thank colleagues in the Centre for Interactive Spaces for comments on the prototype and in particular Kaspar Rosengren Nielsen for programming the interface, Niels Olof Bouvin for programming and administering the server part. We would also like to thank Kaj Grønbæk for useful comments on the paper.

15.1 Copyright

Paper 3

Embracing Values in Designing Domestic Technologies

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Published:
In proceeding for European Conference on Cognitive Ergonomics 12, ECCE12, York, UK, 2004

Embracing Values in Designing Domestic Technologies

1 Abstract

Provoked by the characteristics of domestic life, we seek to embrace a perspective on values in the design of technologies for the home. The focus of this paper is to investigate how we both theoretically and practically can establish a perspective of values in the way we design interactive technologies. We describe how we have worked with this perspective throughout the design process; in user studies, analysis and conceptual design. The methods presented seek to engage the potentially conflicting values of the context as a way of informing the design. Finally, we reflect on our process and the implications of embracing values in design

1.1 Keywords

Values, design, empirical, homes, domestic study, technology, media tour

2 Introduction

As technology migrates from the workplace into the everyday life of people, our way of designing technology needs to embrace all aspects related to living with technology [Hallnäs and Redström 2002, Petersen et al. 2002, Thackara 2001]. This trend urges us to understand how this context challenges existing assumptions on technology use and design [O'brien et al. 1999, Mynatt 2003]. The architect Palasmaa [1994] describes the characteristics of homes as a staging of personal memory. He argues that homes express personality to the outside world at the same time as they strengthen the dweller's self-image and concretizes his world order. This fits well in line with Katzenelson's notion of values. He argues that values define peoples' standpoints, reveal what they strive for, and point to people's identity and orientation in life [Katzenelson 1994]. Thus we suggest a focus on values as a useful approach to dealing with the challenge of designing for the household. Focusing on values in design implies for instance taking a perspective, which reaches beyond specific tasks and problems.

In this paper, we explore a theoretical background, based on the work of Schein [1994] and Katzenelson [1994], for understanding values. We report on our process of eliciting values from specific households, and describe how we operationalized this understanding in a specific design process. We describe the design concepts which

came out of the process, and finally, we reflect on the process in order to provide suggestions for the future.

3 Users and values

Overall, two strands of work relate to the approach presented here. Firstly, there are different approaches to representing users' perspective in design. Secondly a strand of work particularly addresses the notion of values in design work. As discussed in the following, we find shortcomings of both strands of work with respect to designing technologies for everyday life. While existing approaches to user involvement have problems embracing a value-perspective, those who specifically address values tend to impose predefined values in design processes rather than working from values that are grounded in everyday lives of people.

Participatory design represents a strong tradition for involving users directly in the design process. In this way, users' perspectives are represented through the users' direct involvement. Although user involvement has taken different forms and names, a common focus of these approaches has been on work-settings, where technologies are artefacts in a work process. [e.g. Greenbaum & Kyng 1991]. This work represents a tool-view on technology and while we sympathise with the intentions of this work, we find that existing approaches to participation fall short in coping with the complexity of home life in terms of representing users' values in a design process. Dunne [1999] has also advocated this perspective. He argues, provocatively, that classic user friendliness help naturalise electronic objects and the values they embody [ibid, p.30]. He advocates more sensitivity towards the values and ideas about life which inevitably are embedded in designed objects.

Thus there are some attempts, however, which seek to meet shortcomings of existing approaches and explore approaches to represent users and values in the design process. E.g. Gaver and colleagues [Gaver et al. 1999] use Cultural Probes to investigate a specific setting in a broader perspective. They focus on eliciting culture more than solving problems and supporting tasks in a given domain. The probes consists of collections of diverse materials like postcards with questions, disposable cameras which people are then asked to use and return to the designers. Through the probes the designers gather material from users, and engage new groups of users e.g. elderly. This approach seeks to understand their culture more than looking for specific needs and desires. It looks for cultural implications for design. However, the probes are seen as non-committal inspiration for design. E.g. the materials are sent to the designers, so there is no direct confrontation between designers, and users in their specific context. Further, Gaver and colleagues are not specific about how the material from the probes leads to actual design. In contrast, in our approach we emphasise actual visits to users and we use a theoretical framework to guide our use of values in a design process.

Moreover, Friedman, has worked with values in design in her "Value-Sensitive Design" approach [Friedman 1996]. However, her approach is on a few central points quite different from the one we will take in this paper. In her approach to Value-Sensitive Design, she discusses how pre-established ethical and moral values can be incorporated in the design process. Among others mentioned are user autonomy, freedom from bias, human well-being and dignity. This differs from the approach taken here, in that we present an approach to analysis of the concrete, situated values of users – whatever these values may be, and furthermore use these values to give concrete design-pointers for the later parts of the design process.

The work on "value-fiction" [Gaver et al. 2000] is another exploration of the relationship between values and design. Here fictive values are used to provoke new design ideas. Thus this work looks more into how values can be represented in design more than being concerned with where the values originate from.

4 Basic assumption, values and artefacts

In the following, we present our theoretical perspective on values, and we provide examples from our empirical work, before we go into describing how we operationalise the value-perspective in practical design work. Katzenelson [1994, p.136] describes values as more or less absolute rules, which relate to phenomena and human relations, which we admire or even celebrate. Some sets of values are common to members of a culture, where others are held only by groups within society. In our approach we worked from the assumption that a home is a specific culture. We use Schein's conception of culture [Schein 1994] as our theoretical basis for our analysis of homes.

4.1 Culture

According to Schein (ibid), there are three levels at which culture can be analyzed: Basic assumptions, values and physical artefacts.

Basic assumptions form the essence of culture. They are subconscious assumptions about how certain phenomena relate to each other, they form a view upon the world. These assumptions are theories-in-use or use-values. They affect the way we act and behave in certain situations (ibid). Basic assumptions are constructed through social validation. In this process a value of one of the individuals in the group is confirmed by the shared social experience of the group [Schein 1994]. An example of a basic assumption is that preferences in music identify who people are.

Espoused Values define the expressed or explicit interests and worries in a culture, and thus specify what is important and what is not within that culture. Argyris og Schön [in Schein, 1994] denote this level espoused values. This level can support predictions on what people say, but not necessarily on how they will act in a given situation. Thus an espoused value can either be or not be congruent with the basic assumptions of the group. E.g. a person can express that flexibility is important and worth striving for, but this may not necessarily mean that the expressed value is manifested through actions.

Artefacts are the third level on which culture can be analyzed according to Schein [1994]. Artefacts are constructed environments and social contexts. They comprise physical buildings clothes, interior etc. But they are also verbal and behavioural manifestations. Most artefacts are visible manifestations of the basic assumptions and values. However, to infer what the artefact is a manifestation of, can be very difficult, and should involve an investigation of both the espoused values and basic assumptions connected with the artefact. Artefacts are observable through for instance the organisation of the home. E.g. wireless phones and computers can be seen as a manifestation of the value of flexibility. However, if this can not be confirmed through an investigation of the two other levels of culture this deciphering of the artefact could very well be incorrect.

Thus the three levels are highly interrelated. Values and assumptions effect decisions on constructions of artefacts. Thus artefacts can be understood as manifestations of assumptions, and/or values through analysis of their relation.

4.2 Application of framework

Through analysing the three levels of culture in a common context of a home we may understand the self-identity of people, and the story people wish to form about themselves as perceived by others as well as themselves. Through applying this framework in our analysis we seek to understand which groups users wish to identify with, e.g. social class, lifestyle, age etc., as well as their wishes and motives, and what they strive for. Concerning design of technology for homes, the relation between espoused values and basic assumptions can be utilized when contemplating whether to design towards what the users do (basic assumptions) and/or what they express a desire to do (espoused values). In that context it is important to identify the espoused values that are manifested in actions (grounded in basic assumptions) and the espoused values that express what the user would ideally like to do.

5 Studying homes

In eliciting values we conducted a number of visits in private households. We visited three different households of very different nature. One was a nuclear family, which live in a suburban house. The family consists of two adults, three children living at home and one adult child living outside the home. Secondly, we visited a young man living by himself in an apartment, and finally, 5 students living in a shared house. We visited each household once, staying approximately three hours each place. A cross disciplinary team consisting of a psychologist, an architect, and a computer scientist went out to visit the household. At each visit we made three forms of investigation.

First we asked people to take us on a media tour in their house [Petersen and Baillie 2001] explaining us about how they use media, in particular focusing on how they use music in their homes. The purpose of this tour was to get insight into their choice and configuration of artefacts and through informal interviews start to understand the basic assumptions and values. The tour around the home served to establish a common frame of reference, which was used in the following session. The next session consisted of playing a "music game". The purpose of the game was to gain more insight into the use of music and media through establishing a different kind of conversation than in the presentation round. We drew upon the metaphor of a board game to establish engagement in the discussion and for people to take rounds in explaining their experiences with using music, based on a card they drew. The "game" consisted of a board with three categories on "works well", "does not work", and "dreaming of". See figure 1.

The idea of the game is for the family members to take turns drawing a card. The cards were either provocative statements or pictures. E.g. a picture with some nicely structured binders. People were then asked to discuss the statement/picture with respect to their use of music. Through inviting multiple people in the game, we wanted to spur conversation, debate and discussion around different possible uses of music. Through these conversations we intended to reveal more about both the implicit assumptions and espoused values in the culture of the home. The people we visited were highly engaged by the game metaphor. They were eager to take turns and to see the next card.

Finally, one adult was interviewed by the person with a background in psychology.

Figure 1. The music game board

Combined, these studies gave us an overall picture of the values related to the use of music in the different homes. During the media tour the informal interviews gave us a chance to investigate whether a certain artefact should be seen as a manifestation of a basic assumption, or whether it was a way of expressing an un-operationalized desired value. Through asking the people living in the home whether, how often and how a certain artefact was used, it became possible to connect the artefact to either basic assumptions or espoused values. Thus we could establish whether the artefact was a symbol of an actual value implemented in action or just an espoused value expressing a desired state.

6 Eliciting values of the home

We analysed the data from the visits in terms of the theoretical framework presented above. First, observations were grouped around the three levels: basic assumptions, espoused values and artefacts. We found that some attitudes, acts, and artefacts were congruent across the three levels, whereas others were in conflict. We constructed sets of values, i.e. patterns of basic assumptions, espoused values and artefacts. By exposing themes across the different levels of culture, we were able to express people's relationship to music and the ways they value it.

6.1 Value conflicts

Through our analysis, it became clear that the individuals have different values, attitudes and wishes. Some were not conflicting, but others were. For instance, one of them, Peter, explained how he values good sound quality and described his favourite listen-experience. In contrast, we could observe that despite the presence of a hi-fi system he played music from the computer, thus clearly compromising the sound quality. But on the other hand, he emphasised the easy access to music provided by the computer. Thus, eliciting values in homes is not a matter of identifying a clear set of values represented by each person. As we see, there are potentially conflicting values represented in one person, as suggested by others [Dahl 1997]. In operationalising a value perspective in design practice, we chose to focus explicitly on conflicting values as a resource for design. We [Bødker et al. 2001], in line with others [Engeström 1987] have earlier found that such conflicting perspectives are useful triggers for creativity and innovation. As mentioned, Peter is very interested in music. He likes to discover new music and to share music with friends as a social activity. His favourite way of listening to music is to lie on his couch in the dark with a pair of headphones on. This way the music becomes very intense to him. Through the information gathered from the media tour and the informal interview we elicited

three central values to be placed on the valuecard representing Peter. The three values are depicted in the valueset below.

I like to have multiple senses stimulated • I'd like to buy more music-dvd's as they provide a more holistic experience, having both sound and picture.
I choose easy solutions • I use MP3 files, because it is easy, quick and cheap. I mostly listen to music from my computer
I thoroughly enjoy sublime music experiences • I like to listen intensively to music. It should not just be background noise.

Table 1. The value set of the man living by himself.

The values were selected based on a categorization of the value laden statements expressed during the informal interview. The categorization grouped these statements according to their theme and subject. After this grouping each group was attributed with a heading (as seen above). This way we ended up with a general value exemplified by statements describing actions connected to the value or arguments explaining the value. This approach brings life and action to the main values and thus gives them a fuller presence. The value set further represents an example of the aforementioned value conflicts. The first and third value, both signal a holistic and quality focused appreciation of music. In contrast, the second statement represents a value that denotes music as something that should be quick, easy and cheap and thus puts the quality aspect aside. When evaluating such conflicts we need to look at what type of value the specific statements can be categorized as. In this case, Peter had implemented the "easy solutions" on an action level, as a basic assumption guiding action, in a way that dominated his use of music. The first statement however, was not visibly observable: He did not show us any DVD's nor talk about having any. Furthermore, the statement expresses that he "would like to" acquire such DVD's. This analysis thus leads to the conclusion that the first value is an espoused value not grounded in a basic assumption, and therefore merely signals a desired state. As shown earlier, the third value is an abstraction of Peter's favourite way of enjoying music, and is thus an espoused value grounded in a basic assumption, although it may not be the dominant way he listens to music.

7 Promoting a value perspective in design work

In order to work with the value sets elicited in practical design work, we set up a design workshop where three value sets from each home were represented. The criteria for selecting the sets were that they should be characteristic for use of music in each home, and as discussed, we included possible value conflicts as we expected them to be constructive with respect to design work. We represented each value set on a value card, and each participant in the workshop was given a value card which she should then represent in the design discussions. See figure 2.

Figure 2. Valuecard representing both the value expressed in general, on the front, as well as specific examples of how this value came into play, on the back.

Each card had a large font heading on the front which was persistently visible for all members in the design group, and concrete examples were given on the back of the card on how this value was represented in terms of artefacts. We formed three groups representing each of the households, and in each group each workshop participant took on a role as defined by the value set she represented throughout the workshop. All members of a group represented values from the same household, but potentially conflicting value sets. We provide the participants with a scenario they should design for: "It is afternoon, and you are expecting visitors this evening. Develop a vision or a concept for the use of music before/during/after the visit. Thus new design concepts were formed in response to this scenario and as a result of a dialogue between the different values.

8 Visions and concepts

One of the concepts coming from the workshop is this ProxyPlayer. This concept were developed in the group which worked with the values depicted in table 1. The ProxyPlayer provides quick access to music and at the same time delivers a physical and engaging interface by using an RFID-tagged ticket from a certain event. The ProxyPlayer is illustrated in figure 3. It stimulates multiple senses, having the physical ticket, from the specific event, at the same time as it provides easy access to the music. And it is not just any music. It is the music that was recorded on the specific event thus offering a special music experience. Thus this is one way to address the conflict, described in table 1, between quick and easy access and a special music experience at the same time.

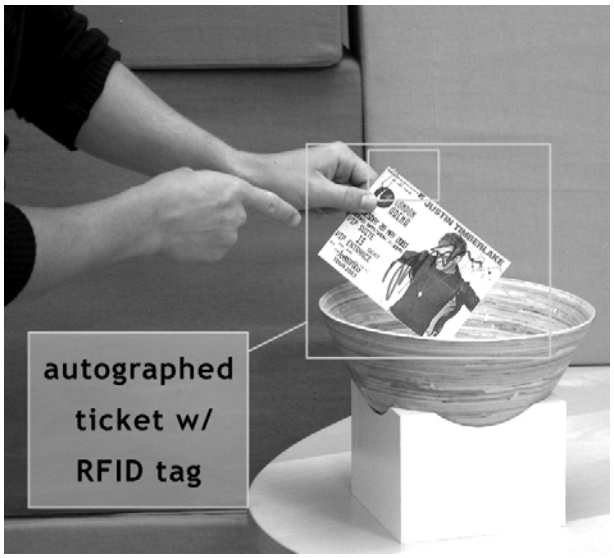

Figure 3. ProxyPlayer

A second concept of "shoal interaction with music" was developed in response to the values of the nuclear family depicted in table 2.

I prioritise things that are flexible and which has a history
I prioritise the social experience
The interior decoration and physical organisation of the home is very important to me

Table 2. The value set of the nuclear family

The idea represented in this concept is that repre-sentations of music are projected on walls and the floor and that the crowd on the dance floor controls the music through moving on the floor towards the music or mood that they wish to engage. In this way the music becomes part of the interior decoration of the home and the choice of music becomes a social experience.

Thus we see traces of the values represented on the cards in the design concepts, but as discussed in the following this mapping is also somewhat post-hoc rationalisations and the exact origins of the concepts can be hard to trace.

9 Reflections

Our effort to embrace values in our approach to design domestic technologies points to both potentials and problems of the approach presented here. In the following we provide a set of reflections on the problems and potentials of the way we represent users, of how to operationalise Schein's theory with respect to design work, and finally some reflections on which values can or should we strive to represent in design work.

9.1 Representing users

Reflecting on the process described, a fair question is why users are not directly involved in the design process proposed here. What argues against this is that it is hard for users to represent a multitude of value sets at one time. As we saw, one person may have conflicting values On the other hand, it was at times hard for people who represented the values, only supported by the value cards, to identify with values, if they were far from their own personal values. Here the visibility of the cards to the rest of the group served an important purpose. Often we saw how references were made to values represented by some of the others' cards. E.g. "You will argue that this is a good idea, as this design clearly represent history well..". However, in the future, we would like to investigate how more direct involvement of users in the design process can be combined with a specific focus on values.

One way of including users would be to incorporate them in workshops after fieldwork is concluded. That way the users could be confronted with the values that the fieldwork revealed as present in the users' culture. This would have two advantages: 1). the designers would get feedback on their analysis of statements and behaviour observed during fieldwork which would reduce misinterpretations and misunderstandings, 2). the designers would have opportunity to engage in deeper conversations with users resulting in a deeper and broader understanding of their values and cultural foundation.

The drawback of this method could be the risk of after-rationalization on the users' behalf. This could possibly occur, when one user's values are confronted with those of other users'. The challenge of the designers would in such a workshop be to utilize these conflicting values as a driving force in the process.

Summing up, extended user involvement in value-driven design could contribute with a more nuanced view of users' values and put the gathered data into play.

9.2 The challenge of operationalising Schein's theory

Besides the question of user involvement, another aspect that is a potential candidate for future investigation is the theoretical foundation of our work. It has become clear that the conceptual framework presented by Schein [1994] yields certain problems when applied in design praxis. The problems stem from rather vague definitions of concepts. This especially applies to the key concepts: espoused values and basic assumptions. In Schein's conception, it is hard to argue what the difference is between a value, and a preference. Nor does Schein make explicit distinctions between values, espoused values. Furthermore, when applying the concepts there was some uncertainty as to whether we had grouped the observations and statements into the right categories. Consequently, the elicited values seem less convincing when the object is to use them as design pointers.

Through our work on operationalising the theory in a design process, we faced a challenge regarding filtering of observations and statements. In order to reduce the complexity of the total empirical data some filtering of statements and observations was necessary. Initially these phenomena were filtered through the application of the three concepts (artefacts, espoused values and basic assumptions]. This filtering obviously relies on an interpretation of these. As discussed these interpretations could benefit from being confronted with users.

9.3 The role of values in design

This last point leads to a discussion on what role values should play in design processes. Our experiences from this process show a central way in which extracted values can be used when designing technology for homes. This potential resides in the dynamics between on one hand, the basic assumptions and the espoused values expressing these; and on the other hand, the espoused values signalling some desired state or possibility, not grounded in current practice. This dynamic can be used as a tool or a new perspective for designers when contemplating what functionalities and aesthetics of the current solutions to keep and what areas that should be subject to improvement or innovation. Given the tradition of participatory design, we need also carefully consider the role of espoused values that does not comply with basic assumptions. In the tradition of participatory design focus has always been on what people do rather than on what they say. However, espoused values cover what people say and not necessarily do. How much shall we comply with these in the design process? Afterall, people may end up never using the technology we design in response to these, but never the less the design may still play a role in forming people's identity, reveal what people strive for. In our design approach we set up a dialogue between those espoused values and basic assumptions.

A further key point in our approach is the level of commitment to the values discovered. Our goal has been to establish the values as the core around which the design process evolved. In our view is crucial that the values obligate the designers in one way or another. In our project we constantly focused on the values, they were points of reference, kept the context represented and alive for the designers. We were true to the values through the whole process by representing them through original statements from the users thus avoiding transforming them through interpretation or rephrasing. Furthermore, they were continually used as argumentation or validation of design decisions, thus keeping them alive and present through the process. In this way the values were taken seriously and were employed through the whole process and as such manifested in different ways in the final design concepts stemming from the workshop.

10 Conclusion

No technology has a "pure" or objective status in the mind of the users. On the contrary design is always directed towards a cultural and value laden human being that perceives the world and the artefacts in it through this value set. Thus, the inclusion of user values in the design process yields an optic providing the designer with a fuller conceptualization of the user. In this paper, we provided an approach to embracing users' values in a design process. We have presented a theoretical basis for conceptualising values, and have described our means of investigating values of specific households. We have described how we organise a design process grounded on values as they were discovered through empirical analysis of concrete users and have provided examples of the resulting design concepts. Our approach to dealing with values in design is to address concrete, situated values, and we provide theoretically based arguments for a focus on conflicts between values as a fruitful starting point for design.

11 Acknowledgements

We appreciate the effort of our colleagues in Center for interactivespaces www.interactivespaces.net. as well as the time and effort of the families we visited.

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Paper 4

Aesthetic Interaction — A Pragmatist's Aesthetics of Interactive Systems

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Published
DIS2004, July 18–21, 2004, Cambridge, Massachusetts, USA.

Aesthetic Interaction —A Pragmatist's Aesthetics of Interactive Systems

1 Abstract

There is a growing interest in considering aesthetic aspects in the design of interactive systems. A set of approaches are emerging each representing different applications of the terminology as well as different inherent assumptions on the role of the user, designer and interaction ideals. In this paper, we use the concept of Pragmatist Aesthetics to provide a framework for distinguishing between different approaches to aesthetics. Moreover, we use our own design cases to illustrate how pragmatist aesthetics is a promising path to follow in the context of designing interactive systems, as it promotes aesthetics of use, rather than aesthetics of appearance. We coin this approach in the perspective of aesthetic interaction. Finally we make the point that aesthetics is not re-defining everything known about interactive systems. We provide a framework placing this perspective among other perspectives on interaction.

1.1 Keywords

Design, aesthetic, pervasive computing, interaction design, pragmatist, interactive spaces, experience.

2 Introduction

There is a growing concern that we need new points of references when designing interactive systems for homes and everyday lives rather than designing interactive systems that are tools to be used in workplace contexts (e.g. [7], [17], [25],[30]). We very much share this concern inspired by our work in a multidisciplinary research center termed Interactive Spaces, where we develop visions and implementations of interactive spaces focusing on the domains of schools, libraries, and domestic environments. These domains all encompass a mixture of work, learning and leisure and call for new ways of interacting with digital materials requiring the expansion of ideals as transparency and efficiency to include subtle poetic elements exciting imagination. Thus in line with others we are looking to aesthetics as a way to pursue these ideals, acknowledging that functionality and clarity is not enough to meet human needs and desires when engaging with interactive systems ([20, [12], [11]).

We seek to frame an extended expressiveness towards interactive systems through the concept of Aesthetic Interaction that can be obtained when the human body, intellect and all the senses are used in relation to interactive systems. However, when looking into the work that takes an aesthetic perspective on the design of interactive systems it becomes clear, that not all perceptions of aesthetics are equally fruitful as we see a danger in adopting superficial understandings of the aesthetics of interactive systems. We wish to challenge the assumption that aesthetics are mainly concerned with the immediate visual impression of products as we see it in e.g., [8], [16], [28].

Drawing upon the work of Shusterman [32] we explain how some of the emerging projects connecting aesthetics and interactive systems represent an analytical approach to aesthetics. We suggest adopting a pragmatist perspective instead and illustrate with cases from our design work why this is a promising path to follow. Finally we point out how there is a lack of discussion of how the perspective of aesthetics relate to other paradigms for understanding interactive systems. We offer a framework, which places Aesthetic Interaction in a wider context of other perspective on HCI.

3 The aesthetic potential in interactive systems

In the search for new agendas for designing interactive systems a set of perspectives has emerged. These include:

- Those who have recognized that something else is needed beyond ideals of efficiency and transparency, e.g. like considering the emotions, attraction, and affect invoked by design
- Those pointing specifically to the notion of aesthetics as the place to look for new ideals for designing interactive systems.

As discussed in the following, what is most striking is perhaps the diversity within each of these trends. In striving for new ideals for interactive system design a lot of new terms emerge. As argued by Norman[28] "To avoid technical distinctions among the concepts of affect, emotion, feelings, mood, motivation and quality I use the reasonably neutral term affect" (ibid, p. 38). In his view products should both be useful and beautiful since attractive things work better (ibid). Given decades of research into aesthetics and related terms, we find that Norman adopts a very pragmatic stance on the use of terms and provide a rather simplistic picture of the world arguing that attractive things work better.

3.1 Aesthetics and emotion locomotion

Despite Norman's rich set of terms, one of the more prevalent tendencies at this time is that of designing for emotions ([28], [24], [8], [31], [26], [22]). With very few exceptions [31], the interaction ideal pursued as part of this "emotion locomotion" ([24], p. 29) is to design for pleasure and attraction, assuming that users "just wanna have fun" (ibid, p. 31). Or as put by Overbeeke et al [29]. "Interfaces should be smart, seductive, rewarding, tempting, even moody, and thereby exhilarating to use" (ibid, p.10). We see two problems inherent in some of this work. First the assumption that users always want to have fun and be pleased represents a simplistic view on human nature. In contrast Dunne and Raby [13] provide refreshing counterexamples with their critical design approach, where provocation and sparking imagination are the concerns with regard to the artefacts in use. Secondly, some of this work assumes that emotional qualities can be assessed detached from use experiences as well as the socio-cultural context of use. E.g. Desmet and Dijkhus[8] have developed a Product Emotion Measurement Instrument. This technique allows for evaluation of emotional

qualities of technologies (in this case of wheelchairs) on the basis of judgements of pictures of wheelchairs.

3.2 Aesthetics as appearance

Some specifically advocates taking aesthetic qualities of interactive systems into account, when identifying new ideals for interaction. But there is a variety of notions of what it means to consider aesthetics of interactive systems. Some work focuses primarily on the properties of form as perceived visually, with vague relations to the functionality and instrumentality of systems. We see this represented e.g. in the work of Fogarty et al.[16], who see aesthetics as "an added bonus" (ibid p. 141). Here aesthetics is seen as the answer to questions like "Does it go with the couch?" (ibid). We also see traces of this in the work of Hallnäs and Redström[20] who argue that "to design with aesthetics in focus means to concentrate on appearance as constituting the essence of things" (ibid, p. 116). Along these lines it is also striking how many references that are made to physical objects without interactive qualities when discussing aesthetics [28], [8]. Notable exceptions to this are the work of Dunne[12], Gaver et al.[17], and Djajadiningrat et al.[10],[29]. E.g. Djajadiningrat et al.[10] explicitly argue "Don't think beauty in appearance, think beauty in interaction" (ibid, p 132).

However, while we appreciate the effort to provide richer bodily experiences in the interaction with systems, as represented by tangible computing approach [11], we find that this leaves out opportunities we have as humans to interact with the world via complex symbolic representations. Direct manipulation also has its drawbacks.

As illustrated above there is wide agreement that new perspectives are needed on interactive systems design, however, the agreement seems to stop there. We see a range of different applications of the same terms and more importantly these different applications represent different inherent assumptions about the role of users and designers (or artists) and interaction ideals. These inherent assumptions are well worth investigating when developing an aesthetic perspective on interactive systems design. For instance, we find that those who view the potential of aesthetics as the possibility to provide users with a pleasing visual appearance of products are leaving out much of the potential of aesthetics. To qualify the discussion on these matters, we draw upon the distinction made by Shusterman[32] between Analytic Aesthetics and Pragmatist Aesthetics. We argue in the following that Pragmatist Aesthetics is a strong theoretical basis to take on with respect to designing interactive systems and we provide examples of how we work to implement systems adopting pragmatist aesthetics.

4 Pragmatist Aesthetics

As stated above a lot of effort is already put into designing interactive systems beyond rational and functional requirements. However, the very notion of aesthetic is used in ambiguous ways when it comes to answering the important question, what is the aesthetics of interactive systems. To answer the question we turn to pragmatic aesthetic as a theoretical foundation for staging a concept of aesthetic interaction. Shusterman[32] propagate pragmatic aesthetics as opposed to analytical aesthetics. We will use this distinction to qualify our discussion. Three central aspects of aesthetics will be discussed to establish a foundation for an aesthetic approach to interactive system design. These are the socio cultural approach to aesthetics, designing for mind and body and the instrumentality of aesthetics.

4.1 A socio cultural approach to aesthetics

The analytic aesthetics in the words of Moore (1952) rely on the intuitive assessment of aesthetics of objects, as if the objects existed by themselves in isolation. In this analytic perspective, as the artist or designer shapes e.g. the chair of exquisite material, and aesthetics arise as a product property. Shusterman argues that until recently most analytic aesthetics simply ignored the socio cultural background as irrelevant, "probably because aesthetic experience was traditionally conceived as pertaining to immediacy, not only because of its immediate satisfactions but because of its assimilation to direct perception rather than inferential thinking." ([32]pp.21). We see this perspective represented e.g. in works that assume that aesthetics of interactive systems can be evaluated based on visual perception of pictures [8]

In contrast, a pragmatic approach to aesthetics is represented by Dewey[9]. Dewey insists that art and the aesthetic cannot be understood without full appreciation of their socio-historical dimensions. He stresses that art is not an abstract, autonomously aesthetic notion, but something materially rooted in the real world and significantly structured by its socio economic and political factors (ibid, pp.22). Accordingly, aesthetic is not inherent in the artefact itself but rather a result of the human appropriation of the artefact. Consequently, the chair is not aesthetic in itself but rather the aesthetic chair is a result of the socio-historical appreciation of the material, and the shapes. Accordingly our ability to engage in an aesthetic experience is based on our social context, manifested in a personal bodily and intellectual experience prolonged beyond the immediate experience. According to the thinking in pragmatist aesthetics, aesthetic is not something a priori in the world, but a potential that is released in dialogue as we experience the world; it is based on valuable use relations influencing the construction of our everyday life.

4.2 Designing for mind and body

Where as analytical aesthetics is preoccupied with separating humans into mind and body, a part for thinking and a part for sensing, pragmatist aesthetics insists on their interdependencies in the aesthetic experience. In a pragmatist perspective, aesthetic experience is closely linked not only to the analytic mind nor solely to the bodily experience; aesthetic experience speaks to both. The role of art and design is to give "…a satisfyingly integrated expression to both our bodily and intellectual dimensions…" [32], p. 7. The sensed is without meaning if de-contextualized from the intellectual and vice versa. According to pragmatist thinking the aesthetic experience encompasses the immediate sensational auditory, visual and tactile qualities of artefacts and the intellectual process of appropriating the artefact, and moreover it points to the fact that past experiences fashion those of the future.

In a pragmatist perspective we have to move beyond ideals of meeting human sensor motor skills and somatic sensing, to include among others the human intellectual capacity to grasp and make sense of complex, contradictory and even ambiguous systems and situations [18]. It is the systems capacity to excite imagination that potentially will reward the user an aesthetic experience comprised of both a bodily sensation and an intellectual challenge.

4.3 The instrumentality of aesthetics

In a pragmatist perspective, when harvesters sing work-songs in the field "...these not only provide the harvesters with a satisfying aesthetic experience, but its zest carries over into their work, invigorating and enhancing it and instilling a spirit of solidarity that lingers long after the song and work are finished"[32]. Through examples like

this Shusterman argues against the tendency to regard art and aesthetics as something above or otherwise outside everyday life, as is the case for analytic aesthetics. In a pragmatist perspective, for anything to have value it must relate to human needs, desires, fears and hopes. If the song was part of a concert the aesthetic experience would be different, but as it is used in the field it becomes an integral part of the work.

From point of view in Pragmatist philosophy aesthetics has the ability to surprise and provoke and to move the subject to a new insight of the world. This goes well hand in hand with existing understandings that systems are not necessarily understood and used as designed [6] [7]. They are appropriated in use. Meaningfulness and aesthetic experiences emerge in use, they are not predefined.

In a pragmatist perspective aesthetics is a part of everyday life. It stems from a use-relationship. Aesthetic Interaction comprises the views that aesthetics are instrumental and that artifacts are appropriated in use [2]. By this Aesthetic Interaction promotes improvisation to be the key modality in how the user explores the world around her and learn new aspects.

What we stress here is that aesthetics has a purposeful role in the use of interactive systems, aesthetics is not only an adhesive making things attractive, and it is part of the foundation for a purposeful system. Aesthetics cannot be sat aside as an "added value". Emerging in use; it is an integral part of the understanding of an interactive system, and its potential use.

4.4 Aesthetic Interaction

To summarize, a pragmatist approach to the aesthetics of interactive systems implies that aesthetics is tightly connected to context, use and instrumentality; circumscribing our perspective on Aesthetic Interaction. Thus it becomes meaningless to think of aesthetics of artifacts in themselves. They might contain an aesthetic potential, but its release is dependent on context and use. In Pragmatist Philosophy aesthetics is also released from its tight connection to art and its many definitions, instead it is connected to experiential quality and value. This provides the basis for focusing on the aesthetics of interaction related to our everyday experiential qualities when engaging in and designing interactive systems.

What makes Pragmatists Aesthetics a particular well-suited perspective on designing interactive systems is that the legitimacy of the experience of the system is not confined to be in line with the intentions of the designer of the system but emerges from the personal and interpersonal sensations, experiences and reflections that is connected to the system in context. It does not regard man and world as separate things but focuses on the integration and interrelations bound to context. Designing for aesthetic experiences invites people to actively participate in creating sense and meaning.

Aesthetic Interaction is not about conveying meaning and direction through uniform models; it is about triggering imagination, it is thought-provoking and encourages people to think differently about the encountered interactive systems, what they do and how they might be used differently to serve differentiated goals.

5 Aesthetic interaction in prototypes

In realizing the concept of Aesthetic Interaction there are several paths to be followed. In the following the perspective of aesthetic interaction is illustrated through two concepts developed in relation to the Centre for Interactive Spaces, which forms the basis for our research. The presented concepts has acted as internal prototypes and provocations to facilitate discussions on Aesthetic Interaction and are not rigorously evaluated through user involvement.

5.1 Aesthetic interaction with music

In Interactive Spaces we have developed a new remote control for interaction with music, film and other media in the home. Existing remote controls neglects and limits our complex understanding of music and potential expressiveness in terms of interaction, while asking us to relate to music and other media through button pressing. Our design departs on the fact that digital media increasingly is published without a physical representation as a CD or DVD, resulting in vast amount of media data stored on hard drives, primarily accessible through traditional computer interfaces. The design issue can be approached in various ways: designing new physical representations, or as seen in many play-list based applications taking advantage of metadata incorporated in the files, Or it can, as illustrated in our prototype, be approached by re-designing the way we interact with music.

Figure 1. Interacting with music: Volume up and down, Skipping tracks, Mute

By means of sensor technologies in the form of accelerometers in the eMote, we are able to record gestures with the device and relate that to playing music-files. The current system allows one to turn the music off as the remote is turned upside down, to skip tracks by making a throw gesture, and to turn the volume up an down through vertically tilting the remote itself. The design ideal of the remote control is to enable the user of the system to relate directly to the music as it is sensed and reflected upon, rather than replicate the functionality of the music-playing appliance. In furthering the implementation of the perspective of Aesthetic Interaction a wide range of design issues and future possibilities are considered, which among others are: dependent on beat mediated by shaking the remote the system will play a music file offering the same beat, a pitch control will add a tonality dimension to the choice of music file, hard or soft throws will determine the style music etc.

The present prototype is but a first step in establishing a new relationship with music through giving people an instrument for interaction allowing them to relate to music with both their body and intellect and allowing people to gradually build up a virtuosity in the way they are able to interact with media. The prototype relates to pragmatist aesthetics and the design ideal of aesthetic interaction in the way that it takes advantage of the complex dialogue between mind and body in a sense-making process, the interaction is based on not just the immediate sensational, but it builds

upon earlier experiences as well as it draws upon the socio-cultural richness of gestures.

5.2 Aesthetic interaction in hybrid environments

Playful interaction is a concept illustrated in a videoprototype [3] [23] developed as part of the WorkSPACE project [19], a predecessor to InteractiveSpaces. The purpose of developing the prototype was to provoke existing interaction paradigms and to engage the design team in the discussion on the use of digitally augmented artefacts [1]. As illustrated below, the prototype envisions a pervasive computing environment, where walls, tables and floors are interactive surfaces, documents can be exchanged, moved around and arranged in a spatial setting. The concept proposes the use of a ball as an instrument for interaction. Targeting a digital document residing on e.g. the floor with the ball, will cause the ball to "pick it up", while when targeting a vacant spot with the ball, a document will be added to the interface. Part of the vision has been implemented, e.g the interactive tables. We currently work on an implementation of the ball and the interactive floor. In the following the concept of *playful interaction* is analysed on the basis of pragmatist aesthetics illustrating the perspective of aesthetic interaction.

Figure 2. A ball is thrown at an interactive surface on the wall releasing a document picked up earlier.

5.2.1 Engaging mind and body in the interactive space

The ball is a culturally significant object with many connotations of e.g. play, competitions, exchange, practice and fun. Applying it to move and exchange digital documents implies an experience where both intellectual and physical capabilities must be drawn upon. As with tangible interaction, aesthetic interaction allows the full faculties of the body to come into play, but beyond that aesthetic interaction recognizes that man is capable of working with complex and abstract models for interaction. Though the ball at a first glance is a "throw-able" clipboard, it, when more closely inspected, also hold functions for arranging and manipulating documents.

Figure 3. In the central office space where a range of different projects is displayed on the floor, the users engage in an informal exchange of digital materials by bouncing a ball to pick up documents

The ball is an artifact challenging our kinaesthetic skills. The idea in the videoprototype is that through use and practice the user can become better at interacting with the artifact and achieve greater expertise, as we know it from all games, in interacting with the interactive system and other users. The ball as a means of interaction promotes playfulness rather than efficiency when exchanging documents and materials. The term tool does not express the full potential of the ball. With a millennia old history, the ball implicitly affords a certain way of engaging the environment, both animate and inanimate. The ball is not an attempt to rule out mistakes and failures happening when people interact with systems. The intrinsic imprecision in and trickiness of manipulating a ball, is an understandable fact in the physical world. Learning to master and use a ball is prone to errors; in general making small mistakes is part of everyday life. If you drop a piece of paper during a meeting you do not think of it as a failure – you simply pick it up again. It is a common thing for a physical artifact to be prone to mistakes. But in the digital world even small mistakes are recorded by the system that reacts and warns you through sounds and dialogue-boxes. From an experiential point of view warning-sounds and boxes in traditional computer systems often can be equally warning whether the printer has run out of paper or you are about to erase a hard drive. Warnings of failures or malfunctions are important, but these warnings could be subtler and in line with their actual consequences. Mistakes that might occur when handling a ball and the gravitas of the action are immediately understandable. Using well-know physical artifacts in pervasive computing environments enables, apart from their general understandability, more subtle communication of system warnings and reactions as these are not only connected to abstract visual displays or audio channels but can be related directly to the physical handling of a device embodying the socio cultural interpretation of the artifact and the connected informal rules. When digital materials and documents become, or are pervasive parts of everyday life, and indeed when dealing with interactive spaces, the affordances of the artefacts are to be explored in regard to how they both address our bodily capabilities as well as our preconceptions of the nature of the artefacts.

Figure 4. The ball is not a personal object. Documents are perceptually stored in it and can be exchanged in a game-like fashion, adding an informal and playful aspect to the work environment.

5.2.2 Instrumentality of the interactive space

When the ball is thrown towards a wall or the floor the entire environment is perceived in a new manner. The world of possibilities is opened up and the user can start to explore the ball as an interaction artefact, and the environment as interactive surfaces. This is in our terms an aesthetic experience since it is experienced with the entire sensual apparatus of the user and at the same time it establishes new relationships between users and digital materials.

The aesthetics of the use experience becomes an instrumental perspective. It is used to instigate a new vision for the user on how to engage the use of e.g. the ball or the documents. As an aesthetic experience it finds its value in revealing the potential of a new experience and thereby broadens the user's perspective on the world.

5.2.3 The game of interaction

Any aesthetic experience is dependent on context: the life and abilities of the user, the affordances of the artefact and in what ever physical and social space the interaction takes place. We need to think of the aesthetic experience as more than a chance for contemplation, but rather as an event that resides in context informing the people who experience it and the people they experience it with.

The ball has a long history of being used in games and play by children and adults alike. It is an open-ended appliance for play. There simply has to be set a few rules to the game and then most people will be comfortable in trying to bend and break these rules and to heighten their abilities within the game.

By designing the videoprototype we wanted to bring a new mode of interaction into the office environment in order to bring a more playful mode of interaction than usually found in such a setting. We utilised the two very different socio-historical contexts of the ball and the office to create a type of clash and surprise comprising an aesthetic potential that could bring the users to redefine ways of working and collaborating inspired by the mode of interaction.

6 Aesthetics as a fifth element of interaction

In 1984, Bødker & Kammersgaard[5] reviewed different perspectives on human-computer interaction and coined four different but co-existing perspectives on interaction styles. Subsequently, these perspectives have been applied to provoke new design ideas through taking the different perspectives to the extreme in design brainstorms [25]. The four perspectives system, tool, dialogue partner and media are briefly introduced in this paragraph to promote a fifth perspective of aesthetic interaction.

Perspective /	**System**	**Tool**	**Dialogue Partner**	**Media**	**Aesthetic Experience**
Man	system component	master	equal partner	Communicator	Improvisator
Man-Machine Interaction	between equal partners	Mediated by machine	Man machine dialogue	Supporting human-human dialogue	Play
Interaction ideals	efficiency	Transparency	human dialogue	Communication	Intrigue

Table 1: from four to five different perspectives on HCI – elaborated on the model proposed in [5]

In the 80s, the *system perspective* was far the most dominant perspective on IT use. When viewing IT use as a system, man-machine interaction is characterized by the user being an integrated part of the system. Practitioners being in control of the machinery characterize the tool perspective. As opposed to the system perspective the human task is not comparable with machine operations. The initiative is on the users' side. The user acts through the machine, and ideally, the computer artefact is transparent for the user. The *dialogue partner perspective* considered man and machine as equal communication partners. The implication of the dialogue partner perspective is further discussed by Engeström[15]. Finally, the *media perspective* assumes that all communication takes places between people. IT can mediate this communication by processing data created by a sender and interpreted by a recipient. In this way the interaction between man-man is mediated by IT artifacts.

By proposing a fifth perspective on interaction, the *aesthetic* interaction perspective, we emphasize the experiential aspects of interactive systems. As opposed to the tool perspective aiming at transparency as its interaction ideal the aesthetic interaction perspective focus on the intriguing potential of interactive systems promoting less directionality of the users interpretation of the encountered system. By focusing on intriguing and sometimes even ambiguous aspects we aim to encourage the user to explore and playfully appropriate the system. As there is not one "right" way to understand and use the system, the process of appropriation encourages the user to improvise her way into the interactive system promoting a freedom of interpretations of the artifact and it potential as it is experienced in use.

We do not wish to claim that these four perspectives on design of interactive systems are no longer valuable, but we argue that these views lack the potential of addressing the experiential sides of everyday life.

There are two main points to distinguish our fifth perspective from the four previous:

First, aesthetic interaction aims for creating involvement, experience, surprise and serendipity in interaction when using interactive systems (for further discussion see, Iversen, et. al. [21]). Whereas the dialogue partner perspective treats man and machine as equal dialogue partners, the aesthetic interaction perspective acknowledges man's ability to interpret and appropriate technology. The ideal appropriation of technology is not the shortest way to mastery (as proposed by the tool perspective) but rather the process of appropriation itself becomes essential.

Second, Aesthetic Interaction promotes bodily experiences *as well as* complex symbolic representations when interacting with systems. It puts an emphasis on an actively engaged user with both cognitive skills, emotional values and bodily capabilities.

As voiced in an earlier paragraph two aesthetic approaches propagate the need for an aesthetic approach to designing interactive systems. However, they either forget to bear in mind the existing perspectives on interaction (e.g Marcus, 2003)(the aesthetic perspective is only meaningful in close relation to the four existing perspectives). or treats aesthetics as an 'added bonus'[16] which does not embrace the potentiality of an aesthetic approach to system design.

In our work aesthetic interaction is used as the fifth element of interaction (the five perspectives are represented in table 1). We set up frame for interaction, but it is up to individual user to interpret and explore the system. The perspective of aesthetic experience creates a frame for allowing the user to express herself through the interaction.

7 Future Work:

Within InteractiveSpaces we are currently focusing on projects in the future interactive environments of schools, libraries and the home. These domains will be the platforms for further experimental work applying the perspective of aesthetic interaction.

As discussed we are exploring e.g. the developmental perspective of aesthetic experiences. Applying it to provide learning experiences for children is one of our immediate pointers-forward. In the up-coming work we will focus on experiments and descriptions of implications for design when pursuing the perspective of Aesthetic Interaction and how we can we promote the perspective in the design processes.
The aim of this research is to operasionalize the perspective of aesthetic interaction with regard to design praxis, and bring a deeper understanding of the nature of aesthetic experiences to the design community by further developing the methods we are currently exploring for user studies, prototyping and interaction design.

8 Conclusion

In this paper we presented Pragmatic Aesthetic as a theoretical foundation for the perspective of Aesthetic Interaction. We reasoned how the aesthetic experience through interaction relies on addressing both the mind and body, as well as it is rooted in the socio-cultural context of people's everyday life. Moreover aesthetics in this perspective becomes instrumental to the use situation, going beyond ideas of

"added value" and the immediate attractiveness of systems, placing aesthetics as an integral element of the artefact and a continuously encouraging element in the future use of a system. In order to exploit the full potential of aesthetics in interactive systems all three aspects has to be addressed. Working with this perspective of Aesthetic Interaction incorporates and highlights the experiential aspect of designing interaction.
Although the aesthetic interaction perspective is important when designing interactive systems we position the aesthetic perspective as the fifth element of interaction design. Designing interactive system requires multiple perspectives.

The perspective of Aesthetic Interaction presented here promotes curiosity, engagement and imagination in the exploration of an interactive system.

We presented two examples of how we work towards aesthetic interaction in design cases. One case represents a new way of interacting with music. In the prototype, we are able to record gestures with the device and relate that to playing music-files.

Secondly, the playful interaction videoprototype and concept envisions a pervasive computing environment, where walls, tables and floors are interactive surfaces; documents can be exchanged, moved around and arranged in a spatial setting. In such an environment the concept proposes the use of a ball as an instrument for interaction. The ball is a culturally significant object with many connotations of e.g. play, competitions, exchange, practice and fun. Applying a ball as means of interaction to move and exchange digital documents implies an experience where both intellectual and physical capabilities must be drawn upon.

The concept of Aesthetic Interaction currently presents theoretical considerations and will need further empirical experiments in order to provide more concrete guidelines for working with aesthetic interaction generally. However we see Aesthetic Interaction as a beneficial perspective when designing interactive systems.

9 Acknowledgements:

We would like to thank Kaj Grønbæk for providing useful comments on the paper and the concept of Aesthetic Interaction, and WorkSPACE (IST-2000-25290) for enabling the production of the videoprototype "Playful Interaction". Furthermore thanks to our colleague Jesper Nielsen in Interactive Spaces for producing the eMote.

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Paper 5

Designing for Social Use in Public Places – a Conceptual Framework of Social Interaction

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Published

Proceedings of Designing Pleasuable Products and Interfaces, DPPI05, Pp 389-408. Eindhoven, The Netherlands, 2005

Designing for Social Use in Public Places – a Conceptual Framework of Social Interaction

1 Abstract

Most interactive technology is designed for the individual user pursuing either a work-oriented accomplishment of tasks or an experience-oriented aesthetic/pleasurable endeavor. In the project here presented that design paradigm is turned up-side-down focusing on social use and social context. I furthermore argue that this social user perspective can be applied in other design projects and I provide a designer's conceptual framework of social interaction, based on both a theoretical and empirical background.

2 Introduction

The goal of this paper is to question the standard outset for designers developing interactive technology for individual use. Human beings are social creatures and many of our activities are socially defined and dependent. Social context and social use are important aspects of the appropriation of most digital products, and an important point for designers to focus on when designing technology that aims at fitting into the fabric of the users' everyday lives.

Therefore I propose a conceptual framework for interaction in social spaces aiming at focusing designers' attention to social use and social context, and providing designers with a tool for deciding what kind of social interaction to develop for. The conceptual framework is based on the work of sociologist Erving Goffman [1] notion of rules governing behaviour in public places. Furthermore the framework is based on the empirical design research study of making and implementing the iFloor [2], an interactive floor prototype installed in a library in order to enhance the level of social interaction and knowledge sharing. The iFloor prototype and the process of designing it are presented as a design case for exemplifying and explaining both the concepts of the framework and the impetus for making the framework in the first place.

3 Designing the iFloor - social use of a digital information artefact

In this example the social interaction was deeply rooted in a context well known to most of us namely the public library.

As many other libraries (e.g. [3]) the Municipality Library in Århus is in the starting phase of redefining their role in the local area as well as in a wider political institutional sphere. Librarians view their institution as one of the foundational pillars of democratic society as it is a place for exchanging and seeking knowledge and information on a very wide basis and on your own accord.

Different kinds of digital technology services have been introduced for the library users: Internet reservations of books and other item, automated drop off of borrowed items and recently also unassisted pickup of reserved items, going to the library has become an almost fully automated activity. If you are familiar with the system, you can use the library to its full extend without ever coming into contact with another human being. So it becomes important for the libraries to develop new ways of stopping the users in their efficient search in order to "sell" books, knowledge and experiences, that the users had not anticipated.

In that sense, the library becomes like a micro version of our industrialized service society. If you master the system and all its services [4] you can walk through your daily business without meeting another live person unless you actively choose to do so. Put to the extreme, the digital ambient technologies of present day allows or entices the individual to walk through life in a bubble [5]. In an effort to achieve efficiency the goal in service design seems to be never having to ask for directions because of GPS-services or never having to talk to real people on the phone because of automated self-dial labyrinths. The development of modern technology is one-eyed individualistic in many respects, but the people using it are only engaged in strictly individual activities some of the time. A big chunk of the rest of the time they are part of something bigger than themselves. This is a good reason that we need to look at these people in plural – as a collective, as we want to make relevant designs and developments of technology for real people in real life.

As another focus the librarians are also very aware that the concept of knowledge is changing or rather expanding. From knowledge in books to information from on-line services, most libraries today offer access to a range of media. As the perspective on knowledge continuously develops, there is a new focus on knowledge as it is also found in or between people, and the question is then; how is the library going to convey and facilitate the appropriation of that kind of knowledge. Somehow the library wants to facilitate a wider range of learning and hands-on experience with knowledge than it has traditionally done.

3.1 Design process

The process of getting to the designed solution started, as all our work at Interactive Spaces [6], with a high degree of user focus and user involvement. There has been written an extensive amount of research lately on the issue of how libraries are used, so we had a good starting point for understanding the needs and structures of use of the library. As designers we also recognise the need to get personal, first-hand experiences with users and the context of use. We therefore made what we called a *Dream Day* at the library. This process was in some ways similar to the Future Workshop method [7], but since we wanted to approach library users in the public

space of the library, we made it into a public stand or event, where library users could tell us their likes and dislikes of the library as it is today, and what they hoped it would evolve into, when the new library is built within the next years. Some users also allowed us to accompany them around the library describing and showing what they did in an ordinary library visit, and where they thought improvements could be made.

The true experts on library life were however the librarians and we had them deeply engaged in the design process, making video prototypes and conceptual proposals as means for us to better get an understanding of their understanding of the library context. As a conclusion of the user studies and brainstorms, the problem statement that evolved throughout these initial steps of the design phase made it clear that what the library needed was to become a more social place. Users lacked spaces for reading material and for being introduced to new literature and ideas, and librarians wanted to have some kind of social platform where users could share knowledge among themselves. Although these are three very different ideas they all informed us on different levels about the problems or potentials of the library, and we decided to aim for a solution aimed at the two latter ones.

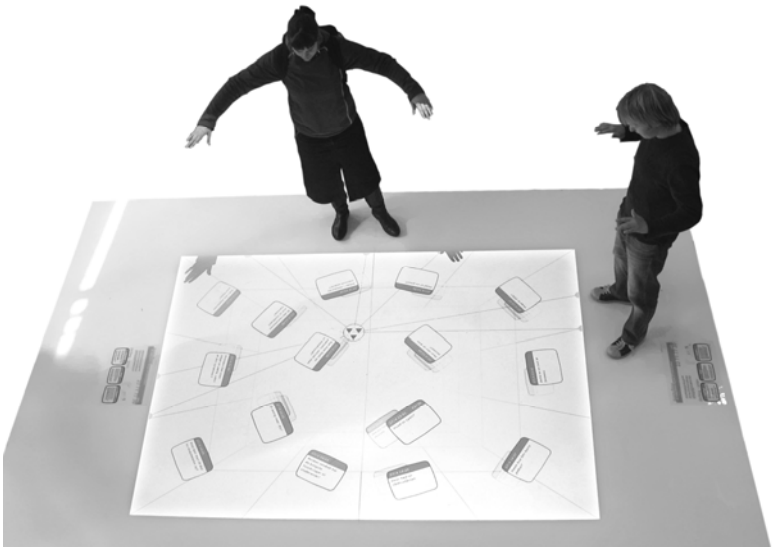

Fig. 1. The iFloor and collaboration to control the cursor

After the initial design and brainstorms were concluded, the decision was to make an interactive floor that somehow could connect ordinary users to each other and open up the possibility for discussions, and at the same time introduce new ways of finding materials in the library. The result of this was the iFloor, which after a lot of developmental work, was installed in the entrance area of the library, being in full use for two periods of three weeks.

3.2 Description of the iFloor

In order to fully explain the iFloor I will first explain the general use of the prototype, and then go over the technical setup, the physical interaction and the graphical user interface as used for interaction by reading and adding content.

The iFloor is an interactive floor that allows users to post and read questions from other users of the library concerning whatever they may fell is relevant to post in this space. Questions and answers are posted on the floor by sending text messages by email or from a mobile phone. As 90% of all Danish households have at least one

mobile phone [8], we decided that this form of interaction was acceptable for public displays. The questions and answers are browsed on the floor using a shared cursor, operated through the physical position of users.

3.2.1 Technical setup

Technically, the iFloor was made of two white sheets of polycarbonate plastic, a projector, a computer and a webcam. In the entrance zone of the municipal library the floor was setup with five meters to the ceiling making a projected display on the white background approximately 5 by 4 meters. The questions and answers on the floor were handled by a remote server receiving both emails and text messages and posting the 15 newest questions and 5 newest answers to each question. The positions of the participants were monitored by the webcam mounted above the floor looking straight down. Using Retina [9], a piece of software developed for visual tracking, we tracked a one meter rim around the projection analysing where there were people present on the white background. Coordinates were sent from Retina to a Macromedia Flash file and translated into attractors pulling at the shared cursor, and so the total influence of all participants pulling the cursor was calculated into a vector. In order to keep people from moving in on the projection itself and cast shadows or get in to other people's line of sight, we separate all the positions of users standing on or within the projection giving the user a visual feedback that they have lost their influence on the system.

3.2.2 Graphical user interface

Due to the novelty of this installation, the graphic interface for the iFloor had to be kept as clear and simple as possible. A user's influence on the shared cursor is showed by a virtual string connecting the position of the user to the cursor. If the user steps too close to the display, the string will disappear and a small dot in front of her will show the disconnection. Users will move around to drag the cursor to the question they want

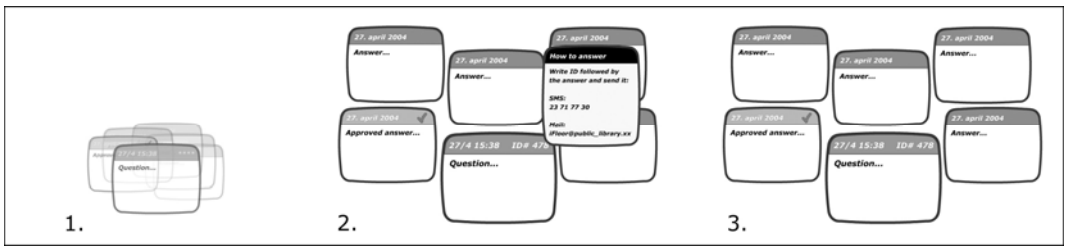

Fig. 1. A question and its answers unfolding.

to read, and by spreading out the arms or feet a single user can attract up to five strings and thereby get five times as much pull as a user standing straight. Stepping out of the tracked area will send the cursor floating back to the centre of the floor. If more than one person is present around the floor each will have a string attached, pulling the cursor in different directions. This makes it necessary for users to negotiate in some way where to take the cursor. This has lead to many different playful interactions around the floor, which I will come back to in section 3.3.

Each question can have answers tucked in behind it and these are unfolded when the cursor is dragged over it (Fig. 1). Hitting a question with the cursor also slows down the cursor so the question will be selected for a longer time. This again gives the user a chance to write down the ID number of the question which is needed for making a

reply to the post. Furthermore, tool tips were embedded in the interface explaining how to post content to the floor, including phone number and instructions.

3.2.3 Physical interaction

On the projected display the question and answers are distributed randomly as can be seen in (Fig. 2). As the projected display on the floor is to be viewed at any angle, the graphical elements are distributed around the centre, making the reading direction full circle. This is our first effort to activate the spatial orientation of the user, making her a participant instead of an observer.

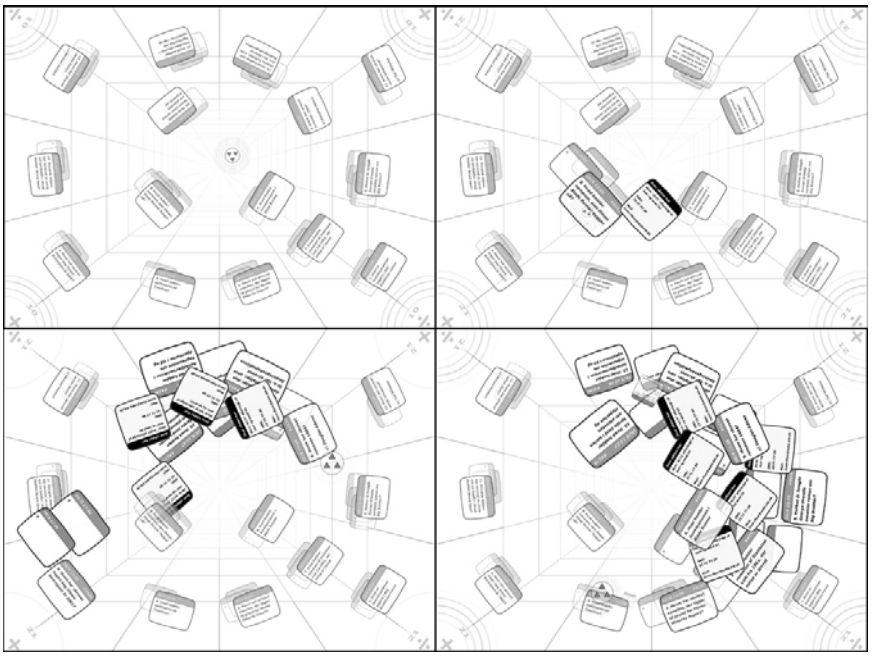

Fig. 2. The distribution of questions on the floor and the questions unfolding as the cursor is dragged over them.

As the participant now moves around the iFloor the videotracking system readily tracks her, and the cursor starts moving towards her.

Moving around the floor the user will now have full control of the cursor and be able to read all the questions in her own good time. However, as it is with public space, one user is seldom alone, and as one starts to use the floor others will soon step up to observe the user and become part of the system, as they walk into the tracked area in order to read the questions. In this way we made a direct translation of the properties of the physical public space, as the use of the digital interface becomes as intrinsically shared as any other public space.

Coming back to the playful aspects of using the iFloor, this physical interaction became an object of much exploration and improvisation. In order to figure out how to control of the cursor, each participant was engaging the cursor directly, but the presence of others soon affects the cursor and takes full control away from the user. The user can then try to attract more strings from the cursor by e.g. spreading out the arms or feet, jumping up and down or snapping the fingers, of which only the first would work. This relatively unusual physical activity for a library was a big barrier to overcome for most participants, but it was one of our main points with the iFloor that we wanted to design an installation that would introduce a physical and playful form of interaction to the library, as this seemed to be a good icebreaker for achieving the goals of increased dialogue, small talk and informal knowledge sharing.

3.3 Observations of the interaction

We observed the iFloor in use in the six weeks it was in the library, and discovered a range of both expected and unexpected social interactions around it. The idea of having a walk-up-and-use interface was very successful. When people stepped closer to take a look at what the iFloor was, they stepped into the tracking area as well thus becoming participants of a collaborative situation. As the next person then stepped up to the floor the collaborative situation was imposed on them as the cursor now responded to both of them at the same time. Exploring the interface in this way, halfway pushing and halfway being pulled into the social use, proved to be a good way of getting people in the public space to actually engage in collaboration. We saw several encounters of people where one user, having tried the floor for a while, was explaining it to other users as they were approaching. Understanding the dependency on other people and the need to negotiate and collaborate quickly developed into a game-like interaction where people tried to pull harder and dominate where the cursor should go and who was in control of it. This kind of co-dependency and negotiation of leadership is at the foundation of many games [10] and therefore the floor easily evolved into a playing field or game board.

However, some library users were a little hesitant or cautious when confronted with the iFloor. But as we ourselves were using the iFloor, we could attract several people and after some initial superficial explanations of what the floor was and who we were, we could retract into a role of participant observer listening to how users would deduce the workings of the floor and interact with each other and us in order to get to the content they wanted. Influencing users in this way, of courses, disturbs the first time user's natural appropriation, but we decided it gave us better knowledge to actively engage the users in the process of discovery. Observational studies made from a distance confirmed our initial finding that if only a single user broke the boundary between observing and exploring, others would soon follow. Goffman's concept of occult [11] involvement explains this hesitation very well, as it describes the kind of involvement where a person is doing something that seems so strange that it is frowned upon by the people around him – like talking to himself. Not using the iFloor could very well be because people did not want to take the risk of looking like a fool or break some kind of rule. People did not know what to expect as both the form and the content of the iFloor was new and did not at first glance have any similarity to a known function in the library. Our participation in the interaction gave potential users assurance that it was ok to interact and a hint to how to decode the interaction.

Inspired by the floor's game-like qualities we initiated a real competition with a school class of 7th graders (age 13 to 14). The game was set up as a quiz game where the five groups were to find the answers to twelve natural science, literature and history questions and post the answers behind each question. Timestamps would help decide who had won each question and subsequently the game. We discovered that when dealing with a relatively defined group of people like a school class, the rules defined by the interaction of the floor in public space could not match the rules for interaction already established in the class. As an example the pupils were pushing at each other instead of trying to collaborate, and as all the 27 of them were standing evenly around the floor, the entire rim of the floor was occupied and the cursor therefore pulled in all directions at once – moving it nowhere. The notion of negotiation and collaboration didn't quite sink in with the pupils. One group would stand on one side of the floor and another on the opposite side, both sides shouting at the other. Again this deadlocked the cursor in the middle. We account this to the fact that the competitive element in the game was stronger than the collaborative incitement in the floor interaction.

Fig. 3. The quiz game. Kids battling for control of the cursor

Funny as it may be, the above observations reflect some of the rules imposed by the floor and onto the floor in different contexts of use. All according to who is using the floor, their relationship and how many they are different rules of interaction are established. These intangible rules are difficult to address in a design but they are essential to how designs for social interaction are appropriated into a context.

4 Goffman's concepts for behaviour in public space as a stepping stone towards a designer's conceptual framework

The rules that we see at work around the iFloor are what Erving Goffman calls the rules of behaviour in public places. In his book *Behaviour in Public Places – Notes on the Social Organisation of Gatherings* [1] he defines a range of concepts and rules that are defining and describing the behaviour of people in social situations. His study is of the middle class in fifties and sixties US, but many of these rules are still valid in a Scandinavian context today, and the framework for looking at these rules still holds as well. The three central concepts are the occasion, the situation and the encounter. The basic understanding of social rules according to Goffman is that they are laid out to the social gathering at these three levels. To understand what happened as we introduced the iFloor to the public library it makes a good reference to hold the case up to this basic framework, and on the basis of that discus how we can describe the level of social interaction in a conceptual framework of social space. Designers need to be more aware of the social context they are introducing products and services into, and a conceptual framework for understanding the context and point to where a future socially interactive service is intended to function, is a tool for understanding the future impact of a design.

The occasion is the social construct of the event. It is what we already know or should know about conduct at a given event; say a funeral or a classic or heavy rock concert. All these situations have a prescribed frame of conduct that we learn through

experiences and observations assimilated over time. Unknown occasions will first constitute a situation since there is no reference. One would have to draw on experiences from an occasion somewhat like it, but the second time one is in the situation there will be a frame of reference to guide conduct. Examples of rules defined by the occasion could be whether one sits down or stands up at the concert – this could also be evident from the physical layout of the concert space, or whether a certain type of clothes is required at the event.

The situation then is the specific manifestation of the occasion. Influencing the situation are among other things the amount of people present and the room or spatial arrangement in which the situation takes place. A situation is "an environment of communication possibilities" [12] in which everyone entering the situation is accessible to the other participants in the situation. In the social situation communication is both expressive and linguistic and messages are conveyed through physical gestures, appearance, posture as well spoken words. Rules defined at the situational level are such as how loudly one would talk depending on the music, how one would react to being pushed or touched in a crowded room or where one would position one self in relation to others present etc.

The encounter or the face-to-face engagement is the smallest unit of social interaction. Consisting of only two or more people currently present in front of each other, focusing on a shared object, it also constitutes and delineates norms that shape the interaction. Even though a given occasion defines a very formal code of conduct, an encounter might evolve into a more informal interaction if e.g. two friends meet and talk about some very amusing shared experience. The resulting laughter might or might not be fitting with the occasion as is the case in Goffman's example from an English wake after a funeral. Another example of encounter proprieties is the distribution of attention to the people in the present encounter. Rules defining interaction at the encounter levels can be difficult to discern from the situational, but they are focused at the interaction of those engagements or encounters that make the situation.

Of course cultural differences are numerous and therefore we are not able to define all occasions in a platonic idealistic way, as it is not possible either to universally to describe in any unambiguous way all situations or encounters. Of the three concepts especially the two latter are dynamic and dependent of the context of observation. However they are still fundamental to the understanding of Goffman's structural understanding of social interaction as layers of rules, one containing the other (Fig. 4).

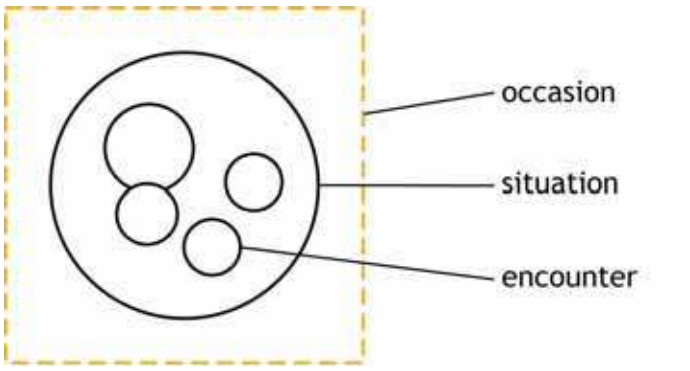

Fig. 4. Layers of rules defining social interaction

This introduction is to lead up to the conceptual framework giving an understanding of different forms of social interaction, and of the fact that it is the distribution of attention in the social situation or in other words how closely people are engaged in the social situation, that defines and distinguishes one type of social interaction from another. The three levels of occasion, situation and encounter help us to understand, in an observational study, why people act as they do – from which layer the rule to interact in a certain way comes, and, in a design process, to define on which level to position a desired change in social conduct.

5 Conceptual Framework

The conceptual framework of interaction in social spaces is structured along a scale of engagement, as in to what extend participants in each type of social interaction are actively engaged in the social activity, or what is the level of attention accredited to the social situation by the participants - how close are they and what do they share.

5.1 Distributed attention

The first level in the conceptual framework is when people are merely present in the same space. If nothing is the apparent centre they will probably have different focuses around the space and seen as a social situation, the level of interaction will be very low. The only thing that is shared is the presence in the space, and this presence can e.g. be regulated through defining spatial elements. Also the appearance, conduct and posture of participants will be defining interaction in the setting. The social aspect of any given setting is of course only one of many, and a situation assigned to this category is not a bad social situation. The distributed attention simply means that as a social space there is not much going on. Distributed attention is seen in many contexts both in the physical realm and in the digital. Social software like intranets or many Web pages can be defined as distributed attention, as the single user never really discovers or acknowledges other users around them.

5.2 Shared focus

The second level of social interaction is when the situation develops a single focus shared among its participants. This shared focus is then the organising point of reference for the entire situation and single encounters might cease as the attention of the participants are required at the situational level. The shared focus is often giving a spatial orientation of participants or vice versa - the spatial configuration of participants is emphasising a shared focus. As e.g. is the case in a room defined by a stage like a theatre. In digital designs and their interaction one of many example of shared focus is the social navigation browser developed by Höök et al [13] where users of a Web page are guided to the interesting pages by seeing where others have gone before them – to some extend as one would navigate a public urban space. Broadcast entertainment is another example of a shared focus that sometimes can be shared by millions or even billions as the world cup in football, or the live8 concerts.

5.3 Dialogue

At the third level participants are engaging in a shared activity in which they are investing themselves and their opinions. The dialogue requires some sort of situated engagement with the counterpart and it puts the participants in a situation where they are accessible to the counterpart's opinions. The dialogue is a more equal organisation of the participants than the shared focus with respect to power and roles, and it is of course dependant on standing on "the shoulders" of the two levels before it as a dialogue would be difficult without shared presence at some form and shared focus of a subject. Social software supporting dialogue are numerous both in research

and in commercial products. From instant messaging to CSCW projects (e.g. [14] and [15]). Dialogue is concerned with separate individuals participating in encounters or situations, taking a stance towards each other and keeping focus on the social situation at hand, either exploring or debating a subject.

5.4 Collective action

Closely related to dialogue but with a stronger emphasis on the shared subject, the collective social activity is the socially most engaging interaction. This fourth level of the conceptual framework is concerned with the type of activity that takes place when participants are working collaboratively towards a shared goal. The activity becomes a collective activity as the goals of each participant coincide with the goals of the entire group. We recognize this in many situations where we act as part of an entity bigger than ourselves: When grown men are watching football and cheering and hugging at a goal, this form of activity would not immediately happen in many other occasions. Or the thrill of a good brainstorm when participants leave personal issues and differences aside and creatively and collectively work towards a goal. These collective experiences are often those big experiences that really stand out [16], being remembered for a long time [17] and able to establish strong bonds between people. In digital product design we do not see that many platforms for collective activities although one might argue that games like Counter Strike often exist at this level. In research projects aimed at mixing the digital and the physical contexts a good example is Citywide [18] from MRL at Nottingham University and artist group Blast Theory. Outside the idea of gaming a lot of CSCW literature holds this level of interaction as the desired ideal.

Presented in a diagrammatic form with explanatory examples the conceptual framework would look like this (Table1):

Social interaction	**Examples from a work place:**	**Examples for a playful situation:**
Collective action	Collaboration in a team of colleagues brainstorming/ working towards a solution to a design problem.	In the game it self kids will quickly loose track of time and e.g. take on new roles in the interaction
Dialogue	Discussion on e.g. how to frame a design problem or understand a specific parameter.	When kids play a large part of they efforts go into deciding what the rules are for the game and they often return to this dialogue level during play
Shared focus	Presentation. One person in front of the rest of the colleagues.	Bystanders to a game might be observing in order to join the game later or just looking at a friend playing GameBoy
Distributed attention	Awareness of colleagues before the presentation starts or in breaks during the work.	In e.g. a daycare where lots of children are playing different games to themselves or in small groups

Table 1: Conceptual framework of social interaction

Finally I would like to introduce the notion of mobility in social settings. Not social mobility in its ordinary sense meaning moving from one social class to another, but here it is focusing on the situation as in *situational interaction mobility*. This notion is

needed in order to describe the social potential of a product or an installation like the iFloor. Basically I see three questions that can be inquired in an analysis of ideas, using this framework:

- Regarding the level of social interaction; where are we presently and where do we want to go?
- Regarding the interaction itself; how is interaction at this level supported?
- And finally regarding the openness of the system or service; to what extend is situational interaction mobility supported – that is; can users themselves take their social interaction to a different level if they choose?

The last question point towards the need to understand what I call situational interaction mobility. Situational interaction mobility describes the change in level of social interaction in the framework, and how well a service, product or installation supports this change in engagement. If the designers want to reach and maintain a certain goal with the social interaction then this needs to be tightly framed and without any great mobility, as the users should not take the situation in unanticipated directions. On the other hand if the designers wish to move the participants to a higher level of interaction then a looser framing is needed, or possibly a greater emphasis is needed on the specific direction through e.g. a focus on aesthetic interaction [19] encouraging an explorative curiosity to the users. As any context you would want to introduce a design into already has a range of interaction rules defined, a design should not only support the specific social interaction you would want to take place, but also support the way to get there, all according to which occasion, situation and socio-cultural background the users are in and coming from.

Fig. 5. Conversation around the iFloor

6 Using the Framework - iFloor Rules

Distributed attention in the library

The library occasion is defined by on one hand a well established use of libraries where silence and attention to posture and focus on actively seeking and finding materials, are the dominating rules. This task-oriented activity has always defined

libraries as very serious places for single users. Groups are silenced and conversations are strictly minimised. Library users are not maintaining a level of accessibility [20] towards the general occasion, simply because the occasion is not demanding it. Other rules defined at the occasion are that participants of the library occasion should have something to do. Of course some are searching in a more serendipitous way than others, but the number of people just hanging out is very limited. This difference from other urban public spaces was something we would like to maintain in the design of the interactive floor. Therefore we refrained from designing a café-like space where people could mingle and share knowledge, removing situational engagement by establishing a known form of relaxation. With installing the iFloor we wanted to make a platform for social interaction that would attract attention from passer-bys, creating a situation in the library occasion which might lead to a conflict between two sets of rules governing social interaction. As the antagonist towards the well established occasion we had to design something that would be interesting enough that people would break their task-oriented endeavours and engage in interaction with the floor and eventually with other people.

6.1 Shared focus to the floor

Shared focus in the library is not something that is normally pursued. If someone was to look at your search engine enquiries or watch what books you were browsing, this would be a very unusual and very out-of-place activity. Therefore the iFloor sets out a social space so different from the rules structuring the library occasion and situation that it is more like a performance or stage inhabiting the space temporarily. The shared focus on the iFloor is on the projection and the moving cursor, and also on reading the messages posted on the floor as these are animated to attract attention. This regulated the physical orientation of the participants toward a point between the users so that at any point in the collaborative interaction, users could look up and start a conversation about what they were just focusing their collaborative efforts on with the shared cursor.

6.2 IFloor dialogues

Interactions on the dialogues level around the iFloor were plenty. They were, however, mostly concerned with using the cursor or trying to understand what this floor was all about. We did not observe many accounts of somebody actually getting into a conversation with another user in relation to a question posted on the floor, but still we made strangers talk to one another in a public space. Users had to negotiate in order to get to where they wanted to go if more than one user was present in the tracked area, but it happened frequently that one would tell other people to get off of the floor or someone would apologized for standing on someone else's turf. It seemed that there were three paths an encounter could take – either the collaborative where conversation would take place, the considerate bystander staying in the periphery, or the users would take it as a challenge that someone else was trying to take away their control of the cursor and start a game of tug-of-war trying to attract more strings from the cursor than the other players.

6.3 Collective action in public

This kind of playful activity then becomes more like a game. But it doesn't quite make a collaborative effort reaching for a goal that is shared by all participants. Nonetheless the game-like character of the social interaction established a shared interest in the floor and if someone proposed an experiment then people would join, in a

collaborative exploration of the floor. And we saw several times that when someone was sending a message to the floor everyone was watching and waiting for it to drop from cyberspace to the floor. We designed the iFloor with a built-in forced collaboration, and we were quite excited that it was possible to introduce collaboration among total strangers. Playful interaction is not supported in the library at all, apart from some playground installations in the children's library. With the iFloor we introduced a game board for all ages and the physical interaction was an opportunity to let go of some of the rules imposed by the library occasion.

This framework did not exist when the iFloor was designed, but it is a reflection of essential concepts that we were dealing with as we designed the iFloor and as such it is the conceptual output to this research-through-design endeavour. It pins down the design discussions we had concerning the impact on the social space and social use we wished to achieve. As an outcome of the iFloor case, the framework gives us an opportunity to reflect on how we engaged the social context of the library. The four levels in the framework also indicate points of focus when designing. What kind of social interaction do we want to support, enhance or introduce into a context, and what is already present? Goffman's concepts defining three layers of rules that are shaping the social interaction can be held as a tool in a design case, where the focus is on the social space. Designers can focus on either creating a platform for social interaction by defining a whole new event or occasion with its own rules, define a new situation within the occasion where people are allowed to express themselves, or provide a tool for a new kind of encounter and in that way support a novel (social) interaction.

6.4 Disturbing the library occasion with an interactive floor

A library tends to be a very task oriented place, the chances of accidental interaction and of people with shared interests simply striking up a conversation with each other are very slim. By introducing an interactive floor to a part of the library, our aim was to disturb this interaction norm and potentially shatter the boundaries that normal users would hold to each other, walking in separate bubbles, as we called it. The goal with the development of the iFloor was getting the participants to talk about subjects of shared interest when reading about them on the floor as they collaboratively were dragging the cursor around. This then is an experience of an alternative approach to a question or problem, which in turn could change how people looked at the library as a public place.

"Resisters are more likely to become aware of social gatherings as an area of life on their own" [21] as Goffman says, and in a designers context this points to the fact that an intervention into a social context with a design embedded with a range of social rules, is a way of discovering the social structure of this context. The intervention at the library was based on our findings about the social life there, but we learned much more about the environment by clashing with the standardised interaction pattern already in existence there. Reflecting on our own role as participants in the gathering-at-large in the library we could se the conflict we imposed on the situation by proposing an altogether different situation of playing and talking. Interventions in design have been a tried and reflected praxis for some time and we find this approach to developing designs both very powerful and agile at the same time, since the prototype becomes a shared artefact or boundary object [22] to reflect upon from all participants both users and developers. Mogensen [23] has called this provotyping, as in a provocation of new knowledge about a context through the intervention, and Gaver and Dunne [24] have worked with similar approaches calling it projected

realities. In both approaches the design process in itself is informing the designers about the context. In this sense the iFloor was a designer's exploration into the social fabric of the library and public space informing the research project and requiring conceptual and theoretical work to fully understand the impact and potential of the design.

7 Conclusion

When designing products more complex than lampposts or coffee cups i.e. products that rely on digital services or are augmented in some way by digital capabilities, designers often need to be aware of the social context that they create these things into. What impact will the designs have and what kind of social interactions is defined by the product? In order to get a better understanding of these design parameters, I have introduced a conceptual framework of social spaces. The conceptual framework is focusing on how the social interaction is structured into what in this article has been called a social space, in an attempt to view social interaction as an entity in itself and not focusing on the single user experiences of participation. According to this structure, the social space then has a distinct character which we can place into a conceptual framework, for a better understanding of a present context and for achieving a better design of a future product. The research prototype iFloor has been presented as an example of a design that is primarily focusing on the social use prior to the individual as we have worked with the user as part of a social situation defined by a set of rules and influenced by a different set of rules embedded in the design.

The conceptual framework is based on the theoretical work of Erving Goffman, and is constructed around the notion of rules defining the social space on three different levels; occasion, situation and encounter. Based on these rules the framework enables designers to predict (to some extend) the organisation of social interaction that will take place when the artefact is introduced into the real world: whether it will affect distributed attention, shared focus, dialogue or collective action. Using the conceptual framework in a design process three questions can be asked to confront design ideas. Regarding the level of social interaction; where are we today and where do we want to go? Regarding the interaction; how is interaction at this level supported? And finally regarding the openness of the system or service; to what extend is situational interaction mobility supported – that is; can users themselves take their social interaction to a different level if they choose?

The conceptual framework is a tool for designers to get a better understanding of the social context or social space of a design proposal and in a sense make the social space an active design material.

8 Acknowledgements

I would like to thank the entire design team behind the iFloor. And also thanks to Kaj Grønbæk for comments and structure in the writing process, and to the Municipal Library in Århus. The iFloor has been awarded the Danish Design Award's Vision Award in 2004 and has been nominated for the German Design Awards 2006. This work has been supported by Center for Interactive Spaces, ISIS Katrinebjerg (project #122).

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Paper 6

Floor Interaction: HCI Reaching New Ground

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Published:

Floor Interaction: HCI Reaching New Ground

1 Abstract

Within architecture, there is a long tradition of careful design of floors. The design has been concerned with both decorating floors and designing floors to carry information. Ubiquitous computing technology offers new opportunities for designing interactive floors. This paper presents three different interactive floor concepts. Through an urban perspective it draws upon the experiences of floors in architecture, and provides a set of design issues for designing interactive floors.

1.1 Author Keywords

Interactive floor, architecture, pervasive computing

2 HCI reaching new ground

What are the challenges and design issues of designing interactive floors, i.e. interactive surfaces embedded in the physical environment, which are controlled by several co-located people?

Rodden and Benford [8] draw upon research in architecture when they point to new directions for ubiquitous computing, and indeed, this tradition has a lot to offer when we seek to understand the role of floors and potentially interactive floors. Rodden and Benford [ibid] further the criticism that much research in ubiquitous computing has focused on 'stuff' and has not yet explored how ubiquitous computing can be realized on higher levels of 'space plan'. Interactive floors are an example of a focus on a higher level of space plan.
In this paper we discuss how architectural knowledge, as it has been used in three concrete prototypes of interactive floors, can provide a basis for design. Furthermore we discuss how new interaction paradigms are challenged and informed by an architectural approach to interactive floors.

3 Interacting with floors

Understanding human computer interaction, when computation is embedded in interactive floors is yet an unexplored topic. However, a few design concepts have emerged, which point to the potential of this area. For instance in the area of game design, interactive floors have been used as means of controlling games [4]. Also a

couple of interactive dance floors have emerged [2]. Thus current applications fall primarily in the area of gaming. There are also a couple of examples of the exploration of the technical side of interactive floors. E.g. camera tracking facilities have been developed allowing for tracking of peoples' movement of floors [5]. Furthermore, Georgia Tech has developed the smart floor concept allowing for seamless identification of users based on the pressure profile of their footsteps [6]. These technological possibilities are yet to be fully explored in design concepts and applications.

In the following, we wish to point out that interactive floors have a much richer potential than what current applications suggests. A way to pursue this is to understand some of the general qualities of interactive floors. Here the tradition of architecture is a good resource.

4 Floors in architecture

Floors seen in a broad architectural frame can be understood as either streets or plazas [9]. To unfold the meaning of this we look to the classic European city where streets lead pedestrians in a direction whereas plazas exist as junctions between intersecting streets. The distinction between street and plaza lays in the controlled framing of the space. Street understood as floor is a surface that holds a certain direction which supports the understanding and perception of the space from a certain point of view, whereas the plaza is the floor where there is no perfect viewpoint and where the perception evolves as the pedestrian explores the space. This framing of floors can be transferred to interiors as well pointing at corridors and junctions of these e.g. a living room. The social impact of these two understandings of floors are not related to private/public but rather to the individual or shared perspective of the surrounding space that street and plaza enables. In the street the pedestrians stroll in a certain direction whereas the plaza supports multiple walk patterns. Over the centuries changes in artistic and stylistic paradigms has experimented with directing peoples' attention and traffic movements in both subtle and more outspoken ways. Throughout history floors either as streets or plazas has been an important architectural element both in terms of decoration, conveying information, regulating use and creating aesthetic and architectural coherence between collocated elements and buildings. To illustrate this two works of classic architecture is used.

In medieval churches and cathedrals the floor functioned as a decorative symbolic guidance as well as an information surface. In the Chartres Cathedral near Paris, France an eleven-circuit labyrinth divided into four quadrants is depicted on the floor. See figure 1, left. A part from being a decorative element, the floor serves symbolic acts of repentance as well as pilgrimage. At other sites such as Piazza del Campo Siena changes in the pavement is used to symbolize Siena's then ruling body, the Council of Nine, their power and the nine folds of the Madonna's cloak. See figure 1, right. Furthermore, del Campo is not owned by any of the 17 "contrada" of Siena which is why the plaza is the preferred place for any public events, ranging from the famous Palio to everyday marketplace activities.

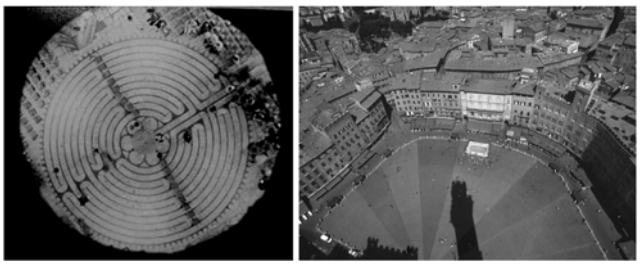

Figure 1 Labyrinth in Chartres Cathedral on the left, and Plazza del Campo on the right

From a design perspective one can take advantage of many subtle signs in defining areas and accessibilities on floors e.g. changes in colour, material and light. However, the main characteristic of a floor is the fact that it is equally shared by all of us.

From an architectural point of view interactive floors address a range of problems such as a high degree of flexibility, which is currently not supported in building components etc. With an interactive floor, surface styles, applications, and interface, can be changed based on who currently visit or rent the facility. In terms of designing applications for interactive floors, this implies that such installations in public space are especially suited for drop-by interaction and that interactive floors support several users cooperating and having a shared experience of a space. Interactive floors however, demands means for interacting with the material displayed on the floor.

5 Three interactive floor concepts

In the following, we present three different interactive floors, which are results of our work in the research center of InteractiveSpaces. The three design concepts have different forms ranging from a vision prototype, a running prototype, to a full implementation, which has been tried out in a library setting over a period of two weeks. Thus although these design concepts have very different status, in the following, we discuss them on an equal basis, as they represent very different solutions to floor interaction, and thus provide a good basis for reflecting on challenges and possibilities around this.

5.1 Playful interaction

Playful interaction (See Figure 2, left) is a vision prototype developed as part of the Workspace project [1]. The motive behind the vision was to explore how more playful relations to materials can be established in a work environment. Among other ideas, this video depicts a vision where digital materials can be placed on- and picked up from a floor through bouncing a ball on the floor. Thus the ball is used as a means for placing and picking up documents on physical surfaces like floors and walls. Documents are organised in dynamic tree structures, oriented primarily one way. People stand on the surface when interacting with it.

Figure 2 Playful interaction on the left, and iFloor on the right

While other aspects of the video prototype have been implemented, the ball itself is not yet implemented due to technical challenges.

5.2 iFloor

iFloor (See Figure 2, right) is a concept for multi-user interaction around a digital floor in a library context [3]. The motive behind the concept is to create an attraction of the physical place of the library, in a time where more and more materials can be distributed from the library remotely. The concept is implemented in the form of a running prototype, and this experimental prototype has been set up at a municipal library for a period of three weeks.

The floor allows visitors in the library to post questions and send answers to each other. The Q/A's are displayed around on the floor, in a circular array such that they are equally well accessed from all directions. There is no dominant direction. Visitors browse them by means of a cursor. There is one shared cursor on the floor, which visitors through their body movements drag around on the floor. It is easier to control the cursor, when more than one person interacts with the floor, and the playful challenge consists in coordinating and negotiating movements to pull the cursor to the intended spot on the floor.

5.3 MediaSurfaces

MediaSurfaces is a concept allowing people to distribute their digital materials on a range of connected interactive surfaces in the home [7]. These surfaces range from being table projection, wall displays as well as projections on floors. Floor projections are oriented in one direction, e.g. such that the materials are displayed at the entrance and viewed as people come home.

Figure 3 From left to right: close-up of table. Emote, and mediafloor.

The concept draws upon various studies of how people handle physical materials in their homes, which also points to examples where placing e.g. paper mail on the floor at a specific spot in the home is a way of attaching status to the mail. The means of interacting with the digital floor display is through a gesture-based remote control. The remote allows users to control the materials displayed on the floor, e.g. flicking

through pictures displayed on the floor. This concept is developed in the form of a prototype, which will be put out in a home for a two week period of testing.

6 Design issues for interactive floors

The three different cases point to the range of different application areas of interactive floors, beyond the prevailing focus on games. The concepts presented in this paper address such diverse domains as the workplace (Playful interaction), public space in libraries (iFloor), as well as private homes (MediaSurfaces) and thus suggests that the full potential of interactive floors are yet to be explored. Using the distinction of street and plaza derived from urban planning research in understanding and characterising the use situation of an interactive floor allow us to bring forward a set of design issues for such installations. The perspective points to a richer use of such floors than we have seen up till now. The architectural approach implies the notion of scale and orientation and alternative positions, which in the three cases goes beyond the common screen display requiring new interaction paradigms.

Figure 4 The iFloor – mud and technology go together

The urban perspective on interactive floors also involves regarding technology as an integral part of the public environment implying that it should cope with filth and rough use as any other public design. In the case of the iFloor this is done by using technologies that slip into ceilings leaving only tracked projected footprint on the floor - street or plaza. Such setup introduces the notion of dirty computing where the interface is not treated as something precious and fragile but rather blurs into the environment through muddy footprints and spots from soft-ice, and is thus adapted into the fabric of everyday life (See Figure 4).

Apart from the three cases' ability to cope with dirty computing they relate, as mentioned earlier, differently to the architectural arc types of street and plaza. Viewing the three design concepts through these perspectives help describe and understand the different nature of the concepts, e.g. their social impacts and interaction styles. The three cases will now be discussed in relation to these issues.

7 Interactive floors as Plaza

Interactive floors as plaza hold the following characteristics. It supports drop-by interaction and provides multidirectional access to materials. Playful interaction and iFloor resembles the plaza more than the street, in that they support people in meeting casually, on the fly, and provide multidirectional access and interaction as well as equal points of view.

As a shared surface between users, interactive floors as plaza hold opportunities for creating truly shared interfaces. Especially the concepts of iFloor and Playful interaction utilize this opportunity. iFloor being placed in the central space of the library, a public place with a public task of being open to any citizen, it needs to be

egalitarian and accessible. This is supported through the walk-up and use interface providing equal and collective access for all library visitors.

Interactive floor as plaza is a shared interface supporting shared focus of attention – right up to the point in time when other people around the floor becomes more interesting. Then the interactive surface moves into the background and the interaction between people will step into foreground. This happens in Playful Interaction where a playful approach to knowledge sharing in the office environment is proposed in terms of picking up documents and transferring them to colleagues through bouncing a ball in the floor and throwing it to a colleague. This is in opposition to a more rigid notion of a productive and functional office environment.

7.1 Interactive floors as Street

The nature of interactive floors as streets is characterised by designing to support individual strolling through providing directed routes, prepared for unidirectional access, and more efficient interaction as compared to what the Plaza represents. The concept of MediaSurfaces holds more the characteristics of the street than the plaza in that it assumes certain directionality in the access to materials. It supports the unidirectional access to materials as they are experienced as people stroll by a floor display. But MediaSurfaces, with the gesture-based remote control, explores more playful ways of interacting with the materials displayed on the floor than the Street arch type suggests.

Design issues for Interactive floors	**Plaza**	**Street**
Nature of interaction	Drop-by interaction	Directed route
Directions of access	Multidirectional access	Unidirectional access
Interaction ideals	Playful interaction	Efficient interaction
Social/individual	Social interaction	Individual strolling

Table 1 Design issues for interactive floors as Plazas and as Streets

While street and plaza are useful for analyzing concepts, they may also be used more generatively, as design parameters, or as a way to broaden up the design space. As summarized in table 1, they raise rather different design issues.

8 Conclusion

We have unfold the challenges and design issues of designing interactive floors through pointing to the distinction between plaza and street. We have suggested that they are useful categories to consider when designing interactive floors. As characterised here, they can be seen as endpoints of a spectrum. Many concepts will be blends of these. However, the arch types illustrate the challenge of giving these different characteristics a concrete form in interactive floor concepts. A challenge, which we have just started to take up with the interactive floor concepts presented in this paper.

9 Acknowledgements

We would like to thank our colleagues in Center for Interactive Spaces, ISIS Katrinebjerg, for supporting our work and the Workspace project (IST-2000-25290) for enabling the production of Playful Interaction. Furthermore we like to thank Kaj Grønbæk for useful comments on the paper.

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Paper 7

Mock Games: A New Genre of Pervasive Play

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Published

DIS 2006, June 26–28, 2006, University Park, Pennsylvania, USA.

Mock Games: A New Genre of Pervasive Play

1 Abstract

In this paper we identify and characterize, in theory and by design example, a new genre of pervasive play for tweens that lies on the border between play and game, called *mock games*. The objective is to design digital support for more or less structured playfulness among preteen children, primarily girls, in a way that emphasizes humor, friendly battle and identity construction. The method used is a combination of a review of a number of theories of games and play and a field study into the social reality of children's playful activities. Based on these two investigations we characterize mock games as a genre and show that it is not covered well by any one of the reviewed theories, taking into account both social and technical aspects. Then we present a design example of such a system, *DARE!* We conclude by discussing ethical issues and set goals for future research.

1.1 Author Keywords

Computer-Supported Cooperative Play (CSCP), pervasive gaming, social computing, children, popular culture, entertainment, tweens.

2 Introduction

"[T]he rhetoric of progress sees play as preparing children for the future by promoting their cognitive, social, emotional, and physical development. And […], though the rhetoric of progress may look like the friend of children's play, at times it can be the rationale for adults wrongly taking control of children's play." –Scarlett et al. [26].

With the still earlier adoption of mobile phones [19], instant messaging, and various digital entertainment systems, pre-teen and early teenage children – tweens[1] – are becoming heavy users of mobile computing technology and digital services. A recent study of Norwegian children aged 7 to 12 years [5] showed that boys and girls have equal and easy access to new media, but also points to gender differences in the way new media are used by children. In fact, in 2003, UNESCO [31] considered the "gender divide" to be "the most significant inequality to be amplified by the digital

[1] In the literature on popular child culture, the term "tween" is usually referring to girlhood and girls between 7 and 12 years of age but it may as well include boys.

revolution". An interesting fact is that the mobile phone is the only technology that the Norwegian girls use as much as the boys [5].

We are interested in how this digital augmentation of the environment and everyday life can be designed to support the life-style of these children, on their own terms. To be more specific, we are interested in designing support for more or less structured playfulness among preteen children, primarily tween girls, in a way that emphasizes humor, friendly battle and identity construction using pervasive computing technologies.

We are not designing learning environments (embedding a rhetoric of progress) and we are not designing games (creating a "magic circle" with no or little relation to the social and physical realities outside it). Actually, in this case we are rather reluctant to create designs – be it computer systems, services, applications, artefacts, or physical places – that have a very constrained scope on children's ability to develop their own meaning, use and experiences. To explore this type of experience or system we propose *mock games*.

2.1 Revolutions in Children's Play

Children's lives and children's play is a heterogeneous set of intertwined activities acted out in a variety of settings with all kinds of different motives. Furthermore, as pointed out by many (e.g Scarlett et al. [26]) "play is tied to history and to economic, social and technological transformations occurring in the larger society". When speaking of the "revolutions" in how today's children play, Scarlett et al. [26] highlight two areas, *electronic play* and *organized youth sports*, where they see signs of drastic changes. They are not offering any specific explanations nor do they point to causes. They simply state that it may be difficult to evaluate what is going on, "when we are in the middle of a revolution" (p. 112). Tween culture (cf. e.g. [22]) may be seen as another example of such a revolution having significant effects on children's play.

The tween years is a time of turbulence where children begin to orient themselves more towards adult values and life-style, finding themselves separating from childhood in the process of becoming or constructing an individual identity. The tween culture is a mix of values from childhood and adulthood. This is not in itself new, children mimic adults – that is what children have always done. The revolution may lie in the extent that the globalized consumer culture in general allows for an easier transfer of values and ways of personal expression from adult culture to child culture in a way that is much less controllable by the parents, e.g. by media exposure (including TV, internet, print media and physical advertising). It is difficult to say whether the change is indirect or direct, i.e. whether this happens because of changes in the culture at large which then extends down into children's culture (so that the children's situation in essence has not changed, they just mimic their close adults as always) or whether this is due to more structural changes in society directly related to the children's situation (maybe they spend less time with parents and are more exposed to media). In any event, this is outside the scope of this paper. We look at some accounts of the phenomenon, summarize our observations and turn them into design.

2.2 Methods

One of the aims in our work has been to identify some of these children's activities that are not well supported by contemporary digital designs. If we can find and characterize such activities, another question follows: What should we design, then?

This relates to our second goal of developing a playful game that fits with the situation of this specific age group – refraining from designing either a children's game or an adult game.

In order to investigate this, we looked to find theories of play and gaming that could help frame our topic. We are taking a broad approach to children's play in order to grasp a rich context instead of focusing on learning or playing a certain type of games. This seems like an obvious advantage, but the downside is the multitude of aspects that need to be addressed in different ways on different levels using different methods and theoretical frameworks. Since it is hard to tell up front which aspects are most important for design, and since we cannot cover everything from every angle, we must make some choices regarding the framing of our investigation.

To lay the foundation for our investigation, we characterize a range of theoretical contributions that seem relevant to the topic: pervasive play for tween girls. Then we present some empirical studies that we have conducted to investigate children's playful activities. After that, we characterize a new genre of playful systems, which we call *mock games*, that seem not to be easily addressed in a focused way by current theories. Then we present a design example of such a system. We also comment on related applications and systems before discussing various aspects that are important to consider when designing technology that has a potential effect in shaping children's lives.

3 Theories about play and games

In his book on video game theory, *Half-Real*, Juul [15] complains that Huizinga's *Homo Ludens* [14] and Callois' *Man, Play, and Games* [7] are too general for his purposes because they cover more than just *games*. We have a similar problem, except our problem is that not much literature covers the juxtaposition of young children's play (including gaming), peer culture (including its socializing effects and role in identity construction) and actual *design* of pervasive and ubiquitous technology.

There are sociological studies of the *impact* of mobile phones [19] and media use, but they are descriptive, not giving many directions for design. There is also a long and strong tradition of design for playful learning building on constructionism [16,23], but here the *learning* aspect is foregrounded, thus putting heavy emphasis on the rhetoric of progress. Research into children's play is generally descriptive [29,24] without many guidelines for design. Psychological research of electronic entertainment has focused a lot on the *violence*, *inactivity* and other *negative consequences* and thus seems more concerned with creating safe games than fun games. Besides, most of the game research that has been done is related to *adult* gamers.

In the following, we present a selection of contemporary theoretical views that focus on games and play and have suggestions for design that are relevant to our investigation.

3.1 Characterizations of frameworks

We have grouped the selected theories in two categories: theories of games and theories of play.

3.1.1 Theories of Games

Juul [15] reviews seven game definitions and presents his own "classic game model". It is called classic because it can be used on any game, digital or not. He uses six features to characterize a game which are summarized in the following definition:

(1) A game is a rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the activity are optional and negotiable. ([15], p.36).

Furthermore, a game can be characterized by looking at it from three perspectives:

The game as a *formal system*
The relationship between the *player* and the game
The relationship between the game and the *rest of the world*

This approach seems useful for our purpose, since it is not restricting itself to deal with just the formal parts of a game or the player and the game. In contrast, Björk and Holopainen [3] choose not to include "implicit rules" (cf. Salen & Zimmerman [25]) in their conceptual framework because they are outside the control of the game designer. This might be true if the game designers are defined as only those defining rules and other "hard" game aspects. However, the informal, socially founded, highly negotiable aspect of being able to change the rules is very important in our case of designing (mock) games for transformative social play.

According to (1), any activity that fully satisfies the definition is a game. However, there is a fuzzy boundary between games and non-games which includes borderline cases that almost satisfy the game definition. Juul [15] claims that a *game* has a negotiable outcome without serious consequences (e.g. in Monopoly, you are not really ruined when you run out of money), whereas a *non-game* has real, non-optional consequences (e.g. in a war, people get killed); a game can be turned into a non-game if the consequences become real and vice versa. The same event can even be both a game and a non-game at the same time (for different participants, though), e.g. a marathon with professional and non-professional runners. Other examples of non-games he mentions are free-form play, traffic, noble war, hypertext fiction, storytelling, and game of life ([15], Figure 2.10).

Walther [32] has used Juul's [15] definition as a basis for characterizing game rules in the special case of *pervasive* gaming. He offers the following definition:

(2) Pervasive gaming implies the construction and enactment of augmented and/or embedded game worlds that reside on the threshold between tangible and immaterial space, which may further include adaptronics, embedded software, and information systems in order to facilitate a "natural" environment for game-play that ensures the explicitness of computational procedures in a postscreen setting. [32]

He notes that pervasive games tend to challenge two of Juul's [15] requirements: (a) by not necessarily having a *quantifiable* outcome, and (b) by not necessarily having a *negotiable* outcome.

Both 'violations' are due to the fact that the game world includes what he refers to as "tangible space". The outcome may be *less quantifiable* (a) because reality imposes a level of uncertainty on the game as opposed to the closed system of a console game where the game designer is in full control. Walther [32] points to Searle's [27] distinction between two categories of social rules to explain the relation between the underlying computational (constitutive) rules of a game world and the negotiable (regulative) rules of players' behavior. According to Walther the constitutive rules are quantifiable but the regulative rules are not. We argue that pervasive computing technology invites game-like activities where not even the constitutive rules are necessarily easily quantifiable (and thus easily represented digitally).

According to Walther [32], the outcome of a pervasive game is *less negotiable* (b) because "tangibility consequence" tend to be non-negotiable. However, while the *physical* consequences are unquestionably non-negotiable, we would point out – in line with the previous argument (a) that bringing the action out in the real world might actually increase negotiability of the *social* consequences. If a game entity like Princess Toadstool gets mad at Mario (the player avatar), the room for negotiation is very limited compared to social negotiations in real life.

There is a range of other proposed typologies (e.g. [1,18]), but we have been selective and presented a few theories that we consider representative and sufficient for our present purpose.

To sum up our view of the impact of pervasive computing technology on games and playful activities compared to Juul's [15] general game definition and Walther's [32] pervasive game theory:

(3) The outcome of a game may become harder to quantify *both* in terms of constitutive rules (laws) and regulatory rules (norms).
(4) The outcome may become *less* or *more* negotiable.

As we shall see these are fundamental characteristics of mock games.

3.1.2 Theories of Play2

Overall, the goals of play in late childhood are the same for boys and girls: to have fun, to belong to a group, and to make friends. However, while boys seem to value an activity in itself, girls seem to put more emphasis on the social context [26]. Humor plays an important role in socialization for this group of children. With reference to McGhee's [20] stages of humor development (based on Piaget's stages of development in general), Cunningham [10] describes some central features that are of importance to us. By preadolescence (9-12 years), not only do the children modulate their humor to depend on social context, they also put increasing emphasis on who gets a joke and who does not – either because of shared knowledge, cognitive skills, or simply different personal preferences (which is closely connected to identity creation). In this way, humor and jokes becomes a powerful mechanism in social group dynamics (think of the inside joke and secret nicknames), both within a group and externally toward others.

Whereas theories of video games and game design are dominated by people who play games themselves and are involved in game development, theories of play, even

[2] It is outside the scope of this paper to delve into theories of play as such, so the following overview is highly selective with regard to our purpose.

electronic play, tend to be written by non-gamers. Salen & Zimmerman [25] is an exception to this pattern, although much of their work is summarizing work done by others. They are them selves game designers, but in their book *Rules of Play* about game design they extend the perspective to include such issues as social play and games in culture, combining views from many sources. The chapter on social play ([25], p.461-489) does not treat digital entertainment but it has a useful set of concepts and discussions derived from conventional social games that we can use to design systems for social play. Here we will only highlight a few of their points which we will use later on:

Social play is a special way of looking at games, focusing on social interactions in a community created around a single game or a larger game context. These interactions may occur in the game (following the rules) or outside the game, i.e. inside or outside the "magic circle". The participants take certain roles in the game, exemplified by Sutton-Smith's [29] list of social play roles.

According to Salen & Zimmerman [25], social play is tied closely to the concept of emergence. Even with simple rules and a limited number of roles, new and unforeseen patterns emerge. Their point is that when a game is viewed as a social system, the number of possibilities explodes. If the game permits, "players will find ways to create their own roles and styles of play." ([25], p.467). Play communities may be strictly tied to one session of a game, i.e. the participants, in which case the community is "bounded", it is a closed system within the magic circle. When spanning more sessions, play communities become "unbounded", i.e. open systems where the participants come to share more than the game world. With reference to Piaget's [24] model for children's acquisition of rules, Salen & Zimmerman [25] note that learning the rules of a game is closely related to understanding social contracts, thereby drawing attention to the social construction of rules. When rules of a game are changed because of social interaction within the player community, it is called transformative social play, and according to Salen & Zimmerman [25] it "causes us to reevaluate a formal understanding of rules as fixed, unambiguous, and omnipotently authoritative." Note that this is a general conclusion that was developed based on non-digital games.

Transformative social play opens up the discussion of conflicts of defining the *real* rules of a game. Many games has a set of core rules and a range of optional or "house rules". But when rules can be negotiated, conflicts may arise. Children that are "ruining" the game for others may be well aware of the rules but choose to enforce their own rules. The conflict can also be between the community and the outside world, e.g. in the case of *forbidden play* [25]. One such example is a kissing game that allows the participants to do something they are not allowed to do if they were not playing this game.

By including the broader social context into the analysis of a game, Salen & Zimmerman [25] invoke what Garfield [12] calls the *metagame*, the game around the game. It consists of four elements: (a) what the player brings to the game, (b) what the player takes away from the game, (c) what happens between games, and (d) what happens during the game other than the game itself. These are highly relevant to our case, because the children's playful activities are characterized by intermittent participation intertwined with other activities.

3.2 Conclusion: What is missing?

To conclude the theoretical overview, it seems that the game-centric theorists have developed a number of theories and typologies that grasp almost any aspect of all possible games (e.g. [1,3,15]), but they do to a large degree (and for god reasons) confine themselves explicitly to 'proper' games, i.e. games that do not mix a game world with real life. Walther [32] – coming from outside the game design tradition – seems closer to addressing this issue with his pervasive game theory by pointing out that "tangibility space" disturbs the traditional game perspective, but even though he touches upon the social construction of reality, he is still locked into the game design rhetoric of a game world with little connection to the social reality outside of the magic circle.

Play theory related to social play (cf. Salen & Zimmerman's [25] game-oriented version), on the other hand, seems rather well equipped to grasp many of the aspects that are left out by the game-centric perspectives. However, digital design for social play is not very developed, and even less so when we look at digital support for children's social play. Although humor is an important element in tween social group dynamics, it is often downplayed in favor of the rhetoric of progress, i.e. learning, in theories of play

In short, game design theories tend to shy away from social reality, whereas play theories tend to shy away from augmented realities. Thus, it seems that something is missing, something that combines both traditions. For the lack of a better technical term, we call this something *augmented social reality play*, or *mock games*.

We shall later use the theoretical concepts and distinctions presented above when characterizing mock games as a genre. But before doing so, we will motivate further the appropriateness, or need, as it were, of a genre of this sort by looking at some empirical support from qualitative studies of children.

4 Empirical Studies

In order to get a first-hand experience with the reality of everyday life for children in our target group, we conducted a range of different user studies from three different perspectives: (a) interviews and observations, (b) cooperative design workshops, and (c) prototyping and testing a simple game which combined physical context and digital interaction.

4.1 Interviews and Observational Studies

Initially we made several rounds of interviews with children of different age and the people who take care of them either as kindergarten staff or as teachers in school. In this preliminary study we worked with kids at the age of kindergarten (age 4-5), 3rd graders (age 8-9) and 9th graders (age 14-15). In the second and third part of our user studies we focused more on directly on the group from age 8 to 13, but we did this preliminary study in order to attain a background for reflection on the broad topic of the children's development.

The interviews with the kids showed us how the notion of play and playful activities evolves with age and, for the older children, points to differences in social sub-cultures affecting perceptions of play and playfulness. We saw social interaction as a big part of almost any kind of playful activity. Even playing a single-player game on a single-player console, like the Game Boy was definitely a social activity. Boys would stand around the player and watch how far he got and if he made a new high score,

comment on it and suggest actions. Another aspect of play that we especially observed with the younger kids was that the physical space is a generative context. A game can be initiated by someone finding an object that can somehow be used for a game or competition – like a string, a skipping rope or a hole in the ground. For the older children, this improvisational aspect of the physical surroundings is somewhat superseded by the importance of the social context. In both cases, the negotiation of rules for the game almost has the same playful and collaborative character as playing the game itself.

As the children are getting closer to adolescence they become increasingly aware of not being perceived as children. They dress up and they attempt to no longer (admit to) play games. "We're not kids, you know" as they responded when we asked if and what kind of games they played after school and during recess. It seems like the girls start earlier to "hang out" and, in game terms, their activities could be better characterized as free play, with a strong social focus, constructing social reality or mock realities where they experiment with social relations. At the same time, we see membership of sub-cultures influencing patterns of play. Some boys play computer or role-playing games together, and girls do shopping and hanging-out, both of which seems mutually exclusive.

4.2 Cooperative Design Workshops

Having observed and interviewed, we turned to cooperative design workshops where we wanted to see whether the kids could produce good ideas for games and plays, as experts on their own lives. Through the design exercises, the kids would then let us get a glimpse of what they thought was important when it comes to playing. We invited three groups from two schools to come and brainstorm based on a preliminary talk about new technology. This time we focused our efforts on the 3rd and 6th graders.

Between those two groups there were still big differences in what they saw as playful. The 3rd graders could get a lot of play from a rope or a ball, but it was difficult for them to project these games into a general idea for a new game. The 6th graders, on the other hand, were better at concluding in general terms on what would be desirable in the future to have as a play device or a game. As we reported in [6] the kids cannot be said to be very creative in this as they basically (re)produced a spin-off of our inspirational examples. They designed a device that could do anything. It was a handheld, pocket-sized device with any relevant functionality built in. This "EF-Watch" should have an instant messenger, calendar, SMS-service, a clock, a mood connector, a projector and several other features personally customizable. But the most important aspect of this EF-Watch was not the functionalities, but the brand strategy behind the product. The EF-watch was to be produced by FUBU, Karl Kani, Nike, Sisters Point and Puma collaboratively, implying a totally optimized street respect object. This duality of being connected and showing off once again points towards this age group as being extremely aware of the social peer network they are participating in and how important it is to do well in this context.

4.3 User Studies Through Prototyping a Pervasive Game: StarCatcher

As the third step in our user studies we developed a first prototype in order to experiment with how simple a mobile game can be in order to be fun and engaging. We developed a version of capture the flag called *StarCatcher*, running on mobile phones with GPS receivers. The game was tested as part of a larger workshop where

7th grade pupils were using a new context-aware system [8] for school work. During recess from school work, a few of the pupils played with our mobile game. Integrating the prototype into a larger context meant that the prototype in itself was not that interesting as technology (the pupils were already "acclimatized" to a quite heavy induction of high-tech at this point) but a playful artifact – a game – in its own right.

The StarCatcher game prototype was based on the physical location downtown with maps on the mobile phone representing the gameboard. Each playing team had a phone and a GPS receiver and these had to be close enough to stay paired via a Bluetooth connection. Then a star was placed somewhere on the map and the task was then to find it first. The center of the map on each mobile phone was locked to the position of the GPS and if the star was located outside the visible area the team had to zoom out. Zooming was relatively slow and the players then had to decide whether they wanted to spend time on zooming or just run in a direction and find the star as they got close enough.

Unsurprisingly we found that the teens were very quick at understanding the game. As they had learned the rules of the game, they started to challenge each other on who could catch the star. Very quickly the game had been integrated into the social context of the class, and results – future, past and present – were claimed, negotiated and debated.

4.4 Conclusion: Design Goals and Values

From our range of studies we believe we have built a good foundation for understanding and developing games for children in this age group.

We are focusing on the age of establishing one's own self – defining "me" as opposed to all others: parents, teachers, friends etc. Therefore we want to design an application that is a value-free platform for social exchange. The users need to be able to create their own values and external rules for using the application and regulating the social play around the application. This openness in the design should also address the fact that the children at a certain age no longer see themselves as someone who plays games. The defining of self implies experimentation with frames for interaction and established norms. Furthermore, the system, platform or genre needs to support the communication of the community around its use. Everything is structured along terms of social interaction, and the exposure of one self in the group is positive and very important.

This change in focus from artifacts to social play, from physical experiments with the world to social experiments is the change from child to teenager we wanted to address with our design. We see a general trend in game design to land in either of the categories of child or adult player. The first being a very young user with a strong focus on physical challenges and kinesthetic experiments often using the rhetoric of progress, and the second, provocatively said, being the designer him- or herself – a young (wo)man with a desire to play video games.

5 A new genre: Mock Games

"Peer interaction is not a preparation for life, it is life itself." –Brian Sutton-Smith [29]

In order for something to be a genre, there must be exemplars in which we can identify a set of common traits, e.g. of format, setting or mood. In that sense, mock games is not yet a genre, since there aren't really many – if any – exemplars to

compare. A brief look at available lists of computer game genres (e.g. [13,17,18,26]) reveals that mock games are certainly not already covered. Therefore, mock games remain a postulate on our behalf. However, the current evolution of information and communication technology combined with our knowledge of preadolescent children lead us to believe that it is only a matter of time before we will see many systems that are designed to fill this vacancy. In this section we characterize what mock games should look like in general terms. The next section offers a first design example of a mock game.

Using the concepts and distinctions presented earlier, we can characterize more specifically what we propose will be the traits of this still tentative genre:

(5) A mock game is a type of peer interaction that combines elements of pervasive gaming and transformative social play. It is a role-based game of emergence involving social reality, explicitly formed by and forming communities. It invites humor and friendly conflict as primary ingredients in social interaction. Real identities are constructed and blended with play roles.

Compared to existing game genres, perhaps a mock game comes closest to a game show or location-based game ([18], Fig. 3). Such a prototypical definition might look like this:

(6) A mock game is an open-ended "game show" for small communities with no clear distinction between the roles as producers, participants, and audience.

No matter how we define mock games, a main feature is that systems within this genre holds a constant invitation to *transgress boundaries* between fiction/reality, physical/virtual, quantifiable/fuzzy, negotiable/absolute, hectic/slow, open/closed, serious/mocking etc.
The most central feature of this new genre, we propose, is the ease of transition across the boundaries between fiction and nonfiction and between playfulness (few rules) and gaming (strict rules) (Table 1).

<table>
<tr><th></th><th>Strict rules</th><th>Changing rules</th><th>Few rules</th></tr>
<tr><td>Fiction</td><td>Pacman</td><td rowspan="3">Mock game</td><td>'House'</td></tr>
<tr><td>Some fiction</td><td colspan="2"></td></tr>
<tr><td>Non-fiction</td><td>Traffic</td><td>Hanging out</td></tr>
</table>

Table 1. Mock Game as a new genre characterized by transformative social play transgressing boundaries.

The participants are not bound by any rules unless they agree with others to be so, and they can find themselves in any mix of fiction and non-fiction. This is similar to other games, but the easy transition is different. An activity that does not break Juul's [15] rules as in (3) and (4) is not a mock game.
For social phenomena, this creates a situation where e.g. roles and identities that are being created may not easily be separated; the mix between game roles and real identity is not discrete as pearls of different color or two immiscible substances. It becomes a blend where once put together they can no longer be clearly separated. The

reason for this irreversible nature is its partial grounding in social reality. As tweens construct their identity, it may be difficult – if not impossible – to separate the various inspirational sources from the resulting identity.[3] This issue, which resembles what McGonigal [21] has been termed "the Pinocchio effect", the wish for a fiction to become true or vice versa, may be seem a bit disturbing, but we shall return to the issue in the discussion.

As the social play aspect of mock games is the grounding rule and all other rules are negotiable, one could argue that it is not a game at all, but merely a platform for pervasive mini-games or an interface for social interaction. So, if it is not a game, why call it a game at all? Why not play environment, chat space or friend finder?

One argument for insisting on the game-ness of mock games is that games may be viewed both as activities and as objects [15]. It is quite likely – although it would have to be verified empirically – the mock games are indeed perceived as games because of the form they take. They reside on hardware, they involve rules, they may require player effort etc. The whole *mock experience* may feel like some kind of game, perhaps because most of the time the consequences can indeed be negotiated and are not serious.
On the other hand, mock games may lack many features of a game according to Juul's [15] definition. Children can choose not to participate (no player effort), or they can be indifferent to the outcome. Maybe participation in the mock experience will not be referred to as playing but as something else, perhaps *mocking*. Still you may stay within mock space, which would indicate that the "game" is still on.

The mock-part of the game denotes the un-real element of the game. Like mock plays or mock battles mock games are not real in the sense that participants act within a safe frame or "magic circle" of set rules and shared understandings. The boundary to reality is very thin and it is this fragility that makes the mock game interesting. Even if a mock game itself takes place in the physical and social reality of the players, the actions and results do not have to be rooted directly in this reality. Furthermore there can be an extra layer of irony or tongue-in-cheek which separates the players and their actions from the real world since they are "just playing a game." E.g., if someone dares another player to expose the name of their secret love, the player can answer that it is her cat, then the other players must evaluate if this is a good answer and why the player gave this answer. This is similar to the evaluation in the card game "Apples to Apples" [] where the players estimate and negotiate semantic associations between objects and adjectives.

As children reach the stages (9-12 years) where humor becomes an important element in forming and maintaining peer groups which, in turn, contribute to the development and construction of the personal identity of the group members, children's urge to form their own definitions of fun and appropriateness are reinforced. Part of this development is to define oneself as different from the parents and their norms. This may result in irresponsible humor that breaks the social codes and goes to the border of good behavior – it is a stage of experiment. Experimenting with humor on the border of the acceptable standards of the parent generation, or humor that is simply too private to share with a larger audience, is likely to be a part of the mock game genre that we expect to see.

[3] We are not saying that personal identity is a pure social construction; we regard peer interaction as a contributing factor.

Lastly, the metagame [12] will be an integral part of mock games since they will by definition be intertwined with other activities. Mock games are in a way metagames, games about gaming.

5.1 Design

The next step in exploring mock games was developing the *DARE!* game. It is a socially embedded mock game of challenge, and users can challenge their friends with different kinds of tasks. The challenges are either readymade or can be constructed through an interface on a mobile phone.

The game itself is inspired by classic social games as spin-the-bottle and truth-or-dare, and the key component is the challenging of friends to do things normally not within social acceptance, almost like the notion of forbidden play [25], but where the actions taken lie on or just a little beyond the limits of the acceptable so that players will be dared to participate.

Figure 5-1. The construction and manipulation of the challenges takes place in an interface on the mobile phone.

The DARE! game has three stages. Firstly there is the creation of challenges. Challenges are supplied with the game as well as the tools needed to construct new challenges from scratch. Challenges are basically constructed in a slot-and-filler fashion based on a linguistically inspired understanding of a challenge as an activity. There must be a sender and a receiver of the challenge, this has to be stated regardless whether the challenge is supplied or constructed from scratch. All challenges have an action, an object and possible a timeframe. An example could be as follows: "I(sender) challenge you(receiver) to take a picture(action) of the one of the boys in our class you like the most(object) within a day(timeframe)". These simple distinctions then make up the building blocks that can be creatively reconstructed into new challenges and written by the children themselves (Fig 1).

Secondly the DARE! game is played anywhere – at home, in the schoolyard or around the neighborhood where the children play or hang out. A challenge is sent to a friend and she then has to decide whether to take the challenge or not. However the challenge is not fully exposed to the receiver upon reception. The example from before would read out like this: "X challenges you to take a picture of Y within Z". Since the DARE! game is about being bold and about trust and challenge, the receiver then has to consider whether the sender is sending something acceptable simply based on the social relation between the two and based on the amount of points attributed to the challenge. If the receiver is uncertain of whether or not he or she

wishes to take the challenge and get the full points, the hidden parts of the challenge can be exposed – at a price. In our example above, the starting price of the challenge is 100 points, and exposing one of the parts "costs" a minimum of 40 points. Thus the price of exposing all the hidden parts of the challenge will always exceed the total amount of points attached to it. At any point in this, the receiver can decide not to take the challenge. This space of negotiation is the first part of receiving a dare or challenge in the game. Next is of course performing it. Here the game play is taking place in the physical world, and our digital tools can only provide some evidence or record of accomplished tasks. One fundamental aspect of the game is that it takes place in the physical context as well as in social context of the players. Results will be reflected in the social group as well as the way the results have been attained. We currently have three other types of challenges: karaoke, poll, and "Truth, Percent, or Dare" (which may lead to a dare as described above).

The third and last part of the game is the community interface (Fig 2.). This is a piece of software running on the players PCs and mobile phones, keeping an eye on the statistics of the game and the current state of affairs within the player's social group. The program is sitting in the taskbar like an instant messenger since this is a known position for social software and applications that are positioned in the peripheral awareness of the user. We suggest it could become as big a part of the children's normal use of computers as messenger is, where they keep a peripheral awareness on the application just to see if things have changed and what is going on. The community interface is connected to the server where all challenges are monitored when sent, received, negotiated, accepted, evidenced and accomplished. The final step of a challenge is to be accepted by the sender and finally socially accepted by the community, leading to discussions and chats on the challenge and the participants. In this way we have designed a way for the community to be alive and present even when the user is not physically present where the action is.

The DARE! game is still a work in progress and we have not yet had the opportunity to evaluate it in a realistic setting.

Figure 5-2. The community interface showing the activities of friends in the same social context

In this paper we have not included results from actual tests of the game as we stress the importance of developing it into a community practice and let it become part of the everyday tween life. Currently we are in the process of refining the system to work over longer periods of time in e.g. an actual school environment and see how children will accept the game and start develop their own challenges, retrofitting the game to suit their social environment.

6 Related work

We do see a few games that in different ways address some of the same issues as mock games. On a general level there are augmented or pervasive reality games that mix physical and digital or virtual space, but keep social space divided between in-game and outside-game interaction. Often used examples of this are *CanYouSeeMeNow* and *UncleRoyAllAroundYou*, both from the UK based artists group BlastTheory [4]. These are physical games where players run around a city trying to catch other players that are running on the same map, but with avatars controlled from computers in their homes or from net cafés.

When it comes to mixing social interaction around the game with the social interaction that occurs in the game *Sissyfight 2000* [28] is one of the few nice examples. Sissyfight is a web-based game where users challenge each other online. Each player plays a girl in a school yard fighting other girls, and there is an extensive use of harsh language, violence and satire. This probably makes the game fitting for adolescents as it fits with the humor aspect mentioned earlier. The very limited set of rules and actions does not leave much space for experiments, but this is somewhat compensated by the wide variety of combinations of moves giving an unpredictable range of possible outcomes. The social interaction takes place both in and around the game in the chat interface. However, the fact that players probably do not know each other and have no relationship beyond the game makes it socially harmless. None of the players are potentially playing with their true social standing. The same argument goes for the very popular *Sims* game series [30]. Although very interesting as a platform for simulating social interaction setups, there is no real interaction between human players in the game.

In contrast to this, interaction between real humans take place in *FIASCO* [8] (which was later launched as "digital street game" [11]), a street performance game developed in New York. The plot is to conquer turf by performing stunts around the city. When a stunt or performance is concluded, the documentation for it is uploaded to a website, and the community will then decide who gets the turf around the site. As opposed to *Sissyfight 2000*, the social interaction takes place both in the physical world and on-line. Although not aimed at children, *FIASCO* is probably the closest we come to an example of an actual mock game.

A design which is based on the use of humor as starting point for interaction is the Danish children's community web site *Arto.dk*. It started out as an exchange of jokes and has ended up being the single most popular site for school children. The site has 550,000+ users[4] building profiles, meeting and making friends and romantic friends, virtual and real, via Arto, and the most important aspect of it is the construction of their profile web site – their identity.

[4] Compared to Denmark's population of 5.5 million, this number represent a considerable proportion of school aged children, even when considering "inflation".

A third aspect of mock games is their being intertwined with the social reality. *MSN Messenger's* mini-games can be said to do exactly this. They are small games to be played in an ad-hoc manner, as breaks from work or while chatting with friends not necessarily co-present. These games fit into the everyday interactions somewhat like mock games as small, lightweight activities, and they can be played among friends and used to tease and taunt each other like any other game. Compared to mock games, they are not open-ended, leaving no space for creating own rules and interactions. And they definitely do not balance on the edge of reality and fiction.

As mentioned, we believe that mock games are something that will evolve and spread in the near future, and platforms such as the *Nintendo DS*, which has peer-to-peer networking as well as internet access over WLAN, are perfect as platforms for such games.

7 Discussion

Next step in developing the concept of mock games is to get the working prototype into a real setting and have it run in a longer test period. Then we will see if the tweens actually appropriate our design as well as we think they will. Hopefully the DARE! game will become a natural part of the playful interactions among the tweens and they will start to develop and construct their own challenges, defining their own rules, using the components that we make available. This requires a stock of components that are ready to use and extend.

The concept of mock games is not fully unfolded with this paper. We need the actual trials and further reflection based on this in order to fully distinguish this game genre from other kinds of games. However, we are certain that mock games is a relevant and novel notion not only within the game developing community, but indeed also as an example of taking children seriously as creators of their own contexts when designing interactive systems aimed at tween users.

7.1 Ethics

When researchers deal with children, there are obvious ethical issues to address. As we design digital, pervasive technologies for children to use, we may be at the risk of letting technology shape children's lives without a close scrutiny on the values implicit in the design. Similarly making mocking games – are we supporting bad behavior? We are rather certain that we are not introducing anything new and harmful into the lives of tweens. As Ling [19] has already shown, the use of technology at a relatively early age is already a fact in some countries, with the blessing of the parents. This, we believe, can be seen as a forecast for other countries. Secondly, the conceptual introduction of mock games is based on observations of activities already present in the social context of tweens. As we have emphasized earlier, providing a platform for social experimentation is not value-laden in either a positive or negative direction – it is simply supporting a kind of interaction which is basically a part of coming of age. A part of children's life that has been left largely unapproached by designers. We do not consider mock games to support harassment any more than mobile text messaging does – on the contrary. This brings us to the ever-present discussion of surveillance in pervasive computing systems. When dealing with children and teenagers there is already some degree of surveillance by parents and other adult supervision. We find it difficult to say whether our proposed DARE! game will be easier or more difficult to monitor compared to "ordinary" teenage activities. On the general level we lean towards the view that systems should

be designed so open that the existing social norms can govern interaction within the system as well as outside.

8 Conclusion

On the basis of a range of qualitative user studies, including a review of some current theories of games and game design and a process of prototyping, we have suggested a new genre of digital pervasive games: mock games. With this new genre of games we are aiming design efforts at developing a game or a game-like application for the preteen age group – tweens. The objective of such a game is to provide a platform for more or less structured playfulness in a way that emphasizes humor, friendly battle and identity construction. We have presented a game of this character in the DARE! game. Mock games provide an alternative to both value-laden edutainment-style games for small children and adult's games with hard defined rules for play and social conduct.

9 Acknowledgements

We would like to extend our thanks to all the children, teachers, and colleagues that have taken part in these explorations. The work has been supported by Center for Interactive Spaces, ISIS Katrinebjerg (project #122).

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Designing for social interaction is a relevant issue to address from an interaction design research standpoint as computational technologies permeate increasing aspects of our everyday lives, and as such are part of creating the social spaces within which we live. As designers are confronted by the challenge of designing and facilitating relevant forms of social interaction, the complexity of this design space can be overwhelming. The reflections and experiments presented in the dissertation are aimed at exploring this design space and build a conceptual understanding for future reference. The social design space has been approached from a range of angles through mainly three different projects; the iHome project, the Future Hybrid Library project and the Nomadic Play project. This has lead to the three perspectives that the main contributions are developed within; how do we describe this design space and what we want to design? Who are we designing the social space for? What and how are we able to affect through design?

The goal of this dissertation is to increase awareness about the potential we have as designers for creating social spaces with and around these technologies. This awareness is established by developing and relating words in conceptual frameworks, aimed at enabling the designer with ways to describe and conceptualize future design proposals.