Aesthetics of Being Together

Stoffel Kuenen

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Samvarons estetik

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Aesthetics of Being Together
Design deals with matters of aesthetics. Historically, aesthetics in industrial design refers to the designed artifact: aesthetics of objects. When designed artifacts include digital technologies, aesthetics in design refers to what happens between people and artifacts as well: aesthetics of interaction. Now that these artifacts increasingly mediate our social lives, what aesthetics in design quite obviously also refers to, is what happens between people.

This dissertation proposes an aesthetic of being together, as a necessary addition to current notions of aesthetics in interaction design practice, when it engages with digital systems that are part of people’s social life. It does not answer the question what Aesthetics is in general, instead it examines the work that particular notions of aesthetics do in interaction design practice.

The practice based design research assembled in this dissertation starts from current notions of aesthetics in interaction design to explore the social experiences that mediated interactions between groups of people offer. What I found, through designing digital systems, is that current notions of aesthetics in interaction design are not conducive to addressing the kind of social experience people have with such systems. On the contrary, current notions actually inhibit interaction design to approach any experiences that cannot in the first place be conceived of as useful in terms of instrumental task performance. Yet, being social is hardly like performing a task or using other people in that sense.

An aesthetic of being together is a proposition of a different fundament for interaction design practice. In addition to referring to properties of things and qualities of interacting with things, it refers to the kind of relations that come to expression between people interacting with each other with these things. Consequently, interaction design needs to resolve basic issues in what it considers and brings to expression, i.e. people’s relations with things and people at the same time. This requires (re-) considering what the designed thing is, what interaction is about and what the role of design is in bringing those to expression.

My work contributes to the field of interaction design research an example of how, through practice, fundamental issues can be addressed. By orienting one set of concepts, ways of working and objectives into a different design situation, tensions built up that exposed foundational issues with that frame of reference, while pointing to the different fundaments needed to enable design practice to engage such situations.

The results of the practical experimentation led to the articulation of a series of structural mechanisms of mediating systems. These mechanisms provide material handles for interaction designers on how experiences of being present with others take shape. They configure the relations of artifacts and people in different ways than current notions of aesthetics afford. This theoretical investigation is then synthesised in the form of a new logic of expression for interaction design practice: an aesthetic of being together.
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Anne, whenever I get lost, the PataPata gets me back on track.
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Introduction
Introduction

The work presented here concerns our experience of being together with other people and more specifically the ways in which design engages with that experience in the context of technological systems.

Picture yourself in a football stadium with 35,000 other fans. Then think of getting on the subway during rush hour. Then think of a classical piano recital at the concert hall. In all these situations, you are interacting with others, probably even feeling the bodies of others near yours. While they are all social situations, they are also very different from each other; ranging from the immersive feeling of being a tiny actor in a giant wave across the stadium, to the physical pressure of crowding through the carriage door, to the shared silence of carefully listening to the precise dynamics of the performance and putting your hands together at the appropriate moment. It is trivial, really, that the way these social encounters are set-up and structured has a significant influence on how we act together and how we experience each other.

One would think that ‘social media’ would be the area in which we elaborated upon such aesthetics of social experiences, the expressions of being together, but as I will try to show, reality is rather the opposite.

The experiences of others that current social media offer us are of a very specific kind. They are constructed around exchanges of symbolic form: the exchange of verbal messages, pictures, emoticons, songs, music and so on. The aesthetics of interaction, the way such media look and present the actions we can perform in them, is carefully crafted towards a kind of experience of others structured around quite rational information exchange. When we think of two people meeting as a verbal exchange of greetings, it makes sense to construct an online social encounter in this way. When we think of two people shaking hands, it is already less obvious how such an experience of mutual presence could develop in mediated form. Now, when we think of more than two people being together in mediated form, conceiving of the experience as talking at the same time seems less attractive.

My interest is in kinds of relations between the one and the many through technology. In particular, I am interested in the experience of being present with many others and how design engages with bringing that to expression in interactions with technology.
Aim

If current social media provide a very particular experience of the social in a particular kind of one-on-one interactions between a person and a system, my work explores the possibility of other experiences of being social in other kinds of such one-on-one interactions. Whereas in current social media these experiences hinge on individual, symbolic expressions, in my work I aim for collective expressions and how an individual experiences and takes part in that.

I elaborate on (and complicate) notions that serve to address what happens at the touchpoint between a person and a system, i.e. interaction and aesthetics of interaction. In particular, I discuss such notions not only in relation to sensorial experience, but also as a particular shaping of a relation between the person and the artificial. The shaping of that relation is a particular expression of what such shaping could be. To make this more precise, in the context of social media: what a social medium looks and feels like, shapes the ways in which you conceive of yourself as a social being. As such, the social medium is a particular expression of a particular way of thinking about what it means to be social in the context of technological systems. And it is a particular expression in that it also reflects a particular way of thinking and doing design.

Notions of aesthetics are central to this thesis in the way that they are central to design. Design works with notions of aesthetics that are particular and refer to what is designed. This is different than answering the question what Aesthetics in general is. I do not start with a working definition of aesthetics in design at this point, but scope and frame it in dedicated chapters in the context of design practice in general and interaction design in particular. With this thesis, I aim to develop the notion of an aesthetic of being together that can form a basis for the design of the things we use to interact with each other that is different from how it is now. With this notion, I aim to reorient interaction design by backing off from current fundamental notions of function and utility and substituting them with a notion of being together.

When I talk about being together in this thesis, I refer to a direct experience of mutual presence; not for any purpose other than sharing a moment and not an interpretation of traces, symbolic expressions, of presence, such as receiving a message, or seeing a footprint. I mean to point simply to the basic experience of being social.

I elaborate on understandings of the social that come to expression in the design of technological systems that mediate our encounters with others. But I start from a basic understanding. When I talk about the social, I generally point to that part of our world that consists of other people, as opposed to the inanimate world or other animals. In particular, with the social I mean to indicate the structures and dynamics formed by many people that are in some kind of continuous relation.
Similarly, I also refine understandings of *medium* and *to mediate*. For now, I start with an everyday understanding of *a medium* as it is used to indicate that a telephone is ‘a communication medium’ or Facebook is a ‘social medium’. An everyday understanding of *to mediate* then is as used to indicate what a medium does, which is to pass something through. Already in such daily speak as ‘social media,’ *a medium* gains some aspects of place. In this thesis, I elaborate such more complex understandings of what is designed when interaction design engages with mediated social interactions.

**Motivation**

My motivation for this project stems from a fascination with the large-scale effects of the individual actions of multiple people. Drawing a parallel between such effects and emergent behaviour of complex systems, I start from the premise that the products/systems that we use for our contact with others influence the way we interact with our social environment and thus shape society and the processes within.

Beyond this personal drive, it seems relevant for design to gain a grip on the relationship between the artificial and social world and in particular to scrutinise the underlying ideas and infrastructures that develop that relationship in the particular directions that we can see in current social media such as Facebook, Google or LinkedIn.

**Personal Background**

I graduated with a masters’ degree from Industrial Design Engineering (TUDelft) in 2002. My thesis project was largely carried out in the Affective Computing group at the MIT Media Lab. These contexts of influence are quite distinct and I think are visible at least in my initial approach to this project.

At the TU Delft at that time, the group around Kees Overbeeke developed a perspective on Interaction Design rooted in Ecological Perception (Gibson, 1986) and Phenomenology of Perception (Merleau-Ponty, 1964), in the context of an industrial design education situated in Technical Universities, that draws on the traditions of Bauhaus and Hfg Ulm. The MIT Media Lab and the Affective Computing group led by prof. Roz Picard come from a tradition of Human Computer Interaction that is maybe even more technology centred. By the time that I started this PhD project, in 2010, many of the Delft group around Kees, including himself, had moved to the department of Industrial Design in the Eindhoven University of Technology and they, together with other colleagues, had founded the Designing Quality in Interaction group. The first year of my project I was a guest in this group.

I carried out the bulk of this project as part of the relatively young and quickly developing research group at Umeå Institute of Design (UID). UID has its roots in the quite rebellious and seminal shift in industrial design practices towards participatory and user centred approaches that developed in the Scandinavian
A central aspect of the DQI school of design research is an emphasis on bodily skills in making sense of the world. That perspective on interaction design is present throughout this thesis. Another important perspective in Eindhoven is to work from a critical human, societal perspective and to develop technological systems that could support desired change in that sense. Much of the work carried out in the DQI group borrows from empirical research methodologies from both psychology and technical sciences and combines this with artistic approaches, e.g. dance and theatre. At the MIT Media Lab methodologies are similarly empirical, though the central drive for projects is less human centred, more natural science and technology centred. The driving idea is to build demo’s of techno-social systems, that illustrate how particular technologies can become part of daily practices.

My perspective on relations of individuals with the group dynamics they are part of is imbued with conceptual imagery borrowed from nature. Take for example the behaviours of flocks of birds: an individual starling flying in a murmuration seems to follow a few simple rules (keeping distance from, but also staying close to and aligning with birds in its immediate vicinity) to guide its actions, yet the emergent behaviour of the flock is an awe-inspiringly beautiful undulating spectacle.

The techno-utopist in me wants to believe that we might achieve or discover similar beauty in our social dynamics with the help of technology. The critical interaction designer in me is looking to get a grip on the societal impact of the things design is part of creating. The design researcher in me questions both.

**Research Questions**

PhD research in general is usually presented as framed by a set of research questions. They provide the basic criteria on which the results of the work may be judged. Furthermore, they should provide the reader of a dissertation with some solid ground to refer back to when losing track of the relevance of particular sections of the dissertation.

This dissertation presents practice based design research. Design at its heart is propositional, aimed at change, and so is my design research work. There are some problems in trying to formulate a research proposition in the form of a research question, because they point in different directions, i.e. a proposition towards action, construction, vs a question towards analysis, deconstruction.

Nevertheless, here I formulate what drives my research in the form of questions, as it shows how I operationalise my intent; questions always have an aspect of direction in the way they are asked. This formulation exposes and helps to frame the research not as a frivolous individual exercise, but one aimed at gaining shareable insight. I go deeper into such epistemological issues in the chapter Methodology.
This dissertation stages a contrast between the design of current social media and my explorations of different forms of interacting with others. An aesthetic of being together is a proposition for an arena in which we can talk about what makes that contrast. At the start of my research this arena is only sketched by my intents as outlined in the previous pages. Here I summarise it as: to bring the many to expression in individual interactions with a technological system that mediates between the one and the many.

The following question can help increase the resolution of that arena, but the work presented here is not aimed at resolving the question(s) in the sense of answering them, but to better understand what they address and what it takes for interaction design to approach that:

- What aspects of social do we find when (a current notion of) aesthetics of interaction is aimed at experiences of being together?
- What structural mechanisms in the design of digitally mediating systems bring experiences of being together to expression?
- How can a notion of aesthetics of being together be articulated that forms a foundation for such aspects and mechanisms, thus opening up interaction design practice towards social experiences in general rather than in particular?

**Approach**

My research is a kind of design practice: I have designed and made iterations of technological systems that form, give shape to, mediated interactions between more than two people. Whereas in traditional design practices this would be aimed at the convergent development of a realised product, in my design research practice the objective is to look into and increase the precision of my proposition regarding mediated group experiences and the question what they are about, through the family resemblances in the series of experimental designs.

Each iteration provides the opportunity to observe and (co-)reflect on the experiences and dynamics that these systems are part of, while getting to grips with the things that constitute them. Such reflections serve to gain a better understanding and sense of what mediated group experiences are about and what structural elements can be found, which in turn leads to the design of a next iteration and to a rephrasing and reorientation of the conceptions they articulate.

This way of working also serves to develop an understanding of how this kind of inquiry unfolds and how that relates to other forms of academic research. In the chapter Methodology, I discuss my work in that light.
**Structure of this Thesis**

Apart from this introductory section, this thesis consists of five sections in which I progressively construct and position *an aesthetic of being together*.

This thesis addresses a notion of aesthetics of a particular kind. In the chapter *Aesthetics in Design Practice*, I start with a brief introduction to the ways notions of aesthetics perform in industrial design practices. The notion I propose is of a similar particular kind as design practice works with.

**Framing**

This section serves to position my work in discourse on Interaction Design and Human Computer Interaction. In this section I outline some general trends and major shifts in the ideas underlying the development of the relationship between people and computers. I discuss some typical examples to further clarify and illustrate what aspects of this development I take on board in my exploration, and in what ways my work departs from and responds to it. In the chapter ‘The Missing Body’, I stage how notions of embodiment treat the presence of a person. In the chapter ‘The Missing Masses’, I discuss how groups of people are present in the development of digital systems. In the chapter ‘Aesthetics of Interaction’, I evaluate how notions of aesthetics figure in this discourse. I end this ‘Framing’ section outlining how these things configure my inquiry in the chapter ‘Looking for Aesthetics of Being Together’.

**Practice**

This section presents the unfolding of my inquiry by means of a series of experimental designs. The first chapter, *Methodology*, locates my series of design experiments in a trajectory of design research practice, i.e. a design research program in tension with its expression in experimental designs, and positions it in the methodological discourse regarding this form of research. The following chapters in this section present one experimental design project each, with some of the insights developed within them.

**Towards an Aesthetic of Being Together**

In this section I string the insights local to each experiment together, to articulate what can be seen emerging in them, i.e. an increasing resolution image of the notion of *an aesthetic of being together*. I first articulate some structural mechanisms that the series of experiments expose; I then discuss how the experimental designs and structural mechanisms point to a different foundation than current interaction design practices build on, which I articulate as a different conception of what aesthetics refers to.
An Aesthetic of Being Together
In this section I assemble *an aesthetic of being together* that is a composition of conceptions, ways of working and objectives that I encountered in my research. I discuss the need for this different composition from current notions of aesthetics in interaction design, pointing to the tensions with particular conceptions, ways of working and objectives in those notions of aesthetics.

Concluding Remarks
In the concluding chapters of this thesis I discuss what this thesis contributes to interaction design research and practice, and what the notion of *an aesthetic of being together* means for these practices. This leads to projecting future research programs implied by this work.
Aesthetics in Design Practice

This thesis explores a notion of aesthetics; in particular, the notion of an aesthetic of being together that works for designing digital technologies that connect people.

Before I frame the context of the exploration itself in the following section, this chapter outlines the scope and structure of the particular that an aesthetic points to in the field of Industrial Design. I first stage how Industrial Design practices use notions of an aesthetic. I then back-off from such particular notions, to point out that from analytical perspectives on what Aesthetics in general is, such particular conceptions of aesthetics are problematic. I will only go as deep into these vast fields as is necessary to show that disparity. I then begin to zoom back into an aesthetic of being together, that emphasises the kinds of social that come to expression in interaction between people and artifacts.

In this thesis, I work with aesthetics in a similar way that design practice does, problematic as that may be, just oriented differently.

Everyday notion of aesthetics of products

When asked about the aesthetics of a product, you would be able to answer that. Take for example the phone in your pocket, you would probably describe what it looks like, its minimal curves, its slender proportions, the smooth jet-black of its back. Maybe you would mention the specific feel when pushing the single button on its front. Many people would be able to respond to a similar question about aesthetics of the brand that produces such products, i.e. the aesthetics of Apple. Assuming some familiarity with industrial design jargon, quite probably it would lead to discussing ‘form follows function’ and similar modernist, functionalist, ideas around what determines the shape of industrial artifacts. Such an aesthetic expresses a particular utilitarian approach to usability and user friendliness in forms and materials that celebrate state-of-the-art industrial production techniques. Similarly, the aesthetics of household goods producer Alessi can be characterised in terms of playfulness and ideas about colour and form that express one set of cultural values regarding the home and not others.

In everyday use, an aesthetic seems to refer to a repertoire for and a way of talking about the shape of a product or family of products, that has a kind of underlying theme or consistency which characterises that whole.
An aesthetic of products in design practice

In his book aimed at supporting industrial design education and practice, Monö (Monö, 1997) proposes an aesthetics of products that is a system of elements, a vocabulary, that expresses meaning in the sense of making intended use manifest. The aesthetics of a product here is conceived of as an understandable message to the user regarding its intended use in a particular context.

Monö articulates ideas that fit in the modernist design tradition that goes back to the HfG Ulm. In revisiting ‘Those monks on the hill’ (Branzi, 1988) Branzi revisits the original program of that tradition in the light of postmodern influences on design since the closure of that school. Rooted in the conviction that rational approaches to design would advance society, that tradition proposed a “neutralisation of expressive qualities within a code of great purity and correctness” (ibid). It is mostly this particular code, this particular logic of expression, that has found its continuation in many of the products we use today. What Branzi points to is that such a notion of an aesthetic is but one approach to the question of what determines the form of industrially produced artifacts; one that proposes a universal, functionalist language for shaping the home and the artifacts in it; one that expresses the unity of a particular orthodox vision of the future in order to stabilise its uncertainty in the face of technological development in industrial society.

In contrast to this North European program, modernity in Italian design comes to expression as an embracing of this uncertainty in heterodox methodologies and provisional artifacts that explore and propose a plurality of relations between the home and new technologies (Branzi, 2001). What emerges from Branzi’s writings is an aesthetic of products not as a universal logic of expressing e.g. intended use, but one that is subjective and complex, that enriches and questions the very act of utilisation in a heterogeneous and continuously changing world.

Similarly critical to the perpetuation of a machine aesthetic that he traces back to the Bauhaus, Papanek (Papanek, 1972) calls upon the responsibility of designers to reorient their work towards social and environmental sustainability from a global perspective. He balks at what he portrays as “self indulgent ‘antidesign’ styling of the new wave of Italian design” (ibid, p.291), though he does acknowledge that the “anti-rationalist appearance and non-functional existence” of its products have to be seen as a reaction to the functional aesthetic of the early and mid 20th century. In the context of a historical account of Industrial Design in the USA, he fulminates against post-depression spectacles of rampant ‘design-for-sale’ of e.g. Loewy’s streamlining, where design, subservient to industrial capitalism and consumerist society, is focussed on the housing (“shroud”) of products, not their use. Whereas Papaneks critiques echo Loos’ Ornament and Crime (Loos, 2010), he doesn’t completely vilify ornament as it has to do with what determines form. Instead he brings both use and aesthetics together in a hexagonal ‘function complex’.
Function Complex, adapted from (Papanek, 1972, p.7).
Note how Aesthetics and Use are placed diametrically.
In his discussion of this function complex, the role of the aesthetics element is ambiguous: It is an element of this function complex to be balanced with the other five elements, while at the same time it has to do with perception of the whole, the gestalt of a product. This tension in ideas of what encompasses the function of a product permeates discussions of aesthetics in design practice. A narrow interpretation of this tension can be seen quite clearly in the phrase “form follows function”, as used by descendants of Ulm, where function refers to instrumental purpose of a product and its aesthetics serve to communicate the use of the product, to invite people to act in an intended way.

An aesthetic in design practice and Aesthetics in general

In industrial design practice notions of an aesthetic sometimes reflect those in everyday use, i.e. a repertoire of form factors, but as I have illustrated, their consistency is also articulated in reference to the underlying ideologies they are meant to bring to expression. These ways of talking about an aesthetic of something in design practice, though quite particular, are obviously not singular, let alone that they say anything about what Aesthetics in general is. Discussions of an aesthetic in design practice often reflect, implicitly or explicitly, such more general discussions.

For example, Aesthetics in psychology is the study of perception and experience of the physical world. It is approached as an essentially psychological process that can be studied with the empirical rigour of science. With this interest in measuring and quantifying links between human appraisal and properties of the perceived, in design discourse we find parts of this perspective underlying the ideas of Monö that we have seen above, or in the idea that attractive things are easier to use (Norman, 2002b) or in principles of aesthetic pleasure proposed to explain people’s preferences for particular designs (Hekkert, 2006). Others, specifically in interaction design (Djajadiningrat, Overbeeke, & Wensveen, 2002; Overbeeke, Djajadiningrat, Hummels, & Wensveen, 2002), build on ideas from ecological psychology (Gibson, 1986), and I’ll go deeper into such notions of aesthetics in the context of interaction design in a later chapter.

When an art historian talks about baroque Aesthetics or the Aesthetics of the renaissance, she principally points to a set of formal qualities, family resemblances of works of art from a particular period. Explanations and interpretations for such formal qualities and what they depict are then sought in narratives of value systems and schools of thought of those periods. In design practice, as we have seen before, notions of an aesthetic have a similar structure and scope but aim for the generative rather than the analytical.

What I have discussed so far touches on fundamental questions regarding existence, reality, beauty, purpose etc. Typically, these are the kinds of things that are dealt with in philosophical disciplines such as metaphysics, epistemology,
aesthetics and ethics. It goes beyond the scope of this thesis to elaborate on that analytical discourse at length, however in the following paragraphs I mention a few key issues that serve to understand particular developments in industrial design that I outline in the Framing section of this thesis.

Monö explicitly refers to Baumgarten, the first philosopher to use the word aesthetics as the name for his inquiries into sensuous knowledge, as opposed to the knowledge one obtains through the mind. Monö uses this definition quite narrowly, to articulate aesthetics of products as conceptual knowledge encoded in the product, i.e. intended use. When Branzi revisits the principles of north European modernist design, he does this to separate the stylistic aspects of that tradition from its rationalistic tendencies, and to articulate a crisis in design caused by the uncertainties of post-rationalist, post-modern thought. This uncertainty is reminiscent of an increasing unease in modern philosophy with a Cartesian polarisation between subjective experience and objective knowledge. There articulations of Aesthetics do not depend on a separation of mind and reality and on conceptual knowledge of the world obtained through the senses. Instead, articulations of Aesthetics are rooted in our immediate experience of phenomena, our (embodied) being in the world. Phenomenology, particularly Heidegger and Merleau-Ponty, is often cited in interaction design discourse because it specifically examines the interconnection between mind and reality through the lens of how people relate to technology.

The general and the particular
It should be obvious that general, analytical conceptions of Aesthetics are of a very different kind than particular and actionable notions of an aesthetic of something in industrial design.

A similar tension between the general and the particular, theory and practice, is put to work when Nelson and Stolterman establish design as a legitimate tradition of inquiry and action (Nelson & Stolterman, 2003). Where e.g. science seeks abstract truth by generalising from particular instances, design creates the ultimate particular to manifest change in the real. If research in general then aims for the general that supports objective answers and rational solutions, design research
aims for the particular that fits with people’s individual life. Notions of an aesthetic in design practice similarly target the ultimate particular, the real, by offering a logic of expression with a particular orientation.

**Framing a working definition of an aesthetic of being together**

As we have seen, the way an aesthetic of something is treated in design practice is always tied to some things, examples, ultimate particulars. My design inquiry does not aim for one unique artifact, rather it seeks to work with the family resemblances of artifacts made with a particular orientation, with particular intent. This thesis aims to open up and unravel such a particular notion of an aesthetic. It starts from a proposition, or rather, a question, that outlines what is at stake:

> **If an aesthetic in design practice refers to the way an invitation to act in an intended way comes to expression through an artifact, more or less oriented to instrumental purposes, what does this look like if the invitation is towards being together; being together not as an instrumental condition towards some joint action, but simply a mutual sense of being together.**

An aesthetic of being together is not a grand theory that explains, rather it is a kind of working definition, a transitional theory (Redström, 2017), that orients designing in a particular way. In this thesis, I design and work with examples to explore what such a proposition means, looking for elements that characterise an aesthetic of being together. Such elements would be quite structural mechanisms, aspects of the digital technologies we use to interact with each other, that relate to the experiences of being together they invite to and bring to expression. Such elements are to being together as form and material of a teapot are to drinking tea.

From the perspective of communication technology, this may seem similar to models of communication developed to explain the human communication process. There the focus is on the function of communication as a quite instrumental and rational process of information exchange. The exchange of information may give rise to particular experiences of being together as a by-product. I am interested in the experience of being together and the ways that design can engage with that, rather than the experience of rationally communicating.

*Being together* is also studied from the perspective of sociology and social psychology. I am not interested in explaining experiences of being together as a psycho-sociological process, I am interested in how design can engage with that process.
Similar to other notions of an aesthetic in design practice, the transitional theory I work with in this thesis begins its trajectory with particular notions of aesthetics and particular theoretical notions and ways of working from other fields as its footholds. An aesthetic of being together is not born from a vacuum and in the chapters of the ‘Framing’ section, I illustrate what my research responds to and what ideas it starts from. After I present my experimental design work in the section ‘Practice,’ I evaluate to what extent those footholds are tenable or useful, and how they are not, to outline and locate the kind of footholds needed to further unpack design in the light of being together.

An aesthetic of being together can be seen as a somehow inverted counterpart of Relational Aesthetics in art. Bourriaud (Bourriaud, 2002) developed that idea to analyse and categorise artistic practices not aimed at individual appreciation (like a painting), but that brings people together in a social context and shared activities. He proposes:

‘... this “arena of exchange” must be judged on the basis of aesthetic criteria, in other words, by analysing the coherence of its form, and then the symbolic value of the “world” it suggests to us, and of the image of human relations reflected by it.’ (Ibid, p.18)

An aesthetic of being together in the context of digitally mediated interactions is concerned with the quite structural mechanisms of a technologically mediated arena of exchange and with the coherence between these mechanisms and thus with the whole that orients the design of that arena in particular ways.
Framing
In this thesis, I explore how design can engage with the kinds of relationships that are established between people by means of digital technologies. More specifically, with my work I probe basic orientations in interaction design concerning the experience of being together with many others through electronic media.

My thesis responds to (what I see as) individualistic tendencies in interaction design and a related utilitarian perspective on the social contexts in which computational systems play a role. I am interested in the ways in which the many (the social) can come to expression in individual interactions with computational things. Current interaction with other people by means of computational systems largely emphasises rational expression of the individual: visual and verbal representations of thought. Ideas of a collective, the social, exist largely in collections, archives or similar traces, of such representations. In my work, I look for experiences of relating to others that are more synchronous, dynamic and continuous, in which being present in a collective is more immediate than scrolling through collections of symbolic representation.

This section, Framing, serves to position my work in discourse on Human Computer Interaction on the one hand and Interaction Design on the other. In this section I outline a trajectory and major shifts in the ideas underlying the development of the relationship between people and computers. I discuss some typical examples to further clarify and illustrate what aspects of this development I take on board in my exploration, and in what ways my work departs from it.

The work in this thesis should be seen in the light of a trajectory from technologically driven and rationalistic perspectives on human computer interaction and computer supported collaborative work, towards more holistic, experiential and socially constructed notions in interaction design. Social media as we see them today seem to be exponents from the earlier period of this development. Later research in interaction design and related fields extensively addresses particularly the more experiential aspects and non-work settings of using computational systems. My work builds on notions such as embodiment and aesthetics of interaction from that research. Yet what I see largely missing is work that addresses the expressions of large numbers of people interacting with each other and the experience of being together through computational systems not necessarily to do work. I illustrate my view on such expressions through a contrast between analytical ideas and conceptual imagery.

In the chapter ‘From Personal Computer to Social Media’ I trace in broad strokes the genealogy of current social media to particular ideas about the relation between an individual and a computer, and by proxy between people.
One of the driving visions behind the development of early computational systems in the 1940-ies and 1950-ies in the context of business and science, was to provide individual access to shared information and knowledge and to support task distribution and shared decision making processes. Cross-pollinating with counter-cultural ideas in mostly the US Westcoast in the late 1960-ies and early 1970-ies, early personal computers went on to be imagined as tools for self-realisation that liberate the individual from the shackles of the establishment of the time, from the impersonal and dehumanised nature of institutional and corporate organisations and even from the physical limitations of appearance and location of the body. Such ideas are at the core of the development of commercially available personal computers in the early 80-ies. Social media as we use them today are not much different from the computer supported communication systems of that era, at least in the concept of what it means to be social using computers.

This illustrates expressions in current social media of individualistic, rationalistic notions of the person and related utilitarian notions of the social (the collective) in particularly early HCI and interaction design.

In the chapter ‘The Missing Body’ I outline specific elements of a general shift from Cartesian dualism and rationalism to phenomenological perspectives in the discourse on human computer interaction (HCI) and computer supported collaborative work (CSCW). Central to this shift is the embodied nature of our being in the world; Physical, bodily, presence and experience is at the heart of our ability to make sense of and act in the world together with others. Such ideas are largely adopted to serve further optimisation of the man-machine performance in work contexts. Pushing beyond situations of work and into the home and our everyday life, research in the so-called 3rd wave HCI also opens up toward more holistic, experiential approaches to the relation between people and computational devices.

My work builds on phenomenological perspectives on our ability to make sense of and act in the world. In much of the discourse in HCI as well as in Interaction Design the ideas of embodiment are still largely individualistic and utilitarian: embodied presence is largely concerned with coupling a person into the computational realm, and with the physical and social situation in which man-machine interaction takes place. In my work, I explore embodied presence from a collective perspective.

In the chapter ‘The Missing Masses,’ I briefly sketch a few approaches that specifically address the relation between large numbers of people and technological systems. Some discourse in HCI and CSCW looks specifically at interfacing crowds and computation, which surfaces some ideas around crowd dynamics. Science and Technology Studies and Philosophy of Technology provide some theoretical
handles on the relation between people, society and the technology used. In Computational Sociology, large scale social dynamics are studied from analytical perspectives, which finds application in e.g. how current social media are run. Biology and physics provide inspiring images of emergent behaviour of complex systems and some pointers to the role that behaviours of individual agents play in it. These elements serve to illustrate a contrast between analytical ideas of the relation between individuals and collectives, and conceptual imagery of emergent behaviour and social structures that have inspired my work.

In the chapter ‘Aesthetics of Interaction,’ I revisit the general trends and shifts brought forward in this section, to go deeper into aspects that are relevant for design that addresses social experiences with computational things. The general line of the chapter is a shifting and expanding notion of aesthetics in the design of computational things: from attention to static form of physical and graphical objects to the socio-cultural expression of artifacts in use.

This sketches an unresolved landscape of varying conceptions of what interaction design is about or should be concerned with, reflected in particular notions of aesthetics. Though of low resolution, particularly for design engaging with mediated interactions between people, some features of this landscape do provide promising and actionable notions from which I begin my exploration of designing interactions between groups of people using computational systems.

In the chapter ‘Looking for an Aesthetics of Being Together’ I summarise the whole of the framing section in the light of notions of aesthetics, drawing out elements that I build on, quite literally, in designing and building systems that bring mediated social interaction to expression.
From Personal Computer to Social Media

“Yet, almost from the computer’s modern inception, searching questions have been asked of what will be its effect on society and on man’s image of himself.” (Sterling, 1974)

The design of current social media, e.g. email, Facebook, Twitter, blogs or Google Docs, inherits much from their ancestors in the quite recent past of development of computing systems. In this thesis, I explore alternatives to current interactions with others by means of digital systems. In order to reorient the design of such systems, in this chapter I trace in broad strokes a genealogy of current social media to particular ideas about the relation between an individual and a computing system, and by proxy between people.

Consider the social media you probably engage with every day. Think of how you use them, in the most immediate, pragmatic sense: using a personal device, you share a piece of information, in verbal or visual form, with a group of people using the same system. Technically, you contribute a piece of information to some digital repository, to which others have access. When you look at someone using a smartphone with others around, it is actually hard to say this person is being social.

Even if today social media perform many different roles in our daily life, the basic structure of using these systems is very similar to the computer mediated communication (CMC) that was developed in conjunction with the rising use of networked computers in rational business and scientific processes in the 1960-ies and 70-ies for collaborative work.

CMC received much attention in that context when it was acknowledged that supporting communication about the work to be done was an important part of improving efficiency and effectivity of the tasks to be performed. For example being able to participate in a conversation in asynchronous form using an individual, personal terminal was seen as an improvement in terms of cost and efficiency over synchronous, verbal modes of communicating in which “Individual participation is sequential and under the control of the group along with any explicit or implicit rules of order that apply.” (Turoff, 1973). Furthermore, networked computers make geographic location irrelevant to participation in the work, enabling distant collaboration.
The basic rhythm and structure of people using computers to collaborate, was most famously enacted in what came to be known as Doug Engelbart’s “Mother of all Demo’s” (Engelbart, n.d.). It is quite striking how much of what was presented there half a century ago, is still visible in our everyday life with computers; not only in the basic physical set-up and asynchronous rhythms, but also in why we (humans) use computers: an individual performing knowledge work with remote others at a terminal consisting of a pointing device, a keyboard and a screen.

Engelbart’s demonstration projected a role of the computing systems as supporting collective human intellect, which contrasted with perceptions of computers as extending or replacing the rational capacities of the human brain (Licklider, 1960). Whatever the role of computing machinery, central to their development is the belief that progress of humanity pivots on intellectual, rational knowledge processing. Already at the end of WWII, Bush formulates such a cultural program and casts a vision of a machine that embodies these ideas.

Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, “memex” will do. A memex is a device in which an individual stores all his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory. It consists of a desk, and while it can presumably be operated from a distance, it is primarily the piece of furniture at which he works. On the top are slanting translucent screens, on which material can be projected for convenient reading. There is a keyboard, and sets of buttons and levers. Otherwise it looks like an ordinary desk (Bush, 1945).

Bush sketches a personal, private and intimate relation between an individual and his memex that primarily refers to individual access. This was a radical vision in contrast to the large, room filling computing machines of the time that were operated by teams of engineers using punchcards, performing tasks for different departments of an organisation one at a time.

In his account of what led the development of human-computer interaction from the large mainframes of the 1950-ies to the personal computers of the 1990-ies, Grudin (Grudin, 1990) gives an overview of a shifting focus from the computing machinery itself to more contextual aspects of use, i.e. human-machine coupling and the social settings of doing work together.
Central in Grudin’s account is the task performance of human-machine systems in the context of rational processes, which resonates with the modernist cultural agenda articulated by Bush. From this account emerges a quite specific notion of a person, that is considered primarily as a set of physical and cognitive ergonomic measures and a source of noise or irregularities to be suppressed. This rationalistic view of an individual leads to an emphasis on semantics and symbolic interaction. In the systems we use today the fruits of those developments are still present in e.g. different ways to interact (point-and-click with mouse, pen or touchscreen) with graphic representations of computational elements (GUI), i.e. the desktop metaphor. Similarly, a specific notion of the social emerges from such accounts that refers to those aspects of interacting with others that are relevant to optimising task-performance of human-machine systems.

Grudin focusses on the interface between computing machinery and people from an engineering driven perspective. Less visible in such an account are voices that are concerned with the impact of such a perspective on people and society.

Commenting on designing the Olivetti Elea9003 in the early 1950-ies, Ettore Sottsass noted that “one ends up conditioning the man who is working, not only his direct physical relationship with the instrument, but also his very much more penetrating relationship with the whole act of work” (Sparke, 1982, p.63). For the countercultural Free Speech Movement of 1964-1965, the punch-card was a symbol of a society that was becoming dominated by a rationalistic and information driven perspective on human beings, supported by the centralised computing machinery of the time. Person-centred computing is concerned with the well-being of the operator of a computer. It questions professional rhetoric that presents computer systems as benign change agents as they may simply reflect the trends and values in organisations, e.g. “that fosters [sic] competition over collaboration, that sacrifices personal autonomy for efficiency and control, and encourages fragmented depersonalized roles for ease of supervision.” (Kling, 1973). Similarly, a set of guidelines for the humanisation of computerized information systems (Sterling, 1974) reads as a warning for and a critique of a rising technocratic society, as much as it proposes ethical and practical handles for developing the computing systems that are thought to be bringing it about.

Nevertheless, what people actually building computer systems were concerned with, had more to do with the line that Grudin sketches: decreasing size of the computers and optimising task performance of human-machine systems from a rationalist perspective. In that context, the idea of a computer as personal, has to do with a person having individual, continuous access to computational power on the desktop for intellectual work with others, much like Bush presented in 1945. Already early in the trend of increasing power-to-size ratio, people began to imagine computers that were personal in the sense that they were portable and
that could be used in everyday life ("Pocket Computer May Replace Shopping List; Inventor Says Device Could Tell Grocery in Advance What Customer Needs," 1962). The Dynabook, initially introduced as science fiction, is construed as personal in the sense of access (portability) but also of ownership. "What then is a personal computer? One would hope it would be both a medium for containing and expressing arbitrary symbolic notions, and also a collection of useful tools for manipulating these structures, with ways to add new tools to the repertoire." (Kay, 1972) A large part of this influential paper is a detailed story presenting the place the Dynabook has in the life of different family members (daughter and father). It was positioned in the context of home appliances such as a TV. Relevant to the argument of this chapter is how this narrative smoothly positions the intellectual task support of the digital device in everyday life of the home.

The Apple Macintosh was one of the first commercially available personal computers targeting the home. Its design echoes that of other home appliances as well (one of its designers is said to have actually referred to it as an Information Appliance (Norman, 1998, p.53). Similarly, the first laptops look like portable typewriters of the time. Handheld personal computers resembling the Dynabook have been around since the 1990-ies mostly used in business and by geeks. The first tablet computer that would find its way into many people’s homes is the iPad. When I think of the presentation of the first iPad, it is not the technological feat of its size or the features the software offered (they were not radical) that won me over, it was the whole act by Steve Jobs of using it sitting on a couch that staged how this personal computer would fit in my life. Note the similarity of this act to the narrative in the Dynabook presentation.

The development of the personal computer to large extent took place on the US Westcoast in a time of societal turmoil; the development of youth culture and counterculture sought alternatives to the established centralised authority of a rationally dominated society. This cultural movement brought together ideas of individualism with distributed, ecological perspectives on power (Turner, 2006). As I pointed out above, the computational systems in institutions (science, business and government) were seen as a symbol and embodiment of the establishment, ‘conditioning’ people to be mere numbers, production units. Somewhat paradoxical in hindsight, at the same time personal access to computing systems away from such contexts was heralded as a means for individual empowerment: people would be able to share knowledge for different forms of self-sufficiency and self-realisation without being dependent on existing societal systems and infrastructures, without dependence on geographical location and without the influence of physical appearance. The idea of the computer as such a personal tool was e.g. championed in the Whole World Catalog, later mentioned by Steve Jobs to be a paper pre-cursor for internet search engines (Jobs, 2005).
The 1983/1984 commercial for the introduction of the Apple Macintosh as a personal computer quite clearly illustrates that idea of the computer as a tool for individual liberation for everyone in everyday life. The imagery of an individual smashing the screen of ‘Big Brother’ from the film 1984 are unambiguous expressions of these countercultural ideas. No more grey boxes for monochromatic drone-workers, but colour!

Apple Macintosh came from a scene of home-brew computer tinkerers that played a big role in pioneering the networking of computers and in particular the communication services that ran on them. Computer Mediated Communication that was developed for science and business contexts was appropriated to these non-professional tinkering contexts. This led to examples of early social media such as the Bulletin Board Systems in the late 1970, more widely used as computers started to be more commonplace in the home in the 1980-ies. A BBS is software running on a computer that you could dial into using a modem and a terminal program. The most basic function of a BBS is a database of text files, often organised by topic, that you can contribute to. More extended versions offered a kind of email and direct textual-chat functions and the possibility to down- and upload software. It is not difficult to understand that such functionalities fit perfectly with the countercultural ideas of distributed power (anyone could start a BBS) and sharing ideas, techniques and tools between individuals. This is for example reflected in referring to the users of a BBS as a virtual community.

The same basic ideas and language are still very visible in how current social media, such as Twitter and Facebook, are portrayed. For example, Facebook’s founder Zuckerberg talks about their mission of building a global community, “…spreading prosperity and freedom, promoting peace and understanding…” (Zuckerberg, 2017). When uprisings happen in countries suppressed by authoritarian regimes, some are quick to claim the liberating and democratizing character of social media as their cause (Howard & Hussain, 2011). Others argue that the role of social media in for example the Arab Spring of 2010/2011 may have been instrumental at best (Zepic, Klotz, Dapp, & Krčmar, 2016).¹

Clearly, this basic narrative of social media is very appealing. Current social media, with its origins in the tech culture of Silicon Valley, make ready use of this in their marketing. However, recently it has begun to come to public awareness, that when such ideas meet with the business of offering such services, paradoxes and

¹ The idea of social media as tools is reiterated in e.g. Wired magazine, a direct descendant of the Whole World Catalog that still reflects the basic countercultural value system of Californian techno-utopism (cf. Hempel, 2016).
contradictions are exposed between social, commercial and even political motivations present in the originating narratives.²

Those tensions are actually quite similar to the issues of “systems conditioning man” raised by e.g. Sottsass in the early 1950-ies that I have discussed above.

In this chapter I have outlined that in terms of size, speed and (some would argue) interaction design the technologies we use to connect with each other have changed dramatically, but in terms of the narrative of living with digital systems surprisingly little has changed.

The cultural narratives of, on the one hand, augmenting human intellect and, on the other hand, enabling self-realisation and individual expression, are still clearly visible in how we use technologies today. The 1-on-1 structure of interacting with others using a personal computing device, e.g. a mobile phone, is an expression of a rationalistic, individualistic notion of a person and a utilitarian notion of what it means to be social that stems from those narratives.

In this chapter I emphasise the Cartesian, modernist perspectives on people and society that have influenced the digital technologies we use today, to show particular ideas about the relation between people, technology and being social. In the next chapter ‘The Missing Body’ I outline more human-centred, phenomenological perspectives that have also been present, especially in the later part of the development.

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² We see this most clearly in the recent controversy concerning Facebook, Cambridge Analytics and manipulation of elections.
In earlier parts of the development of human-computer interaction, a focus on intellectual task performance emphasises techno-deterministic and Cartesian perspectives on man-machine interaction (and vice-versa). People are present in the considerations predominantly for their intellectual skills and the body is largely absent.

In later parts of the development of the relation between people and computers, changing ideas of how people understand and act in the world, attention shifts to, on the one hand, physical aspects and, on the other hand, socio-cultural aspects of using computing systems. In different ways, this brings the body back in view. Often cited is the work of Dourish (Dourish, 2001), that brings both perspectives together in the notion of embodiment, drawing on existential phenomenology and in particular Heidegger’s notion of being-in-the-world. Dourish’ embodiment quite literally points to the physical and social presence of the body engaged in context as essential to existential experience.

In this chapter I first revisit some of the work and then some of the theory on which Dourish based his arguments. I do so to point out the quite particular ways in which embodied presence comes to expression in the design of the relation between people and digital systems.

Dourish is not the only one that articulated notions of embodiment in HCI and interaction design and work in those fields has of course developed since ‘Where the Action is.’ Yet I chose that book as a somewhat arbitrary demarcation of a still ongoing transition between what Bødker called 2nd and 3rd wave HCI (Bødker, 2006).

The previous chapter has parallels with the former part of that transition; the next two figure particular aspects of the latter. In the next chapter, ‘The Missing Masses,’ I refer to more recent work to stage notions regarding the presence of large numbers of people in interactions with digital systems. In the following chapter ‘Aesthetics of Interaction’ I elaborate on ideas regarding embodiment and experience, making use of more recent work in interaction design, to stage different perspectives on presence of and with (interactive) products and systems.
Digital systems in physical and social contexts

The physical

As mentioned in the previous chapter, central to early ideas of the relationship between people and computing systems is that computers would mimic, support and extend the cognitive, rational processes of the human mind (cf. Newell & Simon, 1961). A problem to be solved then is one of communication between man and machine of a symbolic, formal nature (cf. Licklider, 1960; Licklider & Clark, 1962). Interactions with digital systems developed from discrete, batch computing using punch-cards to text-based, continuous (online) interaction through the command line, and then manipulating graphical elements on a screen. Leveraging people’s familiarity with working with objects on a physical desktop, explorations regarding the usability of computers lead to the now omni-present desktop metaphor. Further explorations in bridging the digital and physical world, seek to represent digital elements as physical objects. (Wellner, 1991). Graspable and Tangible User Interfaces (Fitzmaurice, Ishii, & Buxton, 1995; Ishii & Ullmer, 1997) work with metaphors of the physical world in digital representations, and metaphors of the digital world in physical representations. Of relevance to the line of this chapter is the idea of leveraging human skill of making sense of and acting in their spatio-temporal context.

The Social

Networked computers can be used by people to communicate with each other. Computer mediated communications (CMC) looked like bulletin board systems, forms of (textual) conferencing, email and even video-conferencing were part of the picture. In the context of computing systems becoming more widespread and adopted in the workplace, the idea of Ubiquitous Computing (Weiser, 1991) sketches a world where computation becomes embedded in our physical environment. To contrast “people holed up in windowless offices in front of glowing screens (ibid)”, this idea is illustrated by pictures of groups of people together in front of ‘interactive walls’ (large touch screens), holding tablet computers.

The realisation that work happens in a social dimension, shifts attention in the field of Computer Supported Collaborative Work (CSCW) from formal aspects of (distant) collaboration, e.g. being able to work on the same content or task and being able to communicate with others about the work, to more informal aspects of working together. Work on awareness systems illustrate this shift.

“At its essence, mutual awareness refers to a fundamental quality of collaborative work, the ability of co-workers to perceive each other’s activities and expressions and relate them to a joint context.” (Rittenbruch & McEwan, 2009)
When you think of a shared document as a virtual collaboration space, representing and annotating people’s actions in virtual space can provide parts of the awareness of other people that collaborating in physical space provides (Dourish & Bellotti, 1992). Some portray an awareness support system as a kind of vehicle with which you ‘cruise’ through that virtual space to casually and informally ‘meet’ people, echoing what happens at the watercooler or coffee machine in an office (Root, 1988). Such ideas import features of the physical and social context of doing work into the digital collaboration space. Media spaces (Bly, Harrison, & Irwin, 1993) express the inverse of that idea: when you connect distant physical workplaces in more ways than only a shared document on a screen, this results in a hybrid between digital and physical work space. For instance a video link can be seen as a window or a porthole (Dourish & Bly, 1992) between two distant locations, supporting the mutual awareness of the presence and actions of others in another location. ClearBoard (Ishii, Kobayashi, & Grudin, 1993) turns such a window into a shared, transparent whiteboard, that integrates formal and informal aspects of collaborating at a distance. One approach to simulating collaboration in real life settings sees this as an issue of bandwidth, and seeks to create seemingly transparent multimedia links between distant locations. Another approach analyses awareness, and seeks solutions that effectively and efficiently provide a minimal form of awareness.

Of particular interest here, is an expanding notion of awareness, from referring to explicit presence of people as you work with them, to a more implicit, contextual presence, and the ability of people to direct their attention between focus and periphery. Work on tangible interaction similarly embraces the possibilities of explicit, foreground, and implicit, background, presence of digital systems and people working with them. Such developments are clearly visible in ideas such as Calm Technology (Weiser & Brown, 1997) and Ambient Media (Ishii & Ullmer, 1997).

Discourse that contrasts with explicit, goal-oriented, informative communication in the context of work, explores remote personal interactions beyond work contexts. For example ‘Feather, Scent, Shaker’ probes the possibility of minimal, personal, expressive and intimate communication (Strong & Gaver, 1996). Exploring the idea of distant intimate interactions, ‘the bed’ works with abstracted telepresence and physical avatars (Dodge, 1997). Compared to the rational and utilitarian aesthetics of many work-oriented awareness systems, these examples show more poetic and subtle expressions of distant presence. Some projects look into the minimal conditions for an experience of intimate connection between people (Kaye & Goulding, 2004; Ogaki, Suzuki, Hoshikawa, & Uchiyama, 2008). In all these examples, the basic idea is to express the presence of a person in one location as some event in the other. Presence is somehow treated as a signal from one place to another.
InTouch (Brave, Ishii, & Dahley, 1998) is a set of electronically connected remote cylinders. When a roller is moved on one end, the corresponding roller on the other rotates. The crucial difference with other awareness systems is that when someone on the other end stops that cylinder from moving, this can be noticed by the person trying to rotate the cylinder on the one end. In my mind this brings back symmetry to the action in and perception of remote presence.

There is an abundance of historic and current research that looks into mediated remote interactions, from awareness systems (Markopoulos, Ruyter, & Mackay, 2009) to intimate relations (Saadatian, Samani, Toudeshki, & Nakatsu, 2013). What stands out from the examples I gave, is that there are two general conceptions of what mediated presence is about: There is a fundamental difference in approaching presence as an objective signal to be transmitted or as a mutually constituted experience.

**Theoretical perspectives**

Parallel to and to some extent providing basis for the growing attention to physical and social context in HCI and CSCW that I have illustrated above, lie shifts in the theoretical perspectives on how people understand and act in the world. Development of computers initially was largely an engineering discipline. Seeking to optimise the task performance of man-machine systems and to ‘humanise’ (Sterling, 1974) working with computers, other perspectives, e.g. sociology and (cognitive) psychology, began to be included in the development. In those and other scientific fields, a paradigmatic shift in theoretical, philosophical, foundations was also underway, that opened up to alternatives to a Cartesian, positivist worldview (Kuhn, 2012; Lakatos, Worrall, & Currie, 1980).1

**Socially Situated**

In HCI and CSCW Suchman is most known for critiquing a rationalist model of the nature of human experience and expertise (Suchman, 1987). Referencing ideas from existential phenomenology (as others had before, (cf. Dreyfus, 1979; Winograd & Flores, 1986) she stresses that actions are situated, meaning that they are not the execution of disconnected, rational plans, acting on objective, symbolic information. Instead they are a continuous, dynamic response in a particular (spatio-temporal) context and emerge in a social dimension. There is a clear difference between the performance metrics of usability research of earlier HCI, and Suchman’s ethnographic perspectives to the understanding of the complex entanglements that form the relationship between people and technology.

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1. This shift still causes tensions in the discourse in this field. (cf. Davoli & Kuenen, 2013; van Dijk, Moussette, Kuenen & Hummels, 2013)
The importance of the work of Pelle Ehn for the design of computer artefacts in the work context cannot be overstated (Ehn, 1988). Among many things, Ehn lays the foundations for Participatory Design methodologies that bring a more human-centred and democratic perspective to the development of the relation between people and computing systems. This stands in stark contrast to both cognitivist and technono-deterministic perspectives on that relation.

As a part of what can be called Social Computing, the work of both Ehn and Suchman explicitly seeks to develop the theoretical foundations and related methodologies for the design of the relation between people and digital systems in the workplace, taking into account socio-cultural context in particular.

**Tangible Affordances**

For the more engineering-driven perspective of Tangible Interaction, it is harder to find such explicit development of theoretical groundings for HCI. Concerned with usability, the metaphors used in this field are a pragmatic and common-sense appropriation of human physical skills in human computer interaction. Similar to such metaphorical approaches, Norman, a psychologist by training, introduced the notion of affordances to design as a kind of signal to a user of how something should be used (Norman, 1988). Gaver presented a notion of affordances to HCI to bring together the possibilities a digital technology offers with the abilities of people (W. W. Gaver, 1991). Though there is some controversy about these slightly different interpretations in the context of design and HCI, the notion of affordance was developed in the context of psychology of perception by JJ Gibson (Gibson, 1986). Gibson’s affordances point to a mutual relation between the perceiver and the perceived; the world is perceived as action-possibilities for the perceiver, not as things. This behavioural, action based perspective, contrasts with a cognitivist, information-processing model in psychology, that assumes the world is perceived objectively, i.e. as an object.

**Embodied Presence**

Dourish observed that the tangible perspective and the social perspective both emphasise the context of people working with digital systems; spatial-temporal context grounding tangible interaction and socio-cultural context grounding social computing. He argues they have a common foundation in the notion of embodiment (Dourish, 2001).

Dourish notes that embodiment plays a different role in the different phenomenological positions he builds on (i.e. Husserl, Heidegger, Schutz and Merleau-Ponty), but what permeates all is the central role of the body in “the idea of a world that we encounter directly rather than abstractly...” (Dourish, 2001, p.117). In contrast to traditional philosophical traditions that assume a structure of our experience of the world as perception-meaning-action, phenomenological approaches to human existence...
(being-in-the-world) hold that the world is inherently meaningful to us “as it reveals itself as being available to our actions” (ibid, p.117). Actions not as abstract plans, but a continuous and direct physical interplay between embodied beings and the world.

Dourish proposes the notion of embodiment to “capture a sense of phenomenological presence” (Ibid.). From that perspective, it can be argued that attention to physical context emphasises the embodied presence of a digital system to a person and attention to social context emphasises the embodied presence of several people to the digital system and to each other.2

Experiences
Dourish develops a foundation for phenomenological approaches in the field of HCI and interaction design that are particularly concerned with the experience of interacting with technology, rather than being oriented towards task performance alone. As computers began to permeate everyday life, others have also sought further foundations for what constitute more holistic notions of experiences, which I elaborate in the chapter Aesthetics of Interaction.

2. I do not mean to express a direction of presence from one thing to another here, rather to point to their entanglement. Phenomenology in general targets reciprocal relations and wholes, instead of separating things, e.g. an inner and an outer world, or action, perception and meaning, or mind and body. Phenomenological discourse is particular difficult to write and read as it attempts to express circular concepts in linear language.)
Summary
In this thesis, I explore experiences of being together by means of digital mediation systems. Of relevance for my research is a phenomenological perspective on the nature of being human and in particular the notion of embodied presence. What stands out to me from the examples discussed in this chapter are tensions between such phenomenological foundations and the ways they are brought to expression (made use of) in the design of people’s interactions with digital systems.

One such tension is that embodied presence in HCI and particularly CSCW largely refers to being present as a knowledge or task performing entity. This points to a generally lingering assumption regarding the purpose of the relation between people and digital systems and by proxy of the meaning of social interaction: both are rational and utilitarian. This may be stating the obvious, as Suchman and Ehn and to some extent also Dourish, explicitly target the design of digital systems in the work context. Nevertheless, this assumption seems to implicitly persist as those systems spread from the workplace to the home and the rest of our daily life.

Similarly, I want to point to three aspects of the projects above that push beyond work contexts and explore intimate presence. First, I see a tendency to look for minimal ways to establish an experience of embodied presence. Somehow this reminds me of the focus in work-contexts on efficiency and optimisation and related metrics of usability. Second, I see an opening up to less quantifiable, poetic and expressive qualities of embodied presence. In the chapter “Aesthetics of Interaction” I will go deeper into such aspects. Third, these projects are mostly about individual expressions of presence in the physical world: it is about an individual, one person, and it is about a representation of a remote individual in the physical world.

What seems relevant to my inquiry is embodied social presence as a mutually constituted experience, similar to how InTouch brings it to expression, but then an embodied presence in and of mediated collectives.
The Missing Masses

Even if several people using computers together has been part of the development of digital systems since early on, what seems to be largely missing are ideas and expressions of large groups or crowds and in particular the experiences of taking part in group dynamics.

In this chapter I briefly sketch a few perspectives on the relation between large numbers of people and technological systems. Science and Technology Studies and Philosophy of Technology provide some theoretical handles on the relation between people, society and technology. I revisit some discourse in HCI and CSCW that specifically looks at interfacing the crowd, which surfaces some ideas concerning the nature of crowd dynamics. Biology and physics provide inspiring images of emergent behaviour of complex systems and some pointers to how that relates to the behaviours of individual agents in it. In Computational Sociology, large scale social dynamics are studied from analytical perspectives, which finds application in e.g. how current social media are run.

This chapter serves to stage a contrast between analytical ideas of the relation between individuals and collectives, and conceptual imagery of emergent behaviour and social structures that have inspired my work.

Hidden Forces and Agency

When we talk about online (virtual) communities, what we refer to are services such as Facebook or Instagram that offer collections of consecutive individual expressions that effectively hide what goes on at a collective level: we can hardly see the forest for the trees. Generally, people are very good at integrating the stream of information that others share digitally, to get a sense of what is going on in the social network that these services establish. But what is often overlooked is that such platforms curate what we can see on our ‘timelines’ using sophisticated algorithms. We have no way to know what factors these algorithms use to curate which of our ‘friends’ contributions we see, yet they do make up the social reality of the online community we act in. The motivations for us to use these systems are generally quite different from the motivations of the owners and creators of such systems to offer them to us for free. Our view of the social that we partake in is quite different from the perspective that the owners of these systems have. Furthermore, as I have outlined in the previous chapters, the very structure of using these services on digital devices, are an expression of a particular conception of a person in the context of a computer and what it means to be social using digital systems. At best, we see expressions that fit with a particular narrative of what society is about, but what is often hidden is the role of the individual as a data and content generating product to be sold.
What I want to point out here, is a kind of hidden power that the things we use have over our actions. I do not here mean to indicate any nefarious agenda’s that creators of a particular technology impose on the organisation of society, nor do I suggest that people appropriate these systems to fit with how they think of their relationships with others. Rather I point to a complex relationship between society and the technology it creates, that Latour addresses in his approach to sociotechnical systems. An Actor Network approach to Science and Technology Studies (STS) resolves a dichotomy between technological determinism and social constructivism. Those make a distinction between the social world and technology, but each takes one as the unit of analysis in search of what determines social structure and cultural values. Yet each has a different conception of ‘social’ and both conceptions seem to miss weight to fully account for people’s behaviour, i.e. what constrains or induces people’s actions; and in particular, where does morality reside? Latour argues that these missing masses can be found in a re-conceptualisation of ‘the social’ that includes both human and non-human actors (Latour, 1992). To understand the social fabric of society, we must consider how technologies shape and take shape in our everyday lives. Actor Network theory is particularly interesting from an (interaction) design perspective because it brings properties of things and behaviour of people together in design decisions that concern how morality may be delegated and distributed between them in a consistent whole.

Drawing on the work of Latour, Akrich and Ihde, Verbeek investigates this entangled morality in people’s behaviour with technology.

“Designers define users, in terms of their taste, competence, motives, aspirations, and political prejudices. Such definitions then are “inscribed” into the technical contents of the object. Designers anticipate the use people will make of the product they are designing and, because of that, products contain implicit “manuals.” Things co-shape the use that is made of them: they define relations between people, and distribute responsibilities between people and things. Technologies create a framework for action even though it is never certain that they will be used in the way the designers intended.”
(Verbeek & Kockelkoren, 1998, p.34)

Technology embodies ideas and morals of its creators, in their attempt to make technology part of people’s lives. But not only do designers co-shape particular use-acts, the mediating role of technology extends beyond the individual situation, to society.
“When technologies are inherently moral entities, this implies that designers are doing ‘ethics by other means’: they materialize morality. Usually this happens in an implicit way. The question, therefore, is how considerations regarding the mediating role that technology will eventually play in society could be integrated in the design process” (Verbeek, 2006, p.369).

Thus, moral behaviour, observable in the use acts of people with technology (interactions), bring a particular relation between an individual and the masses to expression, i.e. a particular conception of being social. From the perspective of interaction design, this troubles a conception of interactions as use, focussed on utility and instrumental purpose, pointing more in the direction of meaning. In the next chapter ‘Aesthetics of Interaction’, I address the issue of interaction as use in more depth. I stage the work of Latour and Verbeek here to point out that the masses have not really been missing from HCI, as I pose at the start of this chapter, but that they are integral to a technological society. The masses become visible when we re-conceptualise the notion of the social to include both people and artifacts as moral actors, as mediators of socio-cultural values between creators of technology, users of technology and technology itself.

Whereas both Latour and more explicitly Verbeek point out the mediating role of designers, they do not elaborate on what this means for doing design. To this end, though not referring to their work, Forlizzi proposes a methodological approach to interaction design when its focus broadens “from issues surrounding one person interacting with one system to how systems are socially and culturally situated among groups of people” (Forlizzi, 2007). Drawing on social ecology theory, “which is broadly concerned with the dynamic relationship between an individual and the social environment”, she introduces “Product Ecology as a theoretical design framework to describe how products evoke social behaviour (sic)” (ibid). A later iteration of this work extends the framework to Product Service Ecology (Forlizzi, 2012).

Forlizzi was not the first to articulate an approach to the design of digital products (services) that consider social and cultural aspects of use. In the previous chapter I mentioned others, i.e. Suchman and Ehn, that have articulated methodological perspectives on the design of computational artefacts that resonate with ideas of particularly Latour, but that is explicitly in the context of work and rational organizations. Forlizzi targets interaction design for other contexts.

Though Forlizzi’s work is similar to Latour and Verbeek in that it considers the complex interrelations between people and technology and emphasizes the social behaviour of people, there are essential differences. One is that the Product Ecology framework is explicitly product centred as it targets design, whereas Latour and Verbeek look at the mediations between actors, both human and
non-human. Another is that by using the concept of ecology, Forlizzi implicitly seems to import an environmentalist and socialist perspective on evoking social behaviour (particularly visible in the second iteration of her framework), whereas the work of Latour and Verbeek explicitly seek to foreground the ‘hidden’ power, that such normative conceptions exercise.

Thus, the conceptions that underlie the development of technology, frame the basic character of what happens in the socio-technical systems it is part of. Simply put, technology is not neutral, it brings the value systems of their creators to expression. What I bring forward in this inquiry is that, when design engages with systems that are part of everyday life, it has power over what gets hidden and what is revealed in the interactions with those systems. Therefore, interaction designers should be aware of and make explicit what the basic value systems are that infuse the development of socio-technical systems.

Interfacing the crowd
Conceptions of large groups of people, crowds, have entered the attention of HCI in ideas like crowdsourcing. There are many examples of applications and studies that leverage the capacity of groups of distributed individuals to perform large and complex tasks. The online crowd is seen as a resource for e.g. money (Kickstarter), labour (Amazon Mechanical Turk) or knowledge (Wikipedia). (See e.g. (Greenberg, Hui, & Gerber, 2013); (Hara, Le, & Froehlich, 2013); (Savage, 2012); (Lasecki, Murray, White, Miller, & Bigham, 2011); (Roughton, Downs, Plimmer, & Warren, 2011)). The basic structure of interaction is very similar to that predominant in CSCW: a task or target is set and coordinated centrally; a person contributes to the collective effort by means of an individual interface.

In the context of CSCW I have discussed attention to groups of people collaborating, visible in ideas such as Ubiquitous Computing and environments where computational resources, most notably big touch screens, are shared between individuals. Such technologies have found applications in contexts other than the office, e.g. Museums, shop windows or public squares. (See e.g. Hornecker & Stifter, 2006; Brignull & Rogers, 2003; Müller, Exeler, Buzeck, & Krüger, 2009). In these (semi-)public settings, the number of people interacting with a digital system increases, most dramatically in contexts of concerts, sports and such entertainment events. This complicates the ‘unit of interaction’ from a sequence of individuals interacting with a shared interface, to the collective as a unit of study for the design of interfaces with digital systems (Brown, O’Hara, Kindberg & Williams, 2009; Reeves, Sherwood & Brown, 2010). With this complication, the conception of a crowd as a rational, goal oriented entity also becomes troubled, because what happens between people gains relevance.
To illustrate this, consider for example a system such as commercialised by PixMob.com that distributes small light-emitting devices in an audience, effectively turning the members of the audience into pixels of a gigantic screen. The images presented on that screen are part of the light-show that is under central control and does not depend on individual actions. Such a system stages collectivity, but it does not involve people’s individual actions. The effect is similar to that of the mass displays in some Asian countries, where each person in the crowd holds up different coloured shields in a precisely choreographed sequence. Even if in such events members of the crowd are recruited in a slightly more active capacity, it reflects a particular notion of an individual and what makes up a collective.

An approach to actual audience interaction technology emphasises active individuals and is particularly interested in the capacity of large groups of people to self-organise. A seminal experiment of that kind was performed at SIGGRAPH’91 by Loren Carpenter (see Curtis, 2011). Audience members were equipped with small bats with a red and a green side. Using computer vision, different visuals were presented on the screen in front of the audience. One example was a game of pong and the audience spontaneously organised to control the bat on their side. The story is that another visualisation showed each audience member as a pixel, and -after a few tries- the audience managed to self-organise as an active display showing a game of pong.1 Similar work elaborates on the technology used for such crowd-computer interfaces, and mentions some aspects of the social dynamics and experiences in the light of their entertainment value (Maynes-Aminzade, Pausch, Seitz, 2002).

In some research, designers have explored the relationship between performers and their audience, by giving the audience some kind of control over what the performer does (Feldmeier & Paradiso, 2007; J. Freeman & Godfrey, 2010). Expanding the role of a spectator, some work looks at engaging the spectator as a performer (Calvi, 2013; Taylor, Boulanger, Olivier, & Wallace, 2009). Central to that work is the notion of an audience member as a performative entity, a co-creator rather than a consumer of the performance.

Whereas such examples of audience interaction technologies deal with crowds, they are largely interested in the control mechanisms and entertainment value. Though some conceive of the crowd and its members as creative rather than rational entities, they hardly address what constitutes or characterises the dynamics in or experiences of the crowd.

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1. I heard this story 1st hand from a participant Bill Verplank.
When you take part in a crowd, I becomes We; It can be a powerful experience; you feel part of something bigger than yourself. It can be threatening and uplifting at the same time.

In the context of audience participation technology at sports events, Veerasawmy proposes a notion of crowd experience for HCI that explicitly conceptualises the crowd as a non-rational entity. He emphasises behavioural dynamics such as imitation and whimsical behaviour of individuals that drive the emergence of crowd behaviour. Veerasawmy builds on crowd theory in social psychology, that acknowledges behaviour of people in crowds as distinct from behaviours observed in individuals. He establishes ‘the crowd’ as a relevant unit of study for HCI, different from a collection of individual behaviours. Veerasawmy points out that classical thought on crowds, originating in criminology and studies of the riotous crowds of the French Revolution (cf. Tarde, 1962; Le Bon, 2002), has a quite pessimistic view on crowd behaviour. The basic idea there is that individuals in the crowd give up their individual opinions, values and beliefs and give over to instinct (which is used pejoratively) and align their behaviour with that of the ‘mind of the crowd’. Instead, Veerasawmy builds on more recent iterations of suggestive crowd theory that similarly assume mechanisms of de-individualisation, contagion and suggestion, but have a more optimistic view of crowds, visible in positive, festive behaviours. Veerasawmy sees a possibility for HCI to engage with such positive crowd experiences by leveraging the mechanism of contagion and suggestion and by stimulating spontaneous, creative behaviour.

This is relevant in the line of my inquiry as it highlights the difference between approaching crowds in terms of what they do and in terms of what it is like to be part of a crowd.

**Complexity and Emergence**

Social psychology conceives of the crowd as an entity with behaviour that is different from the behaviours of individuals in it. There are various other disciplines that have an interest in understanding emergent behaviours of complex systems as wholes.

An ant or termite can hardly be considered to be intelligent, yet ant- or termite-colonies display baffling behaviours. They build nests that protect the colony from floods or overheating, and they are efficient in foraging and fighting enemies. Similarly, a flock of birds or a school of fish displays behaviour that deters and confuses predators, though there is no central organisation. Large numbers of quite simple nerve cells collectively are capable of understanding these words. I could go on describing systems of interacting elements giving rise to behaviour that is hard to reduce to behaviours of the elements, e.g. electronic or mathematical.
Observing similarities in these phenomena, fields such as Systems Theory, Network Science, Cybernetics, Chaos theory, bring them together in the idea that they all may be understood as a web of interacting elements, i.e. complex systems of agents. They hold that systemic behaviour can be studied and modelled in ways independent from the type of medium (ants, fish, fungi, electronic circuits, chemical compounds) it occurs in, offering a unifying ground for the sciences. Indeed, this perspective feeds back into many -if not all- originating academic disciplines. A striking implication of this perspective is that, whether observing the growth of a fungus or studying the development of a railway network, the global behaviour follows similar patterns, regardless of the intelligence or self-awareness of the agents. Rather, it seems it is the structure and nature of the interactions between them that gives rise to such similarity in emerging patterns.

Building on these perspectives, computational social science uses the power of computers to analyse social phenomena such as the spread of infectious disease, social media memes, health-behaviour or wealth (Christakis et al., 2008; Fowler, Christakis, Fowler, & Christakis, 2008; Lazer et al., 2009; Nishi, Shirado, Rand, & Christakis, 2015). It builds on network theory, that deals with the structure of complex systems, but it is particularly interested in the structure of social ties between people, how they evolve over time and how that relates to the flows in those networks. This discipline takes a large-scale perspective on social behaviour to analyse the emergent behaviour of social networks. It works with network graphs and plots and talks about social networks in terms of e.g. nodes (people) and edges (social ties) and degrees of separation, contagion and influence. A central finding in this work is that our individual behaviour is a function of the influences of our social ties, which questions ideas of individuality and free choice.

“Embedded in social networks (...) we necessarily lose some of our individuality.” (Christakis & Fowler, 2009, p.305)

Some argue that such understanding is an important component to tackle systemic issues in society.

“Like an awakening child, the human super-organism is becoming self aware (...)” (Christakis & Fowler, 2009, p.305)

Whereas awareness of these influences is enormously valuable to contain outbreaks of infectious disease and to curb the spread of lifestyle disease, we are currently experiencing a rude awakening to the power that mediating systems we use exercise in our everyday social life.

Our everyday life with digital systems, in particular social media, generates enormous amounts of data. Owners of these systems sell or make use of this data to
provide targeted advertising services that sustain their business models. Clearly there is a tension between a conception of social media as connecting people, and a conception of social media as a targeted advertising platform; it is a tension between designing these systems to serve people’s social needs, and to serve people up as marketing or propaganda targets. To be sure, there are common interests in these different perspectives, but we are only beginning to see the consequences of the design decisions that negotiate the tensions between them.

It is in a social mediums commercial interest that people spend as much time on their platform as possible. Psychometrics provides, for example, insight in how people’s (online) behaviour influences others. A particular controversial case examined emotional contagion on the social media platform Facebook (Kramer, Guillo, & Hancock, 2014). Its goal was to determine the extent to which a Facebook post with positive emotional content would cause ‘friends’ to also post positive emotional content (and the same with negative). In a large-scale experiment over half a million unwitting Facebook users were exposed to feeds of their friends’ posts, that were altered for more positive or more negative emotional content. A small contagion effect was found. This research is controversial from a research ethics point of view, but more publicly so because it revealed the ‘manipulation’ what people can see of their online social context by social media platforms such as Facebook.

Some research has shown that teenagers that spend a lot of time on social media platforms rather than with people ‘away from keyboard’, are generally less socially oriented and less happy (Gentile, Twenge, Freeman, & Campbell, 2012; Przybylski & Weinstein, 2016; Twenge, 2013). What causes such effects in individual well-being is not clear. Whether it is the physical setting of a person alone with a device, or the influence of curated content, both or something else, these are obviously matters of concern for interaction design.

More recently it has come to light that targeted advertising services built on psychometric insights can also be appropriated for political purposes and may have played decisive roles in swinging elections or seeding ethnic segregation (cf. Graham-Harrison, Cadwalladr & Osborne, 2018; Hogan & Safi, 2018).

Clearly, the structure and nature of the interactions that current social media have crafted for particular purposes, have an influence on our individual and collective behaviours. Some of the consequences were intentional, but there seem to be unintentional consequences we are only beginning to wake up to. I would argue that what is coming to expression in these consequences, reflects some of the basic values and narratives that underlie their development.

**Summary**

In this chapter I point to Actor Network Theory for two aspects that seem relevant to my research. First, it offers a non-hierarchical, reciprocal perspective on the relation between society and technology, instead of a view of technology as neutral and passive. Second, it thus points to a distributed morality that is mediated by all actors in the network, human and non-human, creators and users. Where ANT yields a way of thinking about the global and the local at the same time, Verbeek provides theoretical handles on this entangled morality for interaction design, focussing on what goes on between designer, user and technology. Of particular interest for my work is that his phenomenologically inspired mediation theory complicates notions of ‘use’ in interaction design as merely referring to instrumental task performance, which I also address in the next chapter.

I have presented different conceptions of the crowd in HCI and interaction design. On the one hand, I have pointed out a notion that emphasises the crowd as an intentional, rational entity, mostly dominant in online contexts. On the other hand, we have seen perspectives that look at non-rational, spontaneous and creative behaviours, particularly in settings such as sports stadiums. This also staged how those complementary perspectives draw on notions of the crowd in social psychology.

In my work this is relevant as these two perspectives highlight the difference between conceiving of crowds in terms of what they *do* or in terms of what it is *like* to be part of a crowd.

I have brought images of large scale behaviours in nature to mind, and how they have been interpreted to form a basis for analytical perspectives on emergent behaviour. Of interest for my work is that such perspectives are applied to not only study but also influence the behaviour of people in online social interaction. Particularly relevant is that this is currently quite hidden and done largely for the benefit of the business-models of social media that conceive of people and social interaction as a commodity, or commodity generating labour force. We are beginning to see the effects of such conceptions on society, both in the micro, in people’s wellbeing, and in the macro, in the health of our political and societal structures. That brings ideas in this chapter full circle.
As a whole this chapter is meant to illustrate a kind of circularity: the way we tell stories about what the world is, brings our ideas of that world into being. At the same time this chapter serves to articulate where I see opportunities to tell different stories, which is the object of this thesis. I see opportunity in opening up for other basic narratives of what being social is and, connected, I see opportunity in exploring the nature and structure of the social interactions that the technologies we use enable. My perspective on people’s social presence is inspired by images of flocks of birds, and waves in stadiums. Rather than concealing influences of our mediated social interactions on our behaviour, I am interested in bringing our individual role in large scale dynamics to expression in our mediated social interactions. This resonates with a conception of a crowd that is both intentional and spontaneous and a conception of technology as integral and active in what can come to expression in techno-social systems, in mediated social interactions.
Aesthetics of Interaction

Earlier I began to sketch an outline of what an aesthetic of being together might look like, referring to the practical (and somewhat problematic) way industrial design practice works with ideas of an aesthetic, in contrast to what Aesthetics in general may be from a more analytical, theoretical perspective. With attention to particular aspects of designing of industrial products, interaction design treats the idea of an aesthetic in much the same way. Various conceptions of an aesthetic exist concurrently in the context of interacting with computational things. The aesthetic of being together that I look for in this thesis is of a similarly particular kind.

In the previous chapters I have outlined discourse in HCI and interaction design in parallel, emphasising ideas that I take on board or depart from in my exploration of designing technologically mediated social experiences.

In this chapter I expand on the particular notions of an aesthetic of interaction that those ideas imply or articulate. This serves to then project a more precise image of what my proposition of an aesthetic of being together may be, and how that orients my design experiments towards bringing the many to expression in individual interactions with computational things.

First, I point out that ideas of efficiency, consistency and understandability that drove particularly earlier developments of the relationship between people and computing systems, from a design perspective are a matter of aesthetics. Here, logics of expression are implied in the cultural narratives staged in the chapter ‘From Personal Computer to Social Media’ and, not surprisingly, those are very similar to the modernist aesthetics of industrial design (of that time) rooted in similar, if not the same, rationalist perspectives on people and society in general and usability in particular. Such perspectives orient design in general, and interaction design in particular, on what things are for rather than what things are like.

Second, I argue that a shift to experience rather than task performance seeks to alleviate a dominance of reason, but does it in a framing of interaction that is (still) rooted in instrumental purpose. This leads to quite explicit propositions for specific aesthetics, some that aim the same modernist aesthetics at a wider context (social and physical), some that in response target less rational aspects of the experience. Both are articulated around ideas of embodied presence and begin to expand logics of expression from metaphors to direct experience and active perception (rooted in phenomenology and pragmatism). Most strikingly in the latter, is that the idea of interaction referring to instrumental use begins to be pushed beyond its comfort zone.
Third, I unpack the movements seen in the second argument to expose fundamental conceptual tensions in interaction design practice, i.e. use vs presence and form vs what aesthetics refers to.

In the chapter after this one, I use concepts developed in this chapter to begin to reassemble and project an image of what an aesthetic of being together could be that provides a basis for my generative activities in this inquiry, i.e. my design experiments.

**Using Digital Tools**

**Aesthetic Absence**

In Human Computer Interaction aesthetics is largely an absent issue, at least initially. As we have seen in the previous chapters the main concerns are that interfaces are understandable, consistent and coherent. These are somehow cognitive criteria for efficiency. From a design point of view, they are a matter of aesthetics.1

The actual appearance of a desktop computer, i.e. structure (screen, keyboard, mouse) and physical form, materials and colours, is not a necessary, logic result from a cognitive perspective. Even if we would consider the basic features to be a series of messages concerning intended actions, the actual form these features are given, involve aesthetic decisions made by design.

Thus, design is most present as formgiving of buttons and shrouds. Decisions about the structure and dynamics of working with these objects, were based on ideas about objective cognitive ergonomics and related usability metrics. Such a logic of expression, an aesthetics of interaction, is framed by one-on-one interactions between a person and a machine, and characterises that relation as the use of a tool for a particular purpose or task.

When computing systems are developed for use by several people to perform shared knowledge tasks, the main concern is to bring people to expression to each other for the tasks they carry out and to provide the means to structure and optimise the collective task performance. Again, from a design perspective the precise form of such individual and social presence is a matter of aesthetics; what is visible is a logic of expression that is framed by the instrumental use of an individual to the rational division of intellectual labour.

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1. Terms such as consistency and coherence typically point to aspects of a whole, which is precisely what an aesthetic tends to refer to. Such implicit references to aesthetic issues are also visible in fields such as mathematics and physics, where theories are often referred to in terms of e.g. their elegance. Apparently, such ‘soft’ aesthetic issues are necessary aspects in these ‘hard’ sciences. However, the use of implicit terms conceals aesthetics inside seemingly different concepts.
The Shape of Intellectual Tools

In the chapter ‘From Personal Computer to Social Media’ I have argued that this framing of computing systems as intellectual tools and a focus on efficiency, function and instrumental use, are an exponent of a particular cultural narrative and ambition, i.e. rationalist and individualist perspective on society and the role of computing systems in transforming it.

The modernist tradition in industrial design is based on a similar social agenda and articulates that orientation in very similar conceptions of aesthetics. Fleischmann, while a student at the Bauhaus, writes:

Economy of living must first be economy of labour. Every door-handle must require a minimum of energy to operate it. The traditional style of living is an exhausted machine which enslaves the woman to the house. Today the woman is the victim of a false style of living. It is obvious that a complete change is urgently required. New objects (the car, aeroplane, telephone) are designed above all for ease of use and maximum efficiency. Today they perform their function well. Other objects in use for centuries (the house, table, chair) were once good, but now no longer fully do their job. (Fleischmann, 1998)

As Redström (Redström, 2006) points out, “Not only does this clearly state an ambition of social transformation, it also states the idea of liberation through efficiency, an idea still present in the rhetoric of usability (as is the example of the door-handle (cf. Norman, 1990 [sic])).”

As I discussed in the chapter ‘Aesthetics in Design Practice’ this focus on efficiency places expression of function at the centre of what determines the form of products. This is evident in, for example, the conception of aesthetics that Monö developed, that has to do with adequate form languages to express intended use. What stands out in such a conception of what the design of a product is about, is that it sees a product as an instrument or tool, and its design as striving to an unambiguous invitation to act in a particular way for a particular purpose. This invitation targets a single user, thus framing use as individual and pragmatic, which I think is echoed in the logics of expression visible in computer supported collaborative work outlined above.

The design of everyday things, such as door handles, hammers or chairs, obviously is different from design that works with computational things as its material. Most evident is that what can be done with computational things (and what they are for) is somehow less tangible, or at least there is a larger gap between material form and intended acts, for design to bridge.
A logic of expression that builds on our immediate physical and cognitive skills to read intended use, i.e. a button invites pushing and a doorknob affords turning and pulling, maybe works well for such straightforward functions. When applied to computational things, we see that such invitations to act begin to rely on quite cognitive metaphors and learnable mental models of interaction sequences to perform rational tasks, which stretches the idea of usability as immediately understandable.2

Thus, an aesthetics of interaction implicit in the early developments of working with computers, focusses on efficiency and communicating intended use, casting aesthetic issues in terms of consistency and coherence from a cognitive perspective. This orients designing computational things towards what they are thought to be for, i.e. tools for performing knowledge work. Yet there seem to be tensions building both in regard to communicating intended use alone and to the very idea of use as relating to individually oriented task performance.

The Experience of Using Digital Systems

Embodied Interaction

In the chapter ‘The Missing Body’ I outline how a changing perspective on how people perceive and act in the world leads to a more experience oriented approach in the development of the relation between people and computing systems, expanding from a rationalist focus on getting work done.

There I staged two trajectories in the development of interaction design that are most evident in the context of HCI and CSCW. Visible in both trajectories are a concern for aesthetic issues in designing interactions (in the basic question of usability), but they are often addressed through concepts that somehow frame an aesthetic of interaction as an instrumental means to an end, much like the articulations of modernist aesthetics in industrial design in general.

One, more engineering oriented, trajectory searches for better metaphors to couple people and machines. The notion of tangible computing builds on ideas such as affordances and human bodily skills of perceiving and acting in the physical world to express intended use. Such ideas are articulated in interfaces that address more than the visual senses alone and that not necessarily require focal attention. Ambient interaction and calm computing clearly are aesthetic concepts for the experience of interacting with computing systems, yet they are applied to

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2. If we look at these intents and qualities of interactions you can see the connection to why a concept such as affordances find traction, as it allows to redress that aesthetic issue to something that looks like psychological theory. From a design point of view this effectively hides aesthetic issues in other concepts.
send messages of instrumental purpose. Similarly, attention to human perceptual-motor skills clearly touches on aesthetics in the sense of dealing with perception (and action), yet such modalities are often put to work as quite rationalistic communication and control channels. Thus this trajectory is largely concerned with aesthetic issues in terms of how function is expressed or how intended use is brought to our senses, but it hardly addresses what comes to expression in the interaction, other than an instrumental purpose of a computing system oriented to intellectual task performance.

The other trajectory addresses social aspects of doing work together with others using digital systems. One approach to this, targets methodologies of design and development, bringing in ethnographic and participatory perspectives on the development of the work situation. This shifts attention in the design of interactions with computing artifacts from providing technical controls to composing functional roles of people and things. An orientation towards relationships between people and technology and how that characterises the work situation in an organisational sense, actually deals with aesthetic issues in terms of the (overall) experience of working together, yet it hardly addresses matters of physical form of interacting with digital systems. Another approach to addressing social aspects of interacting with digital systems has more concern for formgiving aspects of interacting with others. Similar to (and to some extent part of) the tangibility trajectory, the work on supporting awareness of others explores ways of representing or expressing availability of other people. Notions such as intimate, abstract and minimal presence quite obviously refer to aesthetic matters in terms of the intended experience of the presence of others, not necessarily as task performing entities. Yet such notions seem to reflect rational metrics of efficiency.

Clearly, these trajectories address experiential aspects of the relation between people and interactive systems. The way such aspects are brought to expression in the work shows a concern for aesthetic issues, though that remains largely implicit in the concepts that guide the design of interactions (e.g. ambient, tangible, intimate). Moreover, each trajectory articulates a different perspective on what constitutes an experience (physically or socially rooted) and how that relates to the basic issue of usability in interaction design. This basic question underlies much of the more recent and current discourse in both interaction design and HCI, while the two trajectories remain quite visible as the field of interaction design has moved beyond work context into everyday lives.
Theorising Experiences in HCI

In a previous chapter I pointed to the work of Dourish (Dourish, 2001) that brings the tangible and social trajectories together in the notion of embodiment, building on phenomenological perspectives on human existence in continental aesthetics. Embodied presence thus is a concept that refers to aesthetic experiences, in which embodied beings encounter the world directly rather than abstractly.

The book ‘Technology as experience’ (McCarthy & Wright, 2004) draws on American pragmatist philosophy, particularly Dewey’s “Art as Experience”, that has many parallels with continental phenomenological philosophy, but is particularly interested in what constitutes an experience. McCarthy and Wright develop the notion of aesthetic experiences in the context of HCI to shift its focus from functionality to the felt experience of interacting with computers.

Rogers (Rogers, 2005) summarises theoretical foundations in HCI and interaction design, that to some extent runs parallel with Dourish’ observations and points out a shift to more experiential approaches, but generally emphasises a cognitivist, symbolic interaction perspective imported from psychology and cognitive science contexts, that targets usability in terms of efficiency.

Bødker (Bødker, 2006) embraces a much broader spectrum of theoretical approaches in HCI. This work coins the idea that 1st wave HCI looked at individual HCI settings at work, 2nd wave at group settings at work, and 3rd wave at contexts beyond work. Bødker points out that 2nd wave perspectives, of which Rogers’ work can be considered an articulation and synopsis, can only meet with part of the challenges of the 3rd wave. Whereas 2nd wave deals with known use-practices, 3rd wave targets use-practices defined by felt-life experiences rather than by task performance alone.

Thus, we see a concern for experiences, but also confusion as to what an experience is, or more precisely, what it means for interaction design to target experiences. That these things, embodied experiences, as pertaining to the coupling of people and machines in a narrow sense, and in a more general sense as pertaining to how the (work) interaction as a situation develops, are a matter of aesthetics is brought to attention explicitly in some HCI discourse.

The papers submitted to the nordiCHI 2004 workshop on Aesthetics include a range of perspectives on what the notion of aesthetics may mean in the context of HCI. Some start from an object or artifact focus and expand towards the experience of interaction in such narrow sense, others start from the overall experience and point to how that includes such an analytical object focus. Generally, these perspectives denote a shift in interaction design oriented to functionality to what happens in use.
According to Graves-Petterson et al. (Petersen, Iversen, Krogh, & Ludvigsen, 2004) aesthetic interaction should be approached from a pragmatist perspective rather than an analytical. These authors characterise work that responds to particularly the tangibility trajectory as an analytical approach to aesthetics, that focusses on the sensory appearance of things. In contrast, they propose to build on pragmatic aesthetics as developed by Shusterman referring to Dewey. They argue that “a pragmatist approach to the aesthetics of interactive systems implies that aesthetics is tightly connected to context, use and instrumentality.” Furthermore they propose that their conception of “aesthetic interaction aims for creating involvement, experience, surprise and serendipity in interaction when using interactive systems...” “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” (ibid.).

Building on a model proposed by Bødker at al., this leads to proposing aesthetic experience as the fifth element of interaction design that has intrigue and engagement as its ideal, in addition to: a systems perspective that has efficiency as an ideal, a tool perspective that has transparency as an ideal, a dialogue perspective that has human dialog as ideal and a mediation perspective that has communication as its ideal.

What seems to be rather unresolved is how aesthetic experience, as pertaining to fleeting, qualitative and emotional aspects of interaction, are closely connected to more instrumental, cognitive aspects of designing interaction. Thus aesthetics is positioned as integral to the basic question of usability; In Norman’s terms “Attractive things work better” (Norman, 2002a). Whereas the intent is to expand the notion of usability to include aesthetic concerns, at the same time it seems to induce a normative framing of aesthetics in what is considered to be better: optimizing understandability and instrumental use.

Some discourse in HCI addresses such issues of normativity in underlying conceptions in designing interactions, e.g. by expanding the criteria of evaluation (Sengers, 2016), or by incorporating approaches from interaction design in HCI (Boehner, Sengers, & Warner, 2008).

**Designing Qualities of Interaction**

In contrast to what can be seen as a lingering cognitivism that often hinges on metaphors and a rationalist notion of affordances in some of the work that extends the tangibility trajectory, another approach to the basic issue of usability departs from a framing of aesthetics in concepts such as efficiency and transparency. On a theoretical level, such work is similarly normative when it proposes that other framings of aesthetics should be explored to orient the design of interactive systems towards e.g. fun and beauty.
“[T]he interaction problem should be dealt with on the level of creating a context for experience allowing for rich aesthetics of interaction” (Overbeeke et al., 2002).

Rich interaction draws attention in interaction design to “augmenting fun and beauty” (Djajadiningrat, Overbeeke, Wensveen, 2000). Such work points out that it is not enough that things are tangible to be understandable. The movements that tangible things invite us to, are a matter of aesthetic in terms of the expressivity of the interaction and relates to emotional aspects of the experience of interacting; Rich interaction pays respect to the interplay between human cognitive, perceptual-motor and emotional skills (Djajadiningrat, Matthews & Stienstra, 2007; Djajadiningrat, Overbeeke, Wensveen & Frens, 2004; Frens, 2006).

That work points out the subtle, but fundamental, difference between on the one hand considering aesthetics in service of efficiency and understandability, as I discussed previously, and on the other hand considering an orientation towards such cognitive aspect as essentially an aesthetic matter. Later work in this vein notes that attention to the expressivity of interacting with computational things not only points towards the embodied, emotional experience. Moreover, it influences people’s behaviour in terms of ethics. In particular the work of Ross (Ross, 2008) develops the ideas of rich interaction towards the ethical expressivity of interaction with digital products.

“Aesthetic Interaction (1) has practical use next to intrinsic value, (2) has social and ethical dimensions, (3) has satisfying dynamic form, and (4) actively involves people’s bodily, cognitive, emotional and social skills.” (Ross & Wensveen, 2010)

This work provides a solid foundation for and practical articulation of embodied approaches to designing interactive products.

Previously I mentioned how discourse in HCI seeks to bridge experiences of interacting with digital systems in a narrow sense and experiences of the interaction situation in a broader sense from a theoretical perspective. From the interaction design perspective discussed here, the issue is how to approach this practically: how do quite physical interaction attributes of digital systems relate to the emerging experience?

Approaching this question, Lenz et al. differentiate conceptual levels targeted by interaction design, i.e. what, how and why. The What-level refers to the instrumental functionality of an artifact, the action to be performed with it, the Why-level refers to the kind of experience intended to elicit, what makes use meaningful to people, and the how-level refers to interaction attributes of the artifact, which is the level of the sonsomotoric (Lenz, Diefenbach & Hassenzahl, 2013). They go
on to develop what they call an “Interaction Vocabulary” that seeks to bridge the How- and the Why levels.

What stands out in much of the work on aesthetics in interaction design is that the interaction situation is often framed in particular use practices and products, i.e. a lamp, an alarm clock, a coffee maker. This brings matters of aesthetics to the forefront that come to expression in the interaction between a person and a product in a relatively narrow sense.

Not targeting particular products or use practices upfront, Trotto explores ways to infuse the design process as well as its outcomes with ethical perspectives, positioning ethics as a basic skill in design practice (Trotto, 2012). The Rights Through Making approach developed in that work starts from a drive to embody basic human rights and aims to develop use practices and relating products.

**Aesthetics, Use and Presence**

**Aesthetic Experiences**

Clearly, an orientation to experiences rather than functionality alone surfaces the notion of aesthetics in various ways that lead to quite fundamental issues in interaction design.

I presented work that seems to hide aesthetic matters in other concepts. This effectively avoids a fundamental question of the relation of aesthetic matters with functionality and intended use, though it does expand those notions to include experiential aspects. When aesthetics is explicitly addressed, in particular in the context of HCI, it is largely concerned with a more theoretical question of the nature of experiences. Such treatment of the matter is closer to the study of aesthetic experiences than the practice of doing interaction design and somehow that discussion generally continues to be staged as one concerning usability in terms of instrumental use (cf. Cila, Smit, Giaccardi & Kröse, 2017; Lenz, Diefenbach, & Hassenzahl, 2014; Nygaard Folkman, 2015).

While concerned with fundamental theoretical issues of the nature of experiences, the work that addresses aesthetics of interaction in the context of interaction design, regards aesthetics in a more practical sense. It seeks to bridge quite material attributes of the interactive artifact to qualities of experiences of interacting with digital systems. Furthermore, it emphasises emotional and social (ethical) aspects that come to expression in interaction. This explicitly pushes the boundaries of what should be considered when dealing with usability in interaction design, yet it somehow acts within a framing of interaction tied to particular instrumentally oriented use practices. Thus, it begins to push the notion of use outside its instrumental comfort zone, and begins to address that framing of usability itself. Yet that is not its focus.
**Aesthetics of Use**

Design practices such as critical design, speculative design and design fiction, explicitly address notions of function and thus a fixation with usability in terms of instrumentality (Dunne & Gaver, 1997; Gaver, Beaver & Benford, 2003).

Dunne talks about the parafunctionality of artifacts referring to their poetic aspects that invite to imagine possible use and use contexts. Instead of framing aesthetics in existing use practices, this opens up interaction design towards how artifacts become meaningful to people. (Dunne, 1999) Thus an orientation towards instrumentality itself should be seen as a normative framing of aesthetics of interaction. A notion of Aesthetics of *use* incites the possibility of concurrent orientations in design, similar to how there are different genre’s in film making, e.g. design noir (Dunne & Raby, 2001).

Some work in this vein presents the resulting artifacts in gallery context and emphasises their open-ended and questioning nature, e.g. (Dunne & Raby, 2013). Other work probes into how interpretations and experiences with such artifacts develop over time, e.g. (Gaver et al., 2010; 2013; 2004).

Along similar lines more recent work in HCI explores that field as critical practices and addresses a fixation with instrumental functionality, e.g. re-orienting towards counter-functional things (Pierce & Paulos, 2014), or unintentional interactions (Odom & Wakkary, 2015).

Such work spurs a debate around what computational artifacts do in real life contexts in general and explores orientations for designing human–technology relations other than tool-use in particular. Whereas critical roles of artifacts certainly serve to question the place of computational artifacts in people’s lives and provide examples of how things could be different, it hardly addresses fundamental conceptual issues in practicing design that are of relevance to my inquiry.

**Aesthetics of Presence**

Previously I staged how an orientation towards experiences expands the idea of usability beyond merely referring to instrumental function. This led to questions regarding the notion of function as referring to intended use. As designing generally refers to determining the appearance of things, this causes uncertainty in what guides formgiving and thus what form is when targeting experiences. Quite central to the growing instability in such concepts as use, function and form is also the question of what a notion of aesthetics refers to.

A shift in interaction design from functionality to experience, is a shift from object to user (Redström, 2006). As we have seen above, if designers think of use and the user in terms of acts to be performed, this somehow imports a framing of designing
as dealing with bringing acts to expression in terms of instrumental purpose, tool use. Even if the designer is concerned with the pleasure of using a particular artifact, or the ethical expressions of use acts with it, it does not address basic conceptions of what that thing is. There is a fundamental difference between interaction design considering what things are used for and interaction design concerned with what things mean to people, i.e. the existential presence “of a thing based on how we invite and accept it as a part of our lifeworld” (Hallnäs & Redström, 2002).

Designing then is concerned with how objects come to be present in people’s life. Thus, it deals with the expressions of things in terms of how they become meaningful to us, which may very well be for the use that we can put things to, but may also be oriented to other expressions. For interaction design concerned with use and function in an instrumental sense, aesthetics refers to the quite material aspects of the form of a designed artifact that expresses intended use. For interaction design that is oriented towards the existential presence of artifacts in people’s life, aesthetics refers to the very logic of expression that guides the design of interactions to particular expressions of use-acts, and thus the design of an artifact towards a particular kind of presence (cf. Hallnäs & Redström, 2002; Hallnäs & Redström, 2006, p.137-140).
Looking for Aesthetics of Being Together

In this Framing section I seek footholds for my interaction design research into mediated group interaction. I’ve sketched a brief history of the development of relations between people and computing systems, I outlined a shift to experiential rather than Cartesian perspectives on people acting with machines, and I staged some conceptions of techno-social relations. In this chapter I summarise briefly how I see these threads come together to increase the resolution of the notion of an aesthetic of being together that I proposed at the beginning.

Thus, I here call on stage those aspects of the framing section that I most strongly respond to or that seem most useful to begin designing computational artifacts that shape the relation between the many and the one, the collective and the individual, the social and the personal.

I am particularly interested in how such technology brings the many to expression at the point where an individual enters that relation, i.e. the interface or touchpoint. Some would say that current social media do this. I argue they do this in a particular way that reflects a narrow perspective on what being social is about, i.e. individualistic expressions of a person and utilitarian expressions of her social context. This perspective seems to stem from the modernist, techno-deterministic cultural narratives concerning the role of computers in society that permeate much of the development of the relation between people and digital systems.

These narratives are still clearly present in current social media. They also persist in research on human computer interaction and seem to implicitly get imported into interaction design practice. In HCI, a shift to embodied presence, rather than intellectual presence alone, embraces other human capacities than the rational and opens up for experiential and socially oriented approaches to human machine interaction. However, the overall objective remains efficiency of the rational task performance of human-machine systems, visible for example in metrics of usability applied to embodied approaches. Embodied presence thus largely refers to individuals being present to each other as task performing entities. Similarly, groups of people are generally considered for collective presence in terms of task performance.

With the notion of aesthetics of interaction, interaction design seeks to move on from efficiency and such metrics of usability alone, to less quantifiable aspects of using things away from work contexts. However, it remains anchored on individuals performing designed actions. What I see here is that: the unit of interaction is *individuals at the touchpoint*; the objective of interaction is *performing an instrumental*
action; and aesthetics of interaction refers to *the experience of performing that action*. What I take on board are ways to address poetical, experiential and emotional aspects of interacting with digital systems. Even if the scope seems to be an individual with an artifact, particularly relevant to my inquiry is when conceptions of aesthetics of interaction begin to include social and ethical expressions of using things.

With a scope of what happens between people with digital systems, useful for my quest seems interaction design that probes embodied, intimate presence and pushes the utilitarian focus further towards what interaction between people with digital systems is *like*, rather than what it is *for*. Of particular interest for my work is how a mutual sense of embodied presence between two people can be brought to expression.

What stands out is that such a mutual sense of embodied presence in and of mediated *groups* of people has received little attention in interaction design, other than for performing joint tasks. This is particularly problematic considering an entangled relation between people, society and technology. Technology is not neutral. It is designed by people and the design of technologies brings their ideas about what it means to be social to expression, offering the possibility for some kinds of interactions while inhibiting others. In turn, this shapes how individuals can conceive of themselves, the social contexts they are part of and the role of technology in that. There is a kind of circularity here that currently seems to be locked into perspectives that emphasise rational, individualistic and utilitarian conceptions of people and society.

In this thesis, I explore what it means for design to give shape to mediated interactions between groups of people, not necessarily for a particular purpose other than a mutual sense of being together. Clearly this is an orientation towards experiences, thus I have turned to design research that explicitly works with notions of aesthetics, to delve deeper into what I can build on for designing things that bring people to expression to each other.

The chapter ‘Aesthetics of Interactions’ sketches a daunting landscape of concepts associated with aesthetics in the context of designing the relationship between people and technology, e.g. use, function, form, expression and presence. Central to the trouble seems to be that what aesthetics refers to is quite unresolved, particularly when design engages with mediated interactions between people. In my experiments I build on some of the features of the current discursive landscape concerning aesthetics. Later in this book I discuss how this leads to a clearer image of other features needed for design to approach interactions between people with technology. I presented work that explores how quite physical interaction attributes of digital systems relate to the emerging experiences. That work targets qualities of interaction other than utilitarian. The social experiences of being part of a collective that I look for, seem closer related to such qualities of embodied presence than to task performance. That work has also ventured into ethical aspects of the behaviour of people interacting with digital systems. Ethics in that
work refers particularly to the social and societal implications of how such qualities of interaction shape people’s actions. Thus, it resonates with my concern for social, collective dynamics and experiences, but its scope seems to be limited to individual experiences with an artifact. Furthermore, what the thing designed is considered to be is often somehow anchored in what it is to be used for, framing aesthetics in instrumental conceptions of interaction.

An aesthetic of being together that I look for, similarly targets what comes to expression in the interactions with an artifact. It is different in that I am interested in collective experiences. Promising to my quest seems to be working with interaction attributes and qualities of interaction to shape what comes to expression in use-acts. Yet I am not interested in shaping use-acts with a computational thing per-se, but in how digital systems shape mediated social experiences directly at the point where people enter into interaction with each other.

Clearly a conception of design as shaping expressions in terms of instrumental purpose or utility here is rather forced. Thus, notions of aesthetics that frame interaction in such a way seem less useful. More useful seems to be an orientation of interaction design towards the existential presence of things in people’s life, how things become meaningful to people in the expressions of use-acts. The design situation that this poses is quite troubling, as it destabilises what the thing designed is in the first place; it shifts the conception of what a thing is from the designer to the person accepting the thing as part of her life.

An aesthetics of being together is similar to the notion of aesthetics as a logic of expression in terms of existential presence. However, my design inquiry is not only concerned with the presence of the artifact, it also concerns social presence with many other people in the context of such a mediating artifact.

Thus, a proposition of an aesthetics of being together that orients design towards the kinds of social experiences that mediating systems may offer, concerns what comes to expression in interacting with the artifact both in terms of the presence of the digital system itself and the presence of others interacting with the system. Clearly the two are intertwined.

In this thesis, I begin to unravel this entanglement by designing systems that establish some form of interaction between an individual and many others. What I seek are elements that characterise an aesthetic of being together as a logic of expression. Such elements would be quite structural mechanisms that bring particular experiences of being together with others to expression. I think of them as similar to the quite material interaction attributes related to particular qualities of interacting with digital artifacts; rather than targeting presence of and with the artifact itself, they would also relate to the presence of and with many others.
Practice
This inquiry is concerned with how design engages with the kinds of relationships that are established between people by means of digital technologies, and more specifically with experiences of being together with many others through such electronic media. My concern for collective experiences clearly aligns with work that deals with notions of aesthetics in interaction design, in that I also look for footholds for designing interactions oriented to what things are like rather than what they are for in a rational utilitarian sense. That work looks at what comes to expression in the interactions between people and technology at the point where they enter into a relationship, i.e. the interface or touchpoint. A promising starting point for my research therefore is to explore how groups come to expression at that touchpoint and in particular to try and work with embodied presence in and of collectives.

In this section, Practice, I present the unfolding of my inquiry by means of a series of experimental designs.

In the chapter ‘Methodology’ I present the genealogy of my way of working, found in Research through Design and in particular in a programmatic approach to constructive design research practice. Based on a brief summary of the trajectory of my work, I here provide an account in hindsight of how the articulation of the intents of my work and their expression in design examples co-evolved. This exposes the need for a different foundation for this work than current conceptions in interaction design provide. Central to my way of working is the design and construction of interactive systems that bring an individual in contact with several others. What I struggled with is how to navigate my research as it unfolded. I had trouble finding support structures in constructive design research discourse to guide my explorative designing, to evaluate my design experiments and to articulate the kinds of insights gained.

This leads to a more general discussion of issues in this form of research that relate to its academic standing, the kinds of knowledge produced and, most saliently, how that happens. It highlights the entangled relation between the things I have done and the insights gained from it, which resonates with ideas around programmatic research practice.

The chapter ‘Experiments’ contains five experimental design projects that respond to the evolving research program of this thesis. For each, I present the initial ideas that seeded it, what was built and how that developed ideas and their expressions. I also report on outcomes of each and reflect what the insight they provide.

My constructive design research experiments, as a series, form a basis for the discussion in the next section of this thesis. There I elaborate what the series of experiments points to rather than gives evidence for, to increase the resolution of the notion of an aesthetics of being together that this thesis proposes.
Methodology

This project started with general ideas about the experience of being part of a collective. These ideas stem from my fascination with emergent behaviour of groups and the role of individuals in it. They respond to my observation of (and frustration with) a general dominance of reason and individualism in western (capitalist, industrial) society. And they are fed by my personal experience of mutual influences in social contexts in non-rational ways. I projected these ideas on the design of electronic systems that mediate the contact between people.

In this project, I have designed and built things that establish some mediated form of interaction between more than two people. With these experimental designs, I explored what my ideas and fascinations entailed. In this process, I got to better grips with and gained a clearer picture of what my ideas were about in the context of interaction design. Though personally motivated and subjectively driven, my inquiry has led to fundamental questions and issues in interaction design. This is interesting from a methodological point of view.

In this chapter I present how my research has unfolded and place it in the context of discourse on methodology in academic design research.

In ‘Constructive Design Research’ I outline what characterises this particular form of design research and how it relates to more traditional forms of academic research. I sketch the theoretical issues on which much discourse has focussed, to point to its underexposure of methodological structures for conducting this form of research.

In ‘Unfolding of my constructive design research practice’ I present my way of working in the context of a general structure, i.e. a set of concepts, ways of working and objectives, for this form of research developed in Delft/Eindhoven. I aimed this general structure at experiences with digital artifacts that mediate social interaction. This is an account of my struggles in navigating my research as it unfolded. I illustrate this with a preview of the series of design experiments.

In ‘Conceptual circles and programmatic drag’ I revisit the trajectory of my research in hindsight. I use the notions of conceptual circles and research programs to articulate what emerged in the growing tension between my program and experiments. It seems that this tension can be resolved by a reframing of the series of experiments, through which fundamental issues in interaction design (research) can be brought forward.
This chapter as a whole presents this tension from a methodological point of view. I find it difficult to separate the insights gained related to the subject of my research, from the way they got exposed. This is part of the methodological issues in this form of research that I want to point to: the entanglement of what is made and what is learned through making. The general trajectory can be presented to look convergent in hindsight, yet what it converges on, or rather begins to indicate or expose, emerges through a process that itself is navigated by this progressing insight.

In this chapter I emphasise methodological issues of navigating the trajectory of my inquiry. In the next chapter of this section, Experiments, I elaborate on each of the experiments in detail. In the next section of this thesis, I emphasise what the trajectory of the series of experiments points to, i.e. foundational issues in interaction design that deals with mediated social interactions.

**Constructive Design Research**

My way of working resonates with academic research in which approaches from design practice are applied to propel an inquiry and thus produce knowledge. Such approaches go by names such as constructive design research, practice based research or Research through Design.

When we look at some of the early work that began to articulate the ideas of Research through Design in the context of HCI and CSCW, it is quite striking how snug my work fits. In 1997, Strong and Gaver presented a paper in the context of CSCW in which they discuss designs that illustrate a similar contrast as I seek, and for a very similar context.

> “These designs open new space for thinking about technology-mediated sociality. They emphasise the potential for technology to mediate interactions that are indicative rather than explicit, expressive rather than informative, and emotive rather than instrumental. The prototypes indicate that devices might be deployed that focus exclusively on these kinds of interactions” (Strong & Gaver, 1996).

In the same year, Dunne and Gaver articulate more generally what contributions a design centred approach can provide to the field of HCI. They call this Research through Design (RtD) (probably after (Frayling, 1993)) and list its merits in contrast to other HCI research:
“First, it points out the possibilities of emphasising aesthetics as much as practicality or usability. Second, the design attempts to provoke a search for meaning, using evocation rather than explicit communication. Third, it illustrates a design-centred approach grounded through contact with users. Finally, and most fundamentally, it suggests a role for designers in raising deep questions about the meaning of digital media and in suggesting alternatives to our current assumptions” (Dunne & Gaver, 1997).

Relevant to this thesis is that these accounts bring the fundamentally questioning and propositional role that design plays to the forefront. These projects are not about proving that a particular design solves a problem better or is more efficient in use; the designs articulate a particular way of viewing an existing situation through an artifact that has the potential to change that situation in a specific way. Like Gregory states in 1966, design is concerned with creating what does not-yet-exist, rather than analysing and describing what already exists. As such, design is a practical and actionable way to engage with the complex and ill-defined structure of bringing about change. Design deals particularly well with such “wicked” situations (Buchanan, 1992; Rittel & Webber, 1973). By proposing temporary and finite examples that combine multiple perspectives, design advances an understanding of the situation as well as how it could be changed (cf. Ehn, 1988, p.124). Cross argues this is a way of knowing with values and praxis in its own right (Cross, 2001). In their extensive analysis, Nelson and Stolterman propose design as a mode of inquiry, that is different from more established academic forms of research, i.e. scientific and artistic research. Whereas scientific research concerns what can be considered true and artistic research concerns the ideal, design brings those together in dealing with the real by creating the not-yet-existing (Nelson & Stolterman, 2003, p.38-41).

In design practice this form of inquiry is aimed at the creation of a specific artifact, in design research the application of designerly approaches emphasises the knowledge and insights gained on the level of the practice of designing artifacts. What is unique to design as a mode of inquiry is where this knowledge resides. Frayling, who is mostly attributed with coining the term Research through Design, articulates this well: Research through Design is

“research where the end product is an artifact – where the thinking is, so to speak – embodied in the artefact, where the goal is not primarily communicable knowledge in the sense of verbal communication, but in the sense of visual or iconic communication” (Frayling, 1993).
The discourse on such practice based research, Research through Design or Constructive Design Research has since grown steadily. With a concern for the academic standing of this form of research, much attention is given to describing outcomes of such design research and the kinds of knowledge it may provide, the purposes those may serve and by what yardsticks those results may be evaluated. Such discussions often lead to a focus on the form and format in which the results of design research are presented and disseminated. The difficulty here is that part of the knowledge resides in the artifacts created and cannot easily be abstracted from them, if at all. One way to resolve such epistemological issues is the notion of annotated portfolios that could do some of the work of theory in this form of research. In an annotated portfolio, a series of experimental designs is presented to illustrate and articulate particular family resemblances (Gaver 2012, Bowers 2012). Further addressing the issue of the tension between theory and practice in this form of research, Löwgren proposes that such annotated portfolios are part of a spectrum of ways to articulate the kind of intermediate level knowledge that practice based design research yields; not quite generalised theory fully abstracted from particular design situations, nor applied knowledge local to it (Löwgren, 2013).

Some discourse goes deeper into what design researchers do in order to generate such outcomes. Koskinen et al. outline three successful strategies to - what they call - constructive design research, i.e. Lab, Field and Showroom (Koskinen et al, 2012). This book gives a concrete insight into actual processes followed in these strategies, how knowledge was systematically generated and abstracted in parallel with - and embodied in - artefacts. Similarly, in a much older paper discussing the role of the object in art and design research, methodologies used in three examples of ‘innovative design research’ are discussed in detail (Seago & Dunne, 1999).

Such detailed accounts of the process can be seen as descriptions of exploratory journeys through a landscape of practice based design research. What remains implicit or underexposed in such accounts, are (the reasons for the use of) particular tools/methodologies by which such journeys are navigated, i.e. the support structures and frames of reference that set up and guide the unfolding of the design research trajectory.

The notion of programs in practice based design research, as most notably developed by Redström, provides a handle on particularly the forming and nature of such guiding strategies and framings as can be discerned in e.g. Lab, Field and Showroom (Hallnäs & Redström, 2006; Binder & Redström, 2006). It articulates a way of working that is true to the nature of design practice: contingent, circular, but rather than aiming for a particular design, it aims towards theory forming on basis of the values, logic and praxis of design, rather than other forms of inquiry.
A design (research) program articulates a general intent, proposing a potential design space and a way to investigate it. A program captures the circularity of design practice - where design is always the design of something given, but that given is expressed in the design - and transposes this to design research practice.

A design research program is both a starting point and a frame of reference for design experiments. It is not a static formalised idea of what a particular design expresses, rather it is a fluid conception that mutually informs design experiments that express interpretations of the program and as such are propositions of how to act and what could be found in that design space. The design research program then can be seen as a *provisional knowledge regime* for evaluating an experiment that expresses it. (Binder & Redström, 2006)

Of particular interest is the dynamic between experiments and the program they relate to, between the concrete and the abstract, in approaching the circularity that exists between them. The experiments operate in the real and are inherently never ideal. Evaluation of the experiments in the light of the program, introduces reinterpretation of both. The dialectic (Redström, 2011) or hermeneutic (Löwgren, Svarrer Larsen & Hoby, 2013) relation between experiment and program leads to what some have called *drift* in the research trajectory. Based on an analysis of the trajectories of several practice based design research projects, it has been suggested that different ways of drifting relate to different kinds of research objectives and articulation of related knowledge contributions (Krogh, Markussen & Bang, 2015).

In my inquiry, I struggled with ways in which to evaluate my design research work and how to stake out its trajectory. As my work unfolded, my perspective in and on my activities developed. I did not knowingly or intentionally conduct my research with a programmatic approach, yet in hindsight the notion of design research program serves well to articulate a methodological structure of my research that supports the contributions to interaction design (research) that this thesis ultimately presents. However, the notion of drift does not seem to capture well the kind of tension that built up between my intentions and the general structure of the Delft/Eindhoven approach that I started out from. The basic conception of aesthetics of interaction in that approach, and its underlying conceptions of use and interaction, did not seem to serve well to bring *being together* in focus in my design work. As such, the type of force I experienced in my trajectory is rather one of *drag*, inherent to the basic framing of the research, rather than *drift* that in my view relates more to external forces.

In what follows, I provide an account of how my design research unfolded; first from within the process and then in hindsight. This serves to illustrate how a clearer picture of what can be called its originating research program emerged and what it consists of. In particular, it surfaces basic issues with the framing of
aesthetics of interaction and the way it can be approached, that is assumed in that program. From a methodological perspective, it also surfaces questions regarding the support that the discourse on design research programs currently provides to this form of design research practice.

**Unfolding of my constructive design research practice**

This design research project departs from multiple points that each originate or initiate particular actions and ideas. Indicating a particular moment, thought or action as the beginning of the process of developing ideas and designs, obscures the whole that they form. Similarly, what propels the project is never singular and often remains implicit to some extent. Objectives, intents, ways of working and basic concepts are intimately intertwined. My research has moved on from what initiated it and has yielded insights. As such, it may hold some of the methodological support needed to work with such multiplicity in constructive design research.

The heart of this thesis are five experimental design projects. In each of them systems were created that establish some form of mediated interaction between a group of people (more than two). Each of these projects explore a different perspective on what it means to design such a system, and as such is a kind of snapshot of progressive insight in both approach to and subject matter of my inquiry.

In this chapter I first relate my way of working to an approach to constructive design research developed in the Netherlands in Delft/Eindhoven that here I’ll call DQI for short (Designing Qualities of Interaction); what its characteristics are and what elements I brought into my own way of working. In brief accounts of my exploratory design projects, I present how these elements have influenced my way of working. For each project I discuss my intent, how I evaluated them and what kind of insight it yielded. This preview articulates a tension between insights local to the activity and their role in my understanding of this thesis’ inquiry as a whole. This illustrates a kind of methodological gap between individual design explorations and overall trajectory of my research.

My work concerns interaction design that engages with the experience of being part of a collective formed by technological means. I began to explore the basic tension between an individual and a group building on ideas from the particular DQI form of constructive design research.¹

The general structure of the DQI approach combines design acts (making) with

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¹ Kees Overbeeke and Caroline Hummels were advisors to my Master’s thesis. For much of the first year of this PhD project, I was a guest in the Designing Quality in Interaction group at that time led by Kees Overbeeke in Eindhoven.
Experimental psychology. Experimental designs are developed that articulate specific design variables based on theory, i.e. a philosophical perspective inspired by the phenomenology of perception of Merleau-Ponty and psychological notions from ecological perception theory of J.J. Gibson. In controlled laboratory experiments the relation between such variables and use-experience with e.g. an alarm clock, a camera or a lamp, is evaluated, which then yields frameworks and ‘notions’ aimed at designing for particular qualities of interaction with a ‘smart’ product or system. The focus of that research is on what happens between people and products as they are using it; how interaction develops between people and products at the point where products enter into dynamic relation with people, at the interface or touchpoint.

Aesthetics of interaction as developed in this strategy assumes a basic structure in which quite physical attributes elicit particular qualities of interaction with the product/system. Such attributes are not only static (material and formal properties), they are aspects of the way a product shapes and dynamically responds to the actions of a person using it. More recent examples from this approach examine ethical and social qualities of such aesthetics of interaction, elicited by these physical attributes (Ross, 2008; Ross & Wensveen, 2010).

In my research, I assumed a similar basic structure, extended to the aesthetic experience of interacting with others:

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basic responses of an artefact to a person’s actions  
(interaction attributes)  
<->  
qualities of experience of interacting with artefact  
(aesthetics of interaction)  
<->  
qualities of the experience of others
```

To be sure, this basic structure locates my design exploration at the touchpoint and in the dynamics of interaction there. Below I provide brief accounts of five such explorations.

Though generally configured by similar philosophical concepts, the act of making, and oriented to the touchpoint, the design experiments I worked with were of a different character. Before it may be possible to evaluate how particular interaction attributes relate to particular qualities of the experience of others, I needed to generally explore and get a grip on what qualities of the experience of others may be and what kind of interaction attributes relate to that.
Sliders
As a first probe into the kind of experience of interacting with several others that I was looking for, I built a system that establishes a kind of force feedback between several people. I was not quite sure what this kind of experience would be or what dynamics it would give rise to. To begin to find out I needed to make something that would approach establishing this situation. It seemed that tangible, embodied interaction between several people was a promising inroad to get a grip (quite literally) on what comes up when bringing group dynamics to expression in the one-on-one interactions with a touchpoint.

In designing and making several versions of such a system, I met with issues related to both the conceptual grounds and to the more practical engineering sides of the exploratory design. I built on theory and knowledge from various academic fields that deal with such issues. As partial and fully functional versions of this system became available, I tried them out myself and observed small groups of people trying them out. An issue is how to account for this form of evaluation, particularly in the context of academic research. I experienced this as an explosion of possible directions and an indecision which to take. Each of the disciplines that I drew upon for designing and making the system casts its own perspective on what the design is, and provides its own frame of reference for research and related systems of evaluation; e.g. an engineering perspective implies an approach to research from technical sciences; a sociological perspective implies an approach to research from the social sciences; and so on. Even if such perspectives give valuable insights in certain aspects and possible directions for the study of those, they were not particularly helpful in driving the project towards or evaluating the whole of the kinds of experiences of interacting with others they bring to expression.

In terms of the basic structure that I assumed, I did find indications of some relations between quite physical, structural attributes of the system and their influence on certain dynamics I observed and experiences people reported.

Haptic Intersubjectivity
Much along the lines of the Lab approach, it seemed relevant to pursue a further exploration of how such quite material, tangible attributes of the product/system related to qualities of the experience of interacting with several others through it. Building on work from this same Lab approach that targets the design for particular experiential qualities in interactive products, I performed a design experiment with students from Eindhoven that similarly targets designing for experiential qualities of products/systems that mediate social experiences.

In psychology, social psychology and intercultural studies general and basic models have been proposed to describe and classify relations of affective responses or relations of motivational values. Students were asked to design installations that
would elicit particular motivational values, as qualifiers for the experience of interacting with others. As a kind of formal experiment people were asked to appraise their experience of engaging with the installations, using the theoretical model of motivational values. The data this yielded was inconclusive and I abandoned the results at the time as a failure in that sense. Something in the project’s set-up didn’t work; At the time, I thought that the general, theoretical model of motivational values was too abstract to base design on. In hindsight, reflections of the students indicate also basic issues with the assumed structure (interaction attributes ... qualities of social experience) and its theoretical underpinnings around which the project was constructed. These issues revolve around the question of utility and purpose of interacting or being together with others.

**DiffractMe!**
The DiffractMe! project was set up to explore two aspects that came up in reflection on my activities thus far. A conceptual aspect following from the Slider exploration is the implicit, largely hidden, presence and role of the mediating system. In DiffractMe! I sought to forefront the presence of the system in the interactions between people. A more methodological issue in the Haptic Intersubjectivity project seemed to be that the motivational values as qualifiers for social experiences were rather abstract. For the DiffractMe! project I looked to an approach that starts from designer’s individual subjective skills as a source of concrete, embodied knowledge for design of aesthetic interactions. The resulting interactive installations were placed in public space. I observed people’s engagement with the installation and discussed their experiences. It seemed that qualities of interacting with the system reflected our design intentions, but their effect on the experience of interacting with others in the context of the installation was different than expected. These qualities did not so much shape the experience of interacting with another through the installation, they were experienced as contributing to becoming skilful performers with the installation in front of spectators.

**Mirror**
The experimental designs so far had involved a few people in mediated interactions. The Mirror project was intended to explore the experience of interactions between a large number of people, to approach the notion of crowd or group in the aesthetics of interacting with others. The project was explicitly set up as a more traditional experiment building on methodology from social sciences. The experiment aims to evaluate the relation between individual experiences and differently designed graphical expressions of the dynamics of many people interacting with the system. Live visuals were displayed in front of an audience, reflecting different aggregates of actions of people in that audience. Participants appraised their experiences using semantic differential scales on response cards and semi structured interviews were conducted. Qualitative analysis of that data seems to indicate some possible relations between appraisal and system attributes, but much can be
questioned on the validity of the results. However, reflection on the experiment as a whole yielded the most valuable insight for the subject and nature of my inquiry. Of particular interest is the influence of staging the experiment in the context of an HCI oriented conference on both my design and the perception of participants.

**Blood in the Mobile (Spots & Varramie)**

The Mirror project engaged with an audience, a group of collocated people. In two projects, I explored the design of a mobile phone app that makes it possible to engage large number of spatially distributed people.

The first, Spots, was rather engineering oriented, similar to Sliders, in the sense that I explored basic technical and related conceptual aspects of making a mobile phone app that approaches the kind of experience of interacting with others that I was looking for; it establishes a minimal form of remote-touch between groups of people.

The second, Varramie, was contextualised as a feasibility study for a commercial app. My research interest targeted staging and shaping the perception of a system that mediates interactions between a group of people. This interest aligns with lean-startup approaches to business development but is driven from the more qualitative orientation of participatory design approaches. The basic strategy is to develop the perception of the app alongside the basic functionality and aesthetics of interaction in the app, in collaboration with potential users of the app, which in turn develops the community of users. I conducted exploratory design workshops with potential users and developed online presence, e.g. through current social media, for potential user community engagement. The Varramie project was not brought to full-scale launch and pilot experiment with the prototype, hence I did not evaluate the project as such. Reflecting in and on the project, did shift and expand the scope of my ideas on what my inquiry was about. In particular, it helped articulate that the complexity of design that engages with systems that mediate experiences of others, seems to need a framing of the aesthetics of such interactions well beyond what happens at the touchpoint.

**Logic of my trajectory**

Above I reported on general approaches to each experimental design project and the way I evaluated them at their “finish”. This methodological presentation of each project does not articulate reflections that happened as I was making each exploratory design. Neither does it do justice to the role of context and opportunity in each project. Such influences are significant parts of the logic of moving from one project to the next. However, I here want to draw attention to the overarching trajectory that such a logic is an element of.
The accounts above emphasize the consistent presence of an assumption regarding the basic structure that constitutes aesthetic experiences of interacting with others. At the same time, it surfaces a persistent dissatisfaction with the insights my activities yielded locally to each exploratory project, when brought in relation with the general ideas that initiated and drove my inquiry. In these descriptions, I have also begun to articulate a shifting or expanding scope of my understanding of what those ideas were about.

The tension between the methodological framework that accompanies the theoretical underpinnings of my work, and ultimately the basic subject and nature of my inquiry, may well be the source of my unease and struggle in evaluating and staking out trajectories for my work as it unfolded. At the same time, it seems precisely this tension has led to fundamental questions and issues in interaction design.

**Conceptual Circles and Programmatic Drag**

The accounts above sketch an image of my way of working as it unfolded. With each exploratory design project, I aimed to get a grip on how experiences of being together with others could be brought to expression in (the rather material, physical aspects of) how the product/system responds to a person’s actions at the touchpoint. Thus, I relied on a configuration of concepts, ways of working and objectives quite similar to the one that configures the Lab approach in research through design as developed in the Netherlands. As I progressed, I began to see each experiment as addressing something different from what such a configuration allows. The trajectory as a whole seems to be more about locating and indicating what causes this shifting perspective, in order to articulate a clearer image of what the research addresses.

I started with a set of ideas about the experience of interacting with many others by means of technology. These ideas are quite precise in what they respond to (and how) and in what direction to seek change, i.e. in articulating intentions. At the same time, they are rather informal (also literally without form) and conceptual when it comes to articulating what they mean or may result in from interaction design research perspective. I began to explore such concepts building on theoretical underpinnings and related methodology developed in the Netherlands (Delft/Eindhoven), which basically looks for ways to (consistently) design relations between rather material, physical responses of an artifact to experiential qualities of using it.

My experiments yielded insights that did resonate with my general conception and objective, but did not seem to fit well with the methodological structure I thus implicitly sought to work with; my experiments seemed to fail in terms of identifying or establishing the kind of relations that that approach aims for. My experiments seem to express something else than what could be evaluated from the frame of reference that I assumed.²
Looking at this situation from the perspective of programs in constructive design research, the experiments can be evaluated quite differently. Central to the articulation of the logic of a research program in interaction design, are two basic elements: the what of the design research and the how. The experiments that are set in motion with the program are then part of a process of exploring a design space, not in the sense of identifying and converging on the ideal artifact in it, but in the sense of gaining insight in the kind of artifacts that can be found there in this way. Somehow this articulation of the programmatic structure seems to emphasise the what, at the same time it aims to expose foundational issues in the how, that have to do with the why that remains largely implicit in the how.

In my work the general what concerns experiences of others as offered by interactive media, the how is initially configured by similar conceptions and objectives as developed regarding qualities of interaction in Delft/Eindhoven, though the way I worked is more exploratory than experimental in a classic scientific sense. This has led to a series of experiments that yield insights that indeed begin to question foundational issues of the how and in doing so, shed light on the what.

Generally speaking, my work seems to consist of the same basic elements and to large extent the same structure as the logics of programs that Redström et al. have elaborated. What seems different is the sequentiality of things, or at least in my work the shift to questioning basic aspects of the originating program emerged from the series of experiments, but was not its initial intention.

In some ways, this emerging program seems to be of a different kind than the program that I set out with. The description of the what and how (the program) that initiated my research, somehow is quite focussed and practice oriented, whereas the program that emerges from the series of experiments seems to deal with fundamental and more abstract issues. This seems to be precisely what programmatic design research is geared towards: where the outcomes of the experiments expose issues with the originating program, while at the same time they must be considered to be expressions of what one originally is trying to get at. As such, it resonates with the basic questioning nature of design, which in the context of design research practice, takes the form of questioning the foundations it is built on.

2. I have written about the lack of scaffolding in the available discourse that I experienced at the time (Kuenen & Redström, 2013)
It seems that this dynamic dis-alignment of intent, result and interpretation of the gap between, is what has been called drift. The notion of drift denotes a shift in trajectory in terms of direction under influence of some external force. What I experienced is more like *drag*, which points to more internal aspects of what is supposed to carry the project. At a certain point the dynamic dis-alignment needs to be considered, not for some external factors that push things off course, but for elements of the originating configuration of concepts, ways of working and objectives. This is where that composition itself can be addressed constructively with the insights gained from the tension in the program-experiment dialectics.
In this chapter I present five constructive design research experiments. In all experiments, I seek to bring several people in contact with each other by technological means and I am particularly interested in the qualities of the experience of presence in a group.

I introduce each experiment with the leading ideas or concepts that initiated it and, where relevant, the context in which it took place. In most projects, I elaborate in detail how my constructive design research unfolded, to draw attention to the way things develop, both in physical and conceptual sense. I report what came out of each project, mostly in the form of first hand or reported experiences and observations. I then discuss and reflect on each experiment to summarise what I learned about the initial concepts or the new ones that emerged.

Each project is aimed at exploring ideas and articulating concepts through concrete expressions, i.e. in designs. These design projects are experiments in the sense that I try things out to get to grips with them. These are not experiments in the sense of proving a theory by disproving a hypothesis. They are exploratory experiments to gain insight in what it means to design (a particular kind of) mediated group interactions, gaining insight in how to do that and what things we need to do that; Things in this case are concepts, articulations of concepts in physical form and the materials needed to do that.
The ways we interact with computers, and by their proxy with other people, evolved in contexts of work, understandings of work and the role of computers in that. It has led to forms of expression and representation that are tied to the visual and verbal domain, and sequential turn-taking rhythms of interaction. Social media as we use them today have inherited much of these interaction aesthetics.

I am looking for social experiences that are decidedly different from what current social media offer. Therefore, I am interested in exploring and locating a basis and basic elements for the aesthetics of interacting with others that is a clear departure from what underlies current social media.

Sliders is the first physical probe I built to begin to explore what interacting with several remote others is about. It is a system that establishes a minimal haptic connection between several people. Haptics seemed to be a good place to start for several reasons. Touch is the sense modality in which action (touching) and perception (being touched) obviously coincide. This makes it an interesting counterpart to the turn-taking, the sequential verbal and visual exchanges, that characterise current social media. The reciprocal character of touch basically counteracts sequentiality. Whereas visual and verbal exchanges are often quite symbolic, touch in its directness and reciprocity seems suited to less abstract expressions. Indeed, touch brings strong emotional connotations to social connection.

I sought to explore experiences as direct as a handshake; the handshake as immediate contact and mutual recognition of existence between two people. What can I find when I try to extend such qualities to interacting with many people at the same time? In this experiment, the sense of touch thus features as a basic phenomenological counterpart to the sequential and symbolic character of existing social media. An exploration of possible aesthetics of interacting with others based in touch is not likely to end up in expressions of others that we are already familiar with.

Touch in the context of many also introduces a tension that opens up a space for questions in a particular direction. Touch basically implies two things, something that touches and something that is touched; at the same time one does not go without the other; it is inherently dyadic. My interest was not remote touch for this dyadic aspect. There are myriad research projects that explore touch of various kinds as a modality for remote interaction between two people, (see e.g. Brave & Dahley, 1997; Thieme et al., 2011; Haans & IJsselsteijn, 2005), and they confirm that it is technically possible to establish remote touch in convincingly transparent form. One particularly inspiring project looks into the emotional experience of relating to another through remote touch and exposes minimal conditions for what is called perceptual crossing.
between two people (Lenay, 2010). My interest in touch is its emotional connotations to experiences of mutual presence.

Many of these projects establish remote touch between two people. One-to-one communication is an exceptional situation, at least historically. Even if our constant use of personal computational devices would make you think otherwise, most of the time, we are together with several others, in families, in bars, at work, in the street etc. My interest in touch is for its basic aesthetic possibilities for the expression and experience of being together with several others. The tension between the dyadic aspect of touch in the situation of interactions between several people, sets a direction for the exploration.

In this chapter I report in detail on the process of making Sliders as a system that brings these ideas together. As I have discussed in the ‘Methodology’ chapter, this is to give clear and concrete insight in how dealing with the friction of material realities, induces shifts in the development of both concepts and articulation of those concepts, through the insights that spark-off this friction. It’s these sparks that show possible new directions.

**Building Sliders**

**One slider**

A first issue in building a system for this exploration was to establish a kind of force feedback. Looking for electro-mechanical devices for this, I came across motor-faders used in the sound-mixing tables of a recording studio. They are convenient as they combine a small motor and a linear potentiometer, making it possible to electronically detect the position of the runner and move it by applying power to the motor. The electromotor is quite small as the fader is engineered to simply overcome the friction in the system and move the runner to a desired position at some speed, without the sound engineer touching it. By applying more power than the motor is rated for, the force can be felt quite distinctly when holding the runner, and is in the order of a few Newton, similar to the weight of few eggs.

The next issue was to control the motor-fader so that someone moving the fader can be sensed and pushed back on. I built a circuit using a simple microcontroller (Arduino Uno) and an H-bridge to be able to read the fader position and control power to its motor with software (code). This constitutes a kind of system that is called a servomechanism. The control of such systems is a field of study in itself, i.e. control theory.

When you move a motor-fader, that experience has to do with how the local technology responds to your actions, how the forces exerted feel over time. For example, if the control loop is set to keep the fader in one particular position, how does it feel when you try to push it away from there? I engaged for a long time with how different parts of a control loop influence the precise feel of force feedback. This
is a basic field of study, one could even say a basic material, that interaction design works with, particularly in tangible interaction. It focusses on the expressions, the aesthetics of interaction, between a person and the thing, the touchpoint. Elaborating such aspects is a thesis in itself, but is not the focus in this particular inquiry. What I was trying to build had to do with what happens when we connect multiple of such feedback systems together, expressing multiple slider positions (and movements) in one. Of course, explorations of experiential qualities of control theory in force feedback locally is part of it, but I am interested in the parts that have to do with combining the many in the one.

Two sliders
Once I thought I had some understanding of and control over the feel of the local force feedback, the basic material, I brought a second slider in. The microcontroller and custom hardware I had built allowed to simply connect a second motor-fader. In the software, it was relatively easy to duplicate the basic control loop for the position the second slider.

What I had thought would now be an exploration of how to map the position of one slider to the other and what that feels like, turned out to be much more difficult. I had not foreseen the recursion that would occur when coupling together two system’s responses. One can imagine that when slider A is moved, inertia and delays due to the properties of slider B and its control loop, cause slider B to not immediately reach that position, which than causes forces in slider A, which in turn influence what happens at slider B and so on.

I revisited control theory on another level of complexity and revised the programming and tuning of the control-loops. I gained insight in technical properties related to the quality or feel of the connection between the two sliders, in the sense of elasticity and sponginess of the experienced physical connection between the two sliders. Consultations with an expert in tele-operation machinery indicated that my basic choice of hardware prevented full control over such properties and how to overcome it. I had not yet begun to touch upon aspects of establishing interactions between several people by means of my sliders. Before investing in more advanced hard and software, I decided to take the qualities and limits of my simple sliders for granted as the basic material to work with towards the next step.

Multiple sliders
I was trying to build a set of basic force feedback devices that could be networked and placed at the hands of several people at some distance from each other so that their interactions with each other would only occur through the devices. This meant I had to find a way to make these devices communicate in a network. In networking, there is a basic choice to make between peer-to-peer communication or using a central server that gathers, processes and distributes data between devices. This
seemed to me a rather fundamental aspect on the conceptual side as well. My perspective on what happens between several people was that it is not a central thing, but something distributed, so also in approaching the technological design I tended towards distributed, peer-to-peer solutions. Wanting to establish direct reciprocal connections between the people interacting, delays due to digital communications were an issue. I looked into various networking technologies and protocols that would allow, given the basic hardware chosen, peer to peer communication between all devices with minimal delay. Standard TCP/IP networking protocols typically amount to delays of several hundred milliseconds in the type of hardware I was working with. I was not looking to build a large number of devices; four or five seemed enough to begin to explore the basic feel of being with several others. I settled for a simple turn-taking protocol on a serial bus. Each device would take turns in broadcasting its slider position on this bus and the other devices could then receive all individual data and process it locally. This way the overall system behaviour never exists in one central place but is always something that happens distributed.

As you can see in this partial description of building the sliders, many of the issues related to the technical solutions have counterparts in thinking about what networks of interacting people is about. Network science is a big research field that studies interconnected agents. Computational sociology takes some of these perspectives and looks at the emergent phenomena in groups of people in relation to properties of the network. I looked to these fields of study for basic ideas that could be of use in building my small network of sliders. Some of the basic properties of networks that these fields of study work with are: network topology, i.e. what nodes in a network are connected to what other nodes; inherent to this structure, degrees of separation, i.e. how many steps from node to node it takes to get from any node to another; degrees of propagation, i.e. what is the influence of one node on the next, and onwards. It has to do with the ‘decay’ of influence across several nodes.

My interest was not necessarily the study of such properties in relation to the overall group behaviour. I am interested in the experience that an individual in the group has of being part of that group. While designing (engineering) technology that connects people, what interested me was the individual experiential implications of such network properties. We can analyse the relation of behaviours of individual nodes and how they interact in relation to the overall behaviour, but it is very difficult to predict what overall behaviour change will occur from making local changes. Thinking about local experiences of acting in a group has similar complexities. It would seem that the basic aesthetics of those experience have to do with network properties like topology and propagation. I will come back to this in a later section.

In order to explore the experiential effects of these network properties, in the network of sliders I was building I implemented a few variables to vary the extent to which each slider could be influenced by slider positions broadcast by other sliders.
It seemed with these variables I finally had arrived at one set of basic properties that express several others in an individual slider. It now was possible to change how much of my actions can be felt by others and vice versa. For example, it became possible to give one person’s actions dominance in the forces that other people feel.

In order to be able to easily change these variables, I connected the slider system to a desktop computer. The GUI software I developed not only allowed the setting of these networking variables, it also allowed to display the positions of the sliders on screen and to log sessions of people interacting with the sliders for later analysis.

I extended these virtual slider representations with the possibility to interact with them on screen using a mouse. This way I could add a graphical slider into the network of physical sliders. In a GUI and mouse, it is not possible to exert actual forces back to a person. The force in a physical slider is a function of the distance between the local slider and the other slider positions. In the graphical slider, I displayed the location of this weighted average position of the other sliders. Interacting with this graphical slider resulted in a surprising experience of what can only be described as force between the position of the cursor on the screen and the graphical representation of the ‘system’ position. Here I stumbled upon the phenomenon of optically stimulated haptic feedback (Mensvoort, Hermes & Montfort, 2008).

**Force Mode and Position Mode**

The system of sliders I had developed so far expresses (represents) the group as the force exerted by a local slider directed at a weighted average position of the other sliders. In a way, what I had built can be seen as virtual tug-of war. I call this mode of expression the Force Mode.

I also developed another way to express (the actions of) others in a local slider that I called the Position Mode. In this mode, remote sliders’ positions are expressed as entities that can be met in the one-dimensional space of local slider: the position of each remote slider can be felt as a localised attraction (dimple) or repulsion (bump) when moving a local slider back and forth. In this Position Mode, the variables that control the expression of remote sliders in a local slider were slightly different from the Force Mode. Such basic qualities of expressing others were: Whether a remote slider is represented or not; whether a remote slider is expressed as a bump or dimple; the width of a bump/dimple (length over which influence is felt) and its height/depth (maximum force). I did not implement variables for the shape of the bump (the way force changes along the width of the bump/dimple) because of the limited resolution of the technology I used.

When implementing these variables, I noticed and interesting aspect of the width of a dimple. There are two sides to this, the width of representation of a remote slider and the ‘sensing’ width of the local slider. This meant that there could be a difference
between my local sensing width and the width of the representation of my slider in a remote slider; and that could also be different in different remote sliders. I will come back to this briefly in the discussion of this experiment.

**Results**

The obvious results of this experiment are the hard and software that I built as described in the Technology and Appearance box-insets in this chapter. Here I elaborate on outcomes of this experiment from a more conceptual perspective. First I discuss individual experiential qualities of force feedback. Second I discuss such qualities in the light of the experience of being present with someone. Thirdly I discuss the experiences and observations of several people interacting with the Slider system.

**Basic qualities of local force feedback**

Throughout building sliders my own and other’s experiences of interacting with sliders helped steer the development. In earlier stages, such experiments regarded the experiential qualities of the forces exerted. I experimented often and informally: I made a little change, tried it out, made another change, tried it out. When people dropped by my desk, they would try it out and we would discuss what they felt and I would let them feel different modes and qualities of the system. As the development progressed the experiments involved more than one person, first two people and then several people. Including the virtual slider, up to five people could be involved.

When describing the building process, I gave the example of pushing on a slider of which the control loop is set to hold that position. When you push lightly on the slider, there is a little play in it, you can move it a few millimetres back and forth with little effort. When you push a little harder, the slider moves a little and the harder you push it, the harder it pushes back. It feels a bit like stretching an elastic band, but there is some graininess in the step-wise build-up of force. When you push harder and so move the slider further away, the push-back reaches a maximum and the grainy feeling disappears. It feels like lifting a weight on an elastic band that reaches its maximum stretch, though in this case moving fast or slow does not change the push you feel noticeably. When you let go of the slider, it shoots back to its set position.

The maximum force that the system can exert is limited by the hardware chosen. Within that range, how the force builds up against your push to move the slider can be changed to some extent. Such properties of the control loop also influence the damping of a free moving slider to its set position, which relates to its speed and overshoot. A feeling of a stiffer elastic band (with a shorter maximum stretch) results in the slider shooting back to its set position and oscillating around it a few times (prrr). This oscillation can be heard quite distinctly. From a control loop perspective, the human introduces welcome damping in the system minimising such oscillations.
Technology

Each slider box contains a motorfader that can travel approx. 120 mm. The motor can exert a maximum force to the runner in the order of 3 to 4 N (which feels like the weight of 300-400 grams). The motorfader is controlled by a small microprocessor system (Arduino) with custom peripheral hardware to handle the 12Vdc power to the motor and the communication with the rest of the system. Sliderboxes are connected by an RS485 (serial) bus carried by standard UTP networking cable that also provides power.

The software running on the microprocessor consist of three modules: networking, transfer function, and motor control.

The networking module sends and receives slider position data as fast as possible, to achieve close to real-time position sharing between the different sliderboxes in the system. Apart from some initialisation commands, the serial protocol lets each slider box take its turn in broadcasting its motorfader position. In effect, each slider box in a system of 5 broadcasts its position every 5ms (200Hz).

The motor control module handles the power that is sent to the motorfader depending on the transfer function. Power is handled by duty-cycling with a rate of 32kHz, chosen so that it lies beyond the upper threshold of normal human hearing (i.e. approx. 22kHz).
The transfer function module determines in what way the movements or positions of remote sliders are of influence on the control of a local slider. Two modes of the transfer function were explored.

**Force Mode:** a (weighted) average of all the slider positions is calculated. This results in each individual slider exerting forces towards this average position.

**Position Mode:** the position of each remote slider can be felt as a localised attraction (dimple) or repulsion (bump) when moving a cursor back and forth.

In order to monitor and log sessions of people interacting in the system for later analysis, a desktop computer running custom software can be connected to the communication bus. This software displays the position of the sliders in graphical representations similar to a horizontal scroll bar. Such a virtual slider also provided for a way to engage in the physical Slider system through this GUI using a pointing device (e.g. a mouse or a pen-tablet).
**Appearance**

A slider box is roughly the size of an A4 paper and 5 cm high, made from laser cut MDF. The top of the box has an embossed surface made of smooth, stretchy surface. Behind this fabric, a bead is mounted that can move 12 cm in a straight line parallel to the short side of the box. But for a slight bump in the fabric, the bead is almost completely hidden from sight, while its movement can still be felt and acted upon. I chose the size of the box and position of the slider so that it supports a hand while putting the slider at the finger tips. I decided to hide the bead behind the fabric to emphasise the haptic interaction rather than visual observation, yet allowing to see that there is something there to act on.

From a short side of the box two standard network cables protrude, that connect each box to the other slider boxes.

When you approach a slider box, you can hear a faint crackling hum and when you look closely you can see the small bump of the bead, or cursor. When you put your hand on the fabric lightly (with your fingers on the cursor), you can feel the horizontal movements of that cursor (assuming others are moving their cursors). When moved under system control, it has a somewhat jittery, grainy, feel as it moves back and forth under the fabric under your fingers, slightly lifting your fingers. The fabric can be pressed harder, allowing you to feel and exert horizontal forces, giving you grip on the horizontal position of cursor.

For some of the experiments the boxes are placed on a table with vertical panels that hide the other boxes and people from each other.
The control loop I built is based on the position of the slider. With the hardware I chose, it is not possible to detect the force that a person exerts on the slider directly. If it had been force based, I could have eliminated the play in the system, as well as counteracted the mechanical friction in the system.

These seemed to be some basic relations between technical properties and qualities experienced in the force feedback of the system that I had to work with.

Rope, elastics and sticks: qualities of force feedback and feeling connected
When two sliders are connected, the algorithms in and tuning of the control loop gain complexity, but the basic qualities of the force feedback remain largely the same.

I wondered if such basic qualities of the electronic medium would inhibit the kind of reciprocal experience I was trying to approach. To get some grip on this I did a low-fi analogue experiment. I connected the hands of two people with three different analogue media: a string, a rod and an elastic band and evaluated their experience of the connection through observation and discussion. To minimise variables in the experience and to closely resemble the single axis movements of the sliders, also in these connections largely isolated interactions along the single axis of these media.

The rod was held horizontally between the index fingers of two people. People had to coordinate their pushing to prevent the rod from falling. When one begins to reduce her pushing, the other has to compensate immediately. People felt they had large control over the actions of the other. The way people engaged with each other was quite aggressive. The string was tied between two index fingers at some horizontal distance from each other. Similar to the rod, people had to coordinate their forces to keep the string taut. The higher the pulling forces, the more immediate you feel what the other does. In those higher ranges interactions feel and look similar to those with the rod, i.e. quite aggressive, like a tug of war. But there was a range between totally slack and fully taut where interactions looked different and were experienced differently. In those lower ranges the experience is less immediate, and it seems to invite a subtler dynamic and exploration of mutual responses.

The elastic band was tied between the index fingers of two people. Similar to the rope people coordinate their pulling forces to keep the elastic taut to some extent. The experience people reported was less immediate than with the rope, but somehow also more intimate. People reported to be be more concentrated on small changes and the dynamic the interaction looked slower. The elastic band seemed to invite a similar subtle exploration of mutual responses as the rope, yet it invited exploration of how forces change differently at different speeds. One subject reported: “I could feel that (the other) was trying to reach me.” The feeling of mutually exploring the qualities of the elastic medium seemed to relate to more subtle and intimate experience of mutual responses.
Through these experiments, I found that even if the connection feels quite different, the basic aspect of reciprocity remains. Most interestingly people reported to experience the connection with the elastic band as allowing for or inviting the most subtle and intimate exploration of mutual responses.

Based on these observations I concluded that the basic properties of the force feedback that the system I had built so far would not get in the way of my inquiry. On the contrary, the particular qualities of the digital medium might play an important role in focussing on particular aspects of the experience of several others as much as they did in the analogue dyadic interactions. These seem to be basic elements of an aesthetics of social touch, that warrants exploration in a context of more than two people. There was something here that invited a particular kind of exploration of the interaction. Such an explorative mutuality is quite different to the kinds of being together that current social media offer. What I found here is that it is not just touch that is interesting, but that ‘elasticity’ is a property of the medium that brings out, expresses, a particular quality of social touch.

Interactions with Sliders
Continuing the development of the sliders towards interactions of several people, I evaluated people’s experiences and behaviours in experiments. First the system only connected two people and later up to five. I’ll summarise observations and experiences of these dyadic interactions and then of interactions between several people.

Many of the experiments were ad-hoc. Some experiments were more formal in that I set the sliders up on a table with space dividers between them so that people could not see each other. In experiments with more than two people the system allows to change the topology of the network, i.e. what slider is connected to which others. This means that even if four or five people were in the same room, they could not know how many others they were actually interacting with. In introducing the experiment to them I made them aware of this. I also told people that the experiments were about their experience of other people by means of the sliders. The system logged the movements of the sliders, I took notes of my observations of people interacting and discussed their experiences individually or in groups.

As I have discussed in ‘Building Sliders’, I explored two ways of expressing the position of other sliders in one. In the force-mode each slider exerts a force towards a kind of weighted average position of the other sliders. In the position-mode the position of each slider is expressed as a local bump or dimple. In the force-mode, as soon as someone moves their slider, the other slider(s) start moving. This can be seen, heard and of course felt. In the position-mode, a local slider does not move, except when another slider passes its position.
**Force Mode, dyad**

When two people interact with sliders in the ‘force’ mode, most of the time they start out with some small movements, they feel how the grainy force builds up and down depending on their small movements. As they explore this grainy elasticity back and forth, it feels different each turn due to the exploratory movements of the other. To probe this, they often then make large movements back and forth with the slider. In those movements meeting with the other slider position results in no counter force to be felt in that position. As both people feel this, they quickly converge their oscillations towards a common position and return to small movements exploring the range of grainy elasticity around the common position. People report that in the dynamic of converging on a common position in large and small movements, they feel they are together with someone else, they feel confirmation of the other feeling them. Once this initial meeting is established people start exploring coordinated movements along the whole slider and in their discussions, describe this as understanding and expressing intentions. Sometimes one person is reported as dominant by the other, sometimes people are not quite sure who initiated a particular direction or even rhythm. Some people also report impressions of the other’s personality.

**Force Mode, group**

When more than two people interact in the ‘force’ mode, the forces you feel in the slider are quite similar to when you interact with just one other person and the general pattern of exploration is quite similar to two people interacting. People experience the forces as coming from other people, but when asked it is hard for them to say with how many others they interacted. Similar to the dyadic interactions, they experience intent and understanding in the force exchanges. In interactions with several others, people often talk about dominance of the slider movements over theirs, yet they also experience coordination even if it is difficult to identify what initiates a particular direction or rhythm. Similar to dyadic interactions, people talk about their experiences in terms of character of the meeting (e.g. subtle, aggressive, impatient, pleasant).

**Position Mode, dyad**

In the position-mode the general exploration follows the small-large-small movement pattern. When describing experiences of the other as a bump (local forces away from the other’s position) people often talk about playfully probing and chasing each other whereas experiences of the other as dimple (local forces towards the other’s position) are described in terms such as collaborating, joining being drawn in. This appraisal was often also experienced as relating to the character people ascribe to the other, and vice versa.
Position Mode, group

In this mode people quite easily identify whether they are interacting with one or several others.

Others expressed as a bump resulted in dynamics where people continuously play with the local repulsion around some common position. The ‘global’ movements of that common position were more erratic and people hardly talked about that movement; they were more engaged with continuously probing the moving bumps of others. They described their experience as fun and playful, and as being together with a group of playful people. They talked about a playful atmosphere.

Others expressed as a dimple resulted in dynamics and experiences quite similar to the ‘force’ mode. People tried to stay within the dimple of a common position. Sometimes resulting in two separate common positions for two clusters of people. The movements of a common position looked more controlled and people experienced this as moving in concert. People talked about working together with others, being part of a collaborative group and some mention feeling responsibility to contribute.

In Summary

I built the sliders system to explore what it is like to experience several others in the form of touch. I was looking for basic aesthetic elements that are different from those in existing social media. In this section I have discussed observations and experiences of mediated group interactions in relation to some basic aspects of touching others remotely and the properties of technical system that I built.

Discussion

As the first design experiment in this inquiry, Sliders exposes a wide variety of aspects that one encounters when designing mediated group interactions focussing on the non-sequential and reciprocal nature of touch, in contrast to current social media. It provides both practical and conceptual insight in expressing actions of multiple others in a minimal point-of-interaction. Not only is this relevant for the design of such minimal systems, it points to basic issues that are relevant for the design of mediated interaction between many people in general. As such this experiment forms a point of reference for each of the following experiments and ultimately for my discussion of and reflection on the series of experiments as a whole in the next section of this thesis.

Obviously, force-feedback technology that mediates between people has basic properties that influence the experience of mediated touch. One approach to dealing with these properties is to seek transparency of the technology, eliminating the influence of its properties on the qualities of the experience to arrive at something that mimics non-mediated touch. I am not interested in non-mediated interaction itself, but in the design of mediating interaction systems. Transparency then is only one aesthetic choice. I am interested in how properties of the system relate to other
experiential qualities of the mediated interaction. Clearly, if the system is not fully transparent, it doesn’t mean it is fully opaque. On the contrary, the Sliders experiment yields some concrete handles on several kinds of properties that together shape the kinds of experiences that emerge in the mediated interaction.

I have presented some of the properties inherent to the physical components that make up the system. For example, the maximum force of the motor-faders is limited by their construction and the electric power available. The number of levels of force within that range is limited by the digital hardware (8 bit PWM output) and our experience of force is shaped by the logarithmic nature of our senses. The speed of sending data between the slider boxes introduces a delay between them (and is a source for hysteresis (prrr) in the feedback loop). Such system properties result in e.g. the crunchy, grainy and elastic/spongy feel of moving the actuated cursor. These properties are the basic elements with which a local slider box can bring mediated interaction to expression and largely depend on basic, one-off engineering choices for the hardware.

Another kind of system properties are more flexible and relate to another aspect of what can be brought to expression in those more local and fixed elements. Variables and algorithms in the software influence experiential qualities of interacting with others through the system. In Sliders such system properties were explicitly designed and changed to explore their effects on the qualities of experience for people interacting in/with the system. I described for example aspects of the transfer-function such as its mode, virtual network topology, weighted averages, size of remote body, etc.

Shaping Group Interactions
As one of the most salient insights regarding the relation of these system properties and qualities of the experience of interacting with mediated others, I here revisit what I previously called the ‘mode’ of the transfer function. The two different modes of the transfer function, Force and Position, turn out to express fundamentally different ways of conceiving what the system mediates and thus brings experiences at the touchpoint to expression in quite fundamentally different ways.

The Force Mode, in which all sliders exert forces towards a common average position, mimics a mechanical connection between the cursors. Experiences of the physical/material properties of that connection is constrained by combinations of software and hardware. An image comes to mind where the fingers of multiple people are mutually connected with a material whose mechanical properties can be adjusted so that it feels like e.g. rods, elastic bands or wires).

One person feels only the resulting singular force that their cursor exerts. When moving the cursor away from the common position, a force is felt in the opposite direction. It is hardly possible to distinguish individuals or their individual actions, or
even how many others there are. Yet the behaviour of this collective, the movement of the common position, is a result of all individual behaviours in relation to this common position.

The system in this mode seems to impose an alignment of people’s actions. The expressive qualities of the combined actions are a result of how people align their actions with the forces they experience. An individual meets with the collective expression, the presence of the collective. The experience of interacting with this collective expression may be closer to interacting with an abstract system (of unknown behaviour), rather than with multiple others. The experience of the system thus may depend largely on what people think or are told what the system they interact with is doing.

*The Position Mode*, in which other slider positions each individually influence the forces you feel in a local slider, allows for individual meetings with others. When moving your slider, you experience forces as if there is a bump or dimple when you cross the position of one of the other sliders. When you hold your position while another slider’s position crosses yours, you first feel an increasing force one way and then a decreasing force the opposite way. Depending on the direction of the force in relation to the direction of the movement this feels like a passing dimple or bump.

When moving back and forth along the linear action space, small dances occur when two slider positions cross, as people mutually explore the (moving) position of the bumps or dimples they encounter.

In ‘Building Sliders’ I already mentioned interesting aspect of meeting another from a technological perspective. The force generated depends on the overlap between the distance at which a local cursor begins to take another cursor position into account (the sensing body) and the locally expressed width of a remote cursor (the present body).

In their research on perceptual crossing, the group around Lenay looked at this from a phenomenological perspective. They have shown that people develop a sense of the size of their expressed (remote) body in relation to their sensing (local) body. They do so through the perceptive actions of the other. This means that not only the fact *that* you are present to another is reflected in the perceptual actions of the other, but also a sense of *in what form* you are present to another (Lenay et al., 2012).

In the terms used by Lenay et al, a sense of being co-present can develop when, on a first level, the width and maximum force exerted by a bump or dimple make them each identifiable as an object in the interaction space. On a second level, the expressive qualities of the explorative movements of each cursor makes them identifiable as perceiving bodies. The observed and reported experiences with the
Slider system seem to confirm these ideas, but also suggest a third aspect: people report having an affective impression of their meeting and, through that, of others. Here the technological properties of the system enter into the experiential qualities of being co-present with another intentional being. The properties influence the possibility for perceptual crossing to occur, but also the affective impression of the meeting and thus of the other person. Similar to perceptual crossing between two people, the Slider system in this mode also allows an individual to meet with two or more others meeting. Experiences with the Slider system indicate that not only do people have affective impressions of meeting an individual, but also of meeting several others. People describe their social experiences in Sliders in terms of atmosphere or character of exchanges with others, regardless of one or several meetings.

In both modes, properties such as rigidity or elasticity of the force feedback, clearly influenced the kind of explorative behaviour’s people developed. Such properties of the system influence the expressive qualities of people’s behaviours in meeting, thus bringing the interactions between them to expression in particular ways.

Sliders thus gives a glimpse into what makes up an aesthetics of being co-present with several others, in structural terms. It yields some ways that properties of the technology that makes up a touchpoint, influence the possibility for and qualities of experiences of being together with several others.

A rather unsettling basic question that emerges from this experiment is what it is that one interacts with when interacting with several mediated others. I have mentioned that a basic conception of what a group is comes to expression in particular ways depending on engineering decisions that initially seemed relatively inconsequential.

Another basic question, addressed in the next experiment, regards how social experiences may be characterised. If we want to intentionally do design oriented to qualities of mediated social experiences, we need to have some idea of what social experiences can be about. We can then try and unpack how mediated systems afford, quite structurally, such particular experiences to come to expression.
Haptic Intersubjectivity

‘Designing intersubjectivity through haptics’ was a design exercise with master’s students in which we explored designing with haptics to elicit particular experiential qualities of mediated group interactions.

In the Sliders experiment I worked with the haptic sense modality for its inherent reciprocal quality. Working on the explorative Slider system other qualities of touch drew attention to the kinds of expressions and experiences of interacting with several others they pertain to.

Imagine we shake hands; apart from the reciprocity, we can talk about that handshake in terms of its physical properties, the strength of my squeeze, the temperature of your hand, the clamminess, the firmness or resistance to movement, the speed of our shake etc. We can also talk about the impression that a handshake gives us of each other. We would describe such impressions in terms of pleasant, comforting, supportive, trustworthy etc., and of course their counterparts. Such descriptions are in the domain of our affective response to and value judgements of each other. I assume there is some relation between the physical properties and our experience of the handshake.¹

When we make use of technology to mediate touch between people, we interfere directly with these physical properties and thus indirectly with the experience of the other. In his work, Lenay has shown that for mutual recognition of another remotely, minimal means suffice. My dyadic Slider experiments indicate that the qualities introduced by the mediating system influence the dynamic of the perceptual crossing, thusly also the reported impressions of the other. My Slider experiments with more than two people suggest that different ways of expressing several others in one slider result in quite distinct ‘group’ behaviour and experiences. Such expressions and impressions are often described in terms of affective responses to and values ascribed to the group dynamics.

In the context of designing social media, in this experiment I therefore proposed to design for particular kinds of social experiences in terms of such affective responses and values.

In this design exercise with students I looked into what this proposition entails and what kind of directions it might invoke, focussing on haptic interactions. More

¹. I do not here claim a causal relation; context and other aspects of the encounter play a role here as well. But I assume that the physical properties play a big role in the immediate impression.)
practically, to seed the exploration, I looked for basic descriptions, qualifiers of socially oriented emotions or values. In psychology, social psychology and intercultural studies general and basic models have been proposed to describe and classify relations of affective responses or relations of motivational values.

This experiment concerns how a generative (design) process unfolds with such models as input and if such models are helpful. It builds on work that looks at similar propositions that target the design for particular experiential qualities in interactive products. This experiment explores if a similar approach works for designing that addresses qualities of mediated social experiences.

In the following I outline the ‘Designing Intersubjectivity through Haptics’ course and how it took place. In ‘Results’ I present some of the resulting designs. In ‘Discussion’ I reflect on the results and evaluate them from the perspective of the proposition presented above.

**An Approach to Designing Intersubjectivity through Haptics**

The ‘Designing Intersubjectivity through Haptics’ project was a 40 hour course for master’s students at the department of Industrial Design at TU Eindhoven. The course was an elective course and 16 students participated.

The brief for this course was to design and build a situation (system, installation etc.) in which more than two people could experience the dynamics between them, ‘colouring’ the intersubjective experiences in an intended way. In this course ‘colouring of intersubjectivity’ is used to indicate the kind of influence that the mediating system has on how people feel and act in it, the values embodied and elicited in the interaction. Obviously, this brief reflects my research interests in designing social media.

With this course, we aimed towards both educational and research purposes. The students developed their design skills on the practical element of haptics and the conceptual elements of designing complex systems. At the same time, my research gained from the practical and conceptual input generated regarding both design process and outcomes.

**Course Outline**

The course consisted of 3 stages. In each stage, theoretical aspects are explored in practical context, with each stage increasing the complexity.
Stage 1: Introduction to Haptics (1 day)
Without any instruction on haptics, students were sent out to gather 3 examples of haptic sensations and bring them back to the course-room. Each student presented their collection and was asked to express the various sensation in words to the others. The students then collectively reflected on the kinds of verbal expressions used and the relation to the haptic sensations.

Students selected one of the examples they gathered and developed ‘an artifact’ through which a particular sensation can be explored from barely noticeable to unbearable (within safe boundaries). During this task students attended a lecture on sketching haptic sensations by Camille Moussette.

The resulting artifacts were each experienced in short sessions by all participants, followed by a joint reflection. Students reported on their artifacts and were asked to reflect on relations of stimulus, sensation and experience, in terms of scale, resolution, continuity and axis.

Stage 2: Expressive Factors (1 day)
Students were first introduced to basic ideas related to the aesthetics of interacting with products in a lecture.

As a basic framework for expressive factors of interacting with products, the coupling of a person’s actions to the designed responses of the product is discussed using Wensveen’s Frogger framework, i.e. feedback and feedforward on the dimensions of Time, Location, Direction, Dynamics, Modality and Expression (Wensveen, Djajadiningrat, & Overbeeke, 2004).

To complement this basic framework for factors that bring the character of interaction to expression, other specific discourse was introduced. Work of (Ross & Wensveen, 2010) and (Stienstra, Alonso, Wensveen & Kuenen, 2012), seeks to bring together people’s affective response, motivational values and behaviour change as perspectives on aesthetics of interaction and of the characters that may be brought to expression through basic expressive factors.

Students received an assignment to create an installation through which a person can experience a transition between two affective states through haptics. The affective states are based on Russell’s model of affect, which proposes two orthogonal axis, valence (unpleasant – pleasant) and arousal (aroused - sleepy).
Russell’s model of affect (Russell, 1980).
Students followed a process based on Ross’ work that builds on (Hummels, Overbeeke, & Klooster, 2007). In couples, the students explored their assigned affective transition in movement and acting-out. A synopsis of this exploration was captured in a 1 minute video and the interactions were evaluated for visible and experienced aesthetic qualities together with the whole group. Based on these aesthetic qualities, they designed an artifact that elicited behaviours with similar aesthetic qualities. The resulting designs were evaluated during an interactive demo session with students and employees of ID, TU/e. Evaluation consisted of observations and discussion with participants, and a response form on which participants were asked to rate their interactions on the same affective dimensions as the students started out with.

Students reported on this assignment with video and written reflections. In their reflections, they were asked to explicitly address the expressive factors introduced in the lecture, i.e. Frogger framework, and their relation to the intended experiences of affective transitions.

Stage 3: Social Dynamics and Designing for Intersubjectivity

For stage 3 of the course, students received their design brief for the rest of the course period. In a lecture and ensuing discussion, the students were introduced to Schwartz’ theory and structure of motivational values, proposed to be the grounds for people’s attitudes and behaviour towards others (Schwartz, 2006). The relation of motivational values and behaviour formed the basis for this assignment, similar to how the relation of behaviour and affective response formed the basis for the previous one. The assignment was phrased as:

“Design an opportunity for more than two people to meet and experience the dynamics between them, colouring this intersubjectivity in a particular way.”

Rephrased by some as:

“Create an experience prototype for multiple users which is designed for intersubjectivity through haptics that evokes the feeling of X and Y, using the Frogger Framework.”

(Where X and Y are taken from Schwartz’ diagram)
Schwartz’ structure of motivational values. Adapted from (Schwartz, 2006)
The basic idea was to design the system to invite particular behaviours that then result in particular dynamics between participants, thus in particular social experiences. The design approach follows the opposite direction. The students worked in groups of 3-4 people. Each group received two motivational values to work with. The process the students followed was similar to the previous exercise, with several additional intermediate iterations.

To help getting to grips with values and social dynamics in the context of social media, each team engaged with Michiel de Lange, philosopher and cultural anthropologist with particular interest in relations of new (digital) media and urban culture.

Based on these discussions, students explored expressions of their chosen values through acting-out in small groups. That exploration was evaluated for salient aesthetic qualities in the behaviours and dynamics of interaction. Through several iterations of physical sketches and mock-ups, ways to invite similar aesthetics were explored and documented in short videos. For the final day of the project a fairly robust experiential prototype was built by each group. These designs were evaluated during an interactive demo session with invited students and employees of the TU/e. Evaluation of the designs consisted of observation and discussion, and participants were asked to complete a form, in which they rated their experience in the Schwartz value space and on various aesthetic qualities. Students reported on this part of the course with video and written reflections, as part of a written report on the whole course.
Results
The different stages of the project yielded many haptic sketches, interactive installations and reflections from students. I structured the course to first sensitise students towards working with haptics and then introduced ways of bringing particular kinds of experiences to expression in interactive systems, thinking through characteristics of coupling people’s actions to system responses as expressive factors. In the final assignment, what was learned about working with haptics and expressive factors in individual interaction with an artifact, formed a basis for working with the influence an artifact as a medium has on the experience of others.

For my inquiry, and in particular to evaluate the question of designing towards particular social experiences in an interaction medium, it serves to present only a few of the results of that last part of the course.

The Tradition Walkway
This team worked to design an interaction medium (phrased as: a way to meet others) that invites behaviours towards the values Tradition and Conformity.

The team interpreted these values towards shaped habits, or behaviours that people have because others before them have done things in that way before, while often not knowing why. Thinking of how habits are shaped by and become visible in the physical world, the team drew inspiration from so called ‘desire paths’. Such paths emerge for example across a field of grass to cut the corner between two footpaths.

The team transposed this idea to haptics in the form of a walkway that detects the steps of people walking across it and plays those footsteps back in the form of vibration pulses in the walkway. The more people fall in step with that same rhythm of vibration, the stronger the pulses become. Over time, the pulses also fade out if no one reinforces the previously established rhythm.
The Achievement Billow
This team worked with values in the area of Ambition, Achievement and Success. Initially a lot of time was spent discussing what these values mean for individuals and in groups. Ambition was considered a general motivation originating from the individual, where Success has a social goal orientation (judgement by others) and Achievement a more personal goal orientation (judged by oneself). The team went on to explore expressions of such concepts in air filled trash-bags connected to each other with tubes. By varying airflow between the bags and constraining the shapes of the volumes in which the bags could be compressed, they discovered ways to give form to the abstract concepts.

In the resulting installation three people can interact with funnel shaped billows. You can only press down on a billow and you need to wait for others to compress their billows for yours to be inflated. The students describe the interaction as follows: Seeing a billow expand outside the funnel, invites to compress it, setting an ambition for individual achievement (of compressing into the funnel shape). Once you compress, you feel counter-forces from others, setting the ambition to overcome those forces, thought to invoke success when overcome.
Different iterations of the Benevolence spheres student project.
Benevolence Spheres
This team worked with values in the area of Benevolence (Helpfulness). Following brief discussion of the values, the team explored how a group could influence a hand shake of two people in the group. They tied strings between four people’s hands in such a way, that two of the hands could reach each other only when the others would leave enough slack in the strings.

The basic allowing/inhibiting quality was then expressed in a smaller scale physical sketch in which again four people could engage with each other through the sketch. Reflecting on the two explorations, the team found them very different. The small sketch worked more as a game, with extrinsic reward of fitting a bead through a tube. Their initial string-handshake had more of an intrinsic reward of meeting someone through a handshake. The team decided to develop another installation that they thought aimed more towards the interaction between people and less between the people and the system. Rephrasing the basic qualities in terms of communication (and not interaction or experience of presence), two installations were built based on the idea to allow communication between two people only if others are ‘quiet’. One version is based on electronics, using microphones and vibrator motors to establish a connection between half spheres. Each participant in one hand has a half sphere with a rubber membrane stretched over its open face and puts the other hand on a centrally placed half sphere containing the vibrator motor. When you touch the membrane, it causes vibrations in the central half sphere.

The other version is based on pneumatics. Four half spheres, each with a rubber membrane stretched over the open face, are interconnected using tubes. When you press on a membrane, the other membranes bulge out a little and when you tap a membrane this can be felt (and heard) in the other membranes.
Discussion
In setting up the course, we did not formalise or looked to validate a coherent framework of relations between haptic properties of interactive systems and the kinds of social experience they bring to expression. Instead the proposition that this experiment explores is that there is such a relation. We conducted the course around a basic structure for that relation:

\[
\text{basic responses of an artifact to a person’s actions} \\
\text{(interaction attributes)} \\
\text{<->} \\
\text{qualities of experience of interacting with artifact} \\
\text{(qualities or aesthetics of interaction)} \\
\text{<->} \\
\text{qualities of the experience of others} \\
\text{(aesthetics of meeting or being together)}
\]

Interaction without instrumentality, experience without intention
The haptics sensitization and haptic sketch exercise provided some grip on the kind of vocabulary in which to describe the ‘feel’ of interacting with something. When making a physical sketch that addresses a range of a particular ‘feel’, the precision of both the vocabulary and creating the actual ‘feel’ needs to increase. Not only in terms of the intensity of the feel, but more interestingly also in the kind of range that is set up. When we try to design a particular kind of smooth feel in turning a knob, the kind of ranges we can work with are for example smooth-crunchy, smooth-bumpy, smooth-spongy, smooth-friction and so on.

When we design an interactive product, for example a desk lamp, the experience of directing light to where we need it is shaped by how the lamp responds to our actions to achieve that. The experience of directing the light is shaped by the properties of the lamp in response to our intentional actions. If the lamp requires constant careful adjustment, we might have an impression of the lamp as shy and weak, which then might elicit us to act helpfully (though this can get quite frustrating when trying to read).

If we take away the pragmatic, utilitarian, aspect, we can still talk about how we experience interacting with an interactive artefact, about the qualities of relating to it (even if we seem to enter the realm of art). We can design things to have particular behaviours that elicit experiences with particular qualities that come to expression when we interact with them.

Students were asked to work with this aspect of designing an interactive system; to try and elicit particular kinds of emotions in people interacting with the artefact. Students had difficulty to think in these terms without a specific purpose for interacting with an artefact other than, well, experiencing it. Possibly this is because it seems nonsensical
to think about designing interactions without thinking about what it is for? However, like in a painting, without basic understanding (even implicit) of colour, shape and composition, it is quite difficult to express something in a painting.

Even if for the resulting artefacts of this exercise it would be hard to prove quantitatively that they were experienced as intended, the kinds of reflections and iterations the students did show promise in this sense.

**Shaping a meeting, for the sake of meeting**

In the final exercise students had difficulties mostly around two aspects.

One source of difficulty, similar to the second exercise, was creating an opportunity for people to meet, without a specific purpose other than the experience of that meeting. For one group this led to a shift in their concept from ‘a way to meet’ to a communication medium in a more traditional sense, that of sending messages.

A second source of difficulty was to work with shaping interactions between people rather than between a person and an artifact. The latter seems more contained, as it concerns the interaction attributes of the artifact that shape an individual’s behaviour towards the artifact. The former seems less graspable, as it deals with interaction attributes that shape how people behave towards each other’s behaviours.

The motivational values were intended to give handles on this aspect, but it was difficult to: first grasp what they relate to from an analytical perspective; and second to operationalize them for designing, to bring them to expression in interaction.
DiffractMe!

My thesis work is about what mediated interactions with several others may be like. In these previous design experiments, questions had come up concerning the kind of interaction ‘space’ that mediating systems provide. For example, in the Slider system that ‘space’ is hidden and only accessible when touching a Slider, more so if you think of the hidden influence of the software. The DiffractMe! Project offered an opportunity to make such a ‘space’ visible, highlighting the role of the interaction qualities of the mediating system for people interacting with each other. In this design experiment my interest was to explore explicit presence of the medium, rendering the interaction ‘space’ clearly perceivable.

This exploration was part of a project aiming to develop an interactive art installation for a cultural event during midsummer in northern Sweden, and was a collaboration between designers, researchers and technologists from Interactive Institute Swedish ICT, Umeå Institute of Design and department of Industrial Design, TU/Eindhoven.

The general brief for the project was to socially connect and engage people in the same and different locations, through interactive installations that manipulate natural light. The installations were to be placed inside a glass facade of a venue. The original client dropped out of the project in a late stage. Apart from finding different locations for the installations this did not change the basic brief and design research ideas for the project.

With an orientation towards direct perception and the reciprocity of touch, in the Slider experiment my perspective was that the experience of others is situated at the individual touch point. The basic issue there was how to bring several others to expression in this individual experience; how do local qualities of interaction relate to the social experience of others. There is an issue of circularity in this. Do we talk about such qualities from the perspective of the social experience or from the perspective of the local interactions? In the Intersubjective Haptics experiment I explored this circularity by starting from qualifiers for the social experience and looked for haptic qualities that resemble that. In the DiffractMe! project we explored this circularity by starting from qualities of the interactions at the touchpoint to look for what those might mean in terms of social experiences.

The design project that this experiment is part of, aims to engage people in a rich interaction with the installation and each other. As an approach to designing the aesthetics of interaction, we worked with the Designing in Skills framework (Trotto & Hummels, 2013). With this approach, we aimed to develop the experiential qualities of the interactive installation not based on general abstractions as qualifiers for the experiences, instead leveraging our own rich, skilful and subjective experiences.
In the next chapter, ‘Designing DiffractMe!’ I report in some detail how we worked with the DiS framework and how we designed and built several installations. The details of the hard and software components used in the resulting installations are summarized in ‘Technology’. In ‘Appearance’ I discuss how DiffractMe! presents itself to people interacting with it. In ‘Results’ I report on experiences with and observations of interactions with DiffractMe! and in ‘Discussion’ I reflect on what I learned from trying to forefront the role of the medium for people interacting through it, for the general program of my thesis.

Designing DiffractMe!

Here I’ll briefly outline the basic ideas for and the process of designing and building DiffractMe!. The DiS framework itself and the process of developing DiffractMe! using the DiS framework has been discussed elsewhere at length (Trotto & Hummels, 2014; Peeters, Kuenen, Trotto & Hummels, 2014).

Central to the Designing in Skills framework, rooted in the fields of aesthetics of interaction and pragmatist aesthetics, is exposing individual sensibilities and unlocking richness on a subjective level in relation to others, rather than to aim for objective and universal qualities. The DiS framework provides handles to orient design towards skilful coping and embodiment in the context of interactive products.

The idea is to start from an individual’s own skills and work through several shifts in points of view (of different people) on these skills to develop an embodied, rich, un-tacit and shared understanding of that skill. These shifts in perspectives revolve around the making and experiencing of iterations of physical sketches. These Enabling Tools embody salient qualities of the skill, teased away from the individual subjective, yet avoiding abstraction through language alone.

Three designers were involved in the DiffractMe! project. The project had three main phases: Sensitisation to Skills, Enabling Tools and Developing DiffractMe!

Sensitisation to Skills

In this phase, each designer expressed his experience of a personal skill (i.e. juggling, running, or rolling a cigarette) in a one minute video. After presentation and discussion of the video, each designer switched of point of view to mirror another designer’s perspective on his skill. Each designer then tried another’s skill and expressed his interpretation of the other’s skill again in a 1 minute video. With the insights gained from this mirroring, each designer then made a physical sketch aiming to elicit the experience of a salient aspect of that skill for a third person. Salient aspects of experiences with this sketch were then expressed in a third 1 minute video made jointly by all three participants. The group also mapped keywords that identify and qualify each of the salient aspects of each skill. Even if such forms of documentation do not do full justice, a hint of the experiential qualities or salient aspects of the skills
Guidance

let the environment guide you

Resonance

find the right pace and place

The basis for designing DiffractMe! were salient qualities of participating designers’ individual skills and how those relate.
that we worked with in this phase can be gleaned from a diagram that represents the clusters of keywords that we used:

**Enabling Tools**

In this phase, we quickly and iteratively made a series of Enabling Tools aiming to integrate our shared understandings of the experiential qualities. Each Enabling Tool was a low-fi interactive installation that was placed in a public space. Observations and discussions with people interacting with each iteration of the Enabling Tool were combined with our own experiences to develop the next iteration. This provided us with handles on how to bring the shared and integrated experiential qualities to expression.

The final Enabling Tool provided insight in how the three themes of Friction, Resonance and Guidance could come together in interactions with an artefact on different scales: Friction - a very intimate, personal haptic interaction takes place on a small scale, between the person’s hand and the touchpoint. Resonance - happens on a mid-scale level: it is experienced between the person’s actions and elements of the system that the touchpoint gives access to. Guidance emerges on an even larger level, as it is about the experience of engaging with the system as a whole.
**Developing DiffractMe!**

In this phase, we transposed the insights from the previous phase to the original design brief: to design an engaging and interactive public installation that allows people to manipulate natural light. We built various light manipulating mechanisms and evaluated them for their potential towards the experiential qualities, using the insights from making the Enabling Tools of the previous phase. This lead to a clear design direction for the installation: an array of rocking prisms, mechanically coupled so that movement of one prism would agitate the next and onward, resulting in a rippling resonance in the array of prisms, visually and haptically guiding the movements. But friction was hardly present.

The basic interactive qualities, friction, resonance and guidance, were explored so far with analogue means and largely focusses on interactions between a person and the system. As we were interested in interactions of several people with the system and in connecting several of these systems in different locations to each other, we moved to electronic means. To keep a clear connection between the rocking movements of the light diffracting prisms and the touchpoint for people we developed the touchpoint as a rocking surface that people can put their hand on. As it turned out, the electronic and mechanical construction of this touchpoint brought in the element of friction. We built small scale prototypes that brought all elements together: a small array of rocking prisms and two touchpoints. When you rock an individual touchpoint back and forth you feel forces originating in the hard and software for the touchpoint (friction, springiness), originating in another person interacting (guidance), and you feel forces originating in the movements of the array of prisms (resonance and guidance).

Building the full-scale installation required substantial engineering and we encountered great difficulties with the mechanics of the larger prism array. After several iterations, we developed a different version of the array, in which the prisms were replaced with vertical strips of a micro-grating film that has light-diffracting properties. Also in this system, it proved the mechanical engineering was the hardest to get right, mostly influencing the subtlety of friction and resonance we sought to bring out. Because of these difficulties, we never built multiple versions of the same installation and hence could not explore interactions of multiple people in different locations.
As you feel the other’s movements, you start to let the other guide, rather than obstruct movements in an intimate dialogue experienced haptically. Together you develop a continuous, resonating series of movements, in which you move the surface back and forward in sync with the other. As you do this, you see that the lower prisms in the array follow your rocking movement, agitating the next row of prisms a little. As you explore the rhythm of interacting with the other and the array, you might notice that particular rhythms propagate further into the array than others. As you do this you might also feel that the oscillations of the prisms can also be felt in your rocking surface. As you tune your movements with the other and the array both visually and haptically, you find a rhythm that results in a resonating, ever increasing ripple-like effect that moves throughout the matrix of prisms.

As you do this, the rainbow light in the space has begun to undulate in much bigger movements than the prisms, resulting in a rippling spectacle of coloured light throughout the space.

**Appearance**

When you enter the space in which DiffractMe! is placed on a sunny day, the space is lit up by rainbow coloured light. Near the glass facade or windows, you find the origin of this light spectacle: a plain, light-wood standing rectangle of about two meters high, a meter wide and 30 cm deep. In it you see a array of five horizontal and 9 vertical, triangular prisms mounted on horizontal stainless steel rods. Between the prisms there are stalks with small magnets on the end. This array and its frame is transparent and light. Near the array, you find two columns of a meter high and 40 cm square. On top of the column you find a transparent object and in it you see some industrial looking electronic parts. The top of this object is a surface that you can rock back and forth. As you do so, you see some of the bottom prisms in the array and the top surface of the other column mimic your movement.

When you and another visitor both put hands on the two rocking surfaces, you feel the subtle and tactile experience of friction, as you move the rocking surface back and forth. Small motors create a slight feeling of resistance as they mimic the movement created by the other visitor on the adjacent column and convey the inertia of the mass of the prisms. These forces are not big, maximum in the order of the weight of a few eggs, inviting you to move your hand attentively and with care.
Communication between Arduino’s is handled the same as in the Slider system, using a turn taking protocol on an RS485 bus. Also for DiffractMe! a PC could be connected to the bus to control variables of the PD and network topology and to record data. Different in the DiffractMe system was that the role of a PC was extended to be able to communicate with similar systems in different location across the internet.

As I mentioned, the engineering of mechanics of the array of prisms did not work as intended, so the installation did not work quite as expected. This highlights the difficulty of realising the subtleties of the experiential design intentions.

A second version of the prism installation was built without electronics, using pneumatic pistons and tubing to connect the interaction surfaces and the light diffracting elements. Some of the engineering problems were solved by this and the pneumatics supported the experiential qualities we sought very well, but the analogue, non-electronic nature of the pneumatics made it impossible to connect installations in different locations.

A third version of the installation replaced the array of prisms with vertical strips of a light-diffracting film. We used the same actuators, but again the mechanical engineering for coupling the light diffraction elements turned out to be the bottleneck for realising our design ideas.
Results
Here I summarise what came out of this design project as an experiment aimed at more experiential results. I elaborate on the subtlety and richness of experiential qualities we worked with, first as they pertain to interacting with the installation individually and, second, as they pertain to interacting with the installation with two people. Only two people at a time can interact with the DiffractMe! installations we built. This limits my discussion to the experiences and observations of one and two people interacting with the system, but not more.

Individual interactions with DiffractMe!
If something would not push back on you when you act on it, you would hardly be aware of it at all. Friction and resonance relate to the qualities of the system pushing back on you, and so has to do with how you come to be aware of the thing pushing back on you, how you experience that thing. They are the qualities of relating to that thing, both in concrete physical terms and then immediately also in their emotional sense.

Experiential qualities that we sought after in DiffractMe! are best described in terms of resonance, friction and guidance. Friction inhibits your action, there is something immediately negative in friction, it works against you, but it also challenges you to push harder. Friction sometimes has a kind of sticky quality, where at a certain level of force, you have overcome the friction and it doesn’t take more force to effect movement. When the loss of energy and the stickiness is of just the right level, it is inviting and pleasurable. If it is too much, it simply costs too much energy. In DiffractMe! the limited power of the actuators was enough to generate forces noticeable and of that pleasurable magnitude, inviting subtle movements.

When interacting with DiffractMe! you can find a rhythm of moving the rocking surface back and forth that resonates with the array of swinging light-diffracting elements, causing ever larger undulations. The basic rocking motion of the surface already elicits a rhythmic movement back and forth in itself, but this seems to be reinforced by the pendulum motion of the prisms. Resonance has a different temporal quality than friction. When you push, there is a springiness in the forces you encounter and you can play with the bouncy response. Resonance somehow pulls you forward: as you start playing with springy, bouncy qualities, you feel that after each push, the system comes back with a stronger push, it seems to accumulate your energy. In friction, when you push harder, your energy is simply lost. Both friction and resonance provide a particular experience of what you push on, they induce changes in how you experience the relation of action and response, they both guide your movements but in different ways.

Dyadic Interactions with DiffractMe!
Our initial design intention was that the two interaction surfaces would only be coupled to each other through the array of prisms. The system was set up so that each rocking surface only moved one prism in the array each. Due to the engineering
issues, the ripple-effect of a moving prism on the next was much less pronounced than we intended. This meant that, when moving a rocking surface, the connected prism would start moving and if you got the rhythm right, over time you could get a whole row of prisms moving. This could then be felt in the other rocking surface. This effect was very subtle and most people did not report to have felt or understood this in their relatively short (3-5 minutes) interaction sessions. Only in a few cases it was clear that together you could get the whole array to swing, and people reported a feeling of achievement and in one case high-fived. Most of the time people’s actions did not align or even cancelled each other out. Not seeing much movement in the system people got rather bored with the system or thought it was broken.

We decided to change the programming so that the movements of one rocking surface directly influenced the movements in the other. When two people interact with the installation in this mode, they ascribe the forces felt to each other, rather than the installation itself. We observed people placing their whole hands on the rocking surface first moving it carefully, then more aggressively and then back to subtle movements and then often settle into a rhythmic motion in sync with each other. The maximum force that the actuators can exert is much smaller than the full force an average person can exert. So, to feel the actual movements of the other, the system invites more subtle movements. When exploring more subtle motions to get in sync with each other, people do this with only a few fingers on the rocking surface. As they are also looking at the installation, people notice that their movements cause the prisms to start moving. They then explore and coordinate the speed of the rhythm to get in sync with the swinging prisms together.

People expressed that they felt that interacting with the system strongly elicited coordination and collaboration between each other. When asked about the friction, they mostly report that they thought this was inherent in the system and largely ignored it. As mentioned before, they mostly say that the forces they feel, relate to what the other person does. When asked about how they perceived of the array of prisms, people say that once they had explored the interaction with the other person, they saw the array as providing a shared goal. It also provided a challenge to get the whole array moving. This would cause a spectacular effect in the space, so people also reported to feel like performing in front of the other people in the space. They felt they had to show that they were good at it.

The spectacle also seemed to draw other people to try interacting with the system for themselves. This performance aspect also motivated people to really try and get the big effect going together, paying attention to the subtlety of coordinating their actions. In the next section I discuss and reflect further on the kinds of expressions of the social that the outcomes of DiffractMe! point to, and I outline some of the more fundamental issues that this experiment raised.
Discussion
Judging from the experiences felt and reported when interacting with DiffractMe! it seems we were quite successful in eliciting the resonant and guiding qualities that we had elaborated in the earlier parts of the design project, both in individual and dyadic interactions. What is surprising is the role that such qualities of the system seem to play.

The spectacular aspect of what the system does as a whole seemed to be the most engaging and motivating aspect for people to interact with the system. This shifts attention away from the experience of meeting another person through the installation, and away from the subtleties of resonance, friction and guidance that we sought to bring to expression.

Thus, DiffractMe! constitutes a mediator for social interactions not just between the two people in contact with the installation, but everybody in the space. It establishes those two people as skilful performers and other people as spectators. Conceiving of the installation as an interactive art piece therefore was most defining in terms of aesthetics of being together.

Our attention to the qualities of interaction as the coupling of actions to perceivable effects was important for the development of the skill of collaboration between two people: Crucial was that people could quite quickly learn how to collaborate to get the biggest effect. Their experience of acting together had to do both with this performance perspective and the perspective of being able to coordinate actions with each other and the installation.

Clearly, the experiences reported had more to do with joint actions on a shared object, than the experienced connection with each other. The behaviour and properties of the shared object and resulting spectacle seemed to overshadow the experience of interacting with each other through the system. The subtlety of the experience of being coupled to the system together was important for coordinating and aligning actions with each other and the system.
Concept sketch for audience interaction system in the Mirror design experiment.
Artist: Nigel Papworth.
Mirror

You can look at mediated social experiences from the perspective of the individual and how she becomes aware of being present with many others. In the explorations, I have previously discussed I have explored aesthetics of interaction from such a phenomenological perspective on qualities of direct action-perception. An issue with these explorations was that staying close to individual experiences of this kind, it involved only small numbers of people. It quickly becomes resource intensive to work with large numbers of people if you have to make e.g. tangible touchpoints for each of them. This meant that aspects like group or crowd are not so much present in those explorations.

In the ‘Mirror’ experiment that I describe and discuss here, I took a perspective on social experiences that emphasises the representation or expression of the collective. The basic idea was to work with a large number of people (>100) and to focus the exploration on the expression of the combined actions of people, the group behaviour, for an individual in that collective. An augmented audience mirror of sorts.

I had limited resources for creating the mediating system. Creating a large number of electronic artifacts for interaction was out of the question. I drew inspiration from a seminal experiment done at Siggraph’91 by Carpenter (see Curtis, 2011). That experiment uses cheap artifacts held by an audience and a computer vision system that detects these artifacts. Carpenter’s experiment aimed to test the computer vision system to support the self-organising behaviour that occurred between the crowd and the projected images in front of them. My intention was not so much to evaluate system performance, but to find out more about how individuals experienced such a ‘crowd interface’, when presented with different ways of expressing the crowd in the projected images.

I found an opportunity to perform such an experiment at the Tangible, Embodied and Embedded Interaction conference (TEI’15) that was held in Stanford, CA, USA, in January 2015. As the name suggests, this conference revolves around ideas of embodiment in the context of Human Computer Interaction. I presented my proposed experiment as dealing with ideas of embodiment of the crowd, to contrast the prevalence of notions of embodiment related to the individual in TEI discourse. My experimental design built on qualitative research methodologies from the social sciences.
Experimental Approach
In this experiment, I sought to gain a general understanding of a live audience feedback system in terms of social mediation and a more specific insight into people’s experiences interacting with the system.

My basic premise for the experiment was that people would have different experiences and would behave differently in relation to different ways of representing their combined actions on the screen in front of them. The experiment was intended to find out if there were differences, to yield some insight in the way they were different and how visualisation and experience might relate.

The experiment has two research questions:

1. Does the experience vary with different visualisations?
2. How do people’s experiences relate to the different visualisations in terms of a specific set of concepts?

The hypothesis related to the first question is:

An individual’s experience of an audience interface will vary with the kind of representations of the overall audience behaviour that the system provides.

In order to evaluate an individual experience, the experiment makes use of participants self-reporting on a set of semantic differential scales. In combination with observation and interviews this data should provide answers relating to the second question. This approach to the experiment builds on qualitative research methodologies in social sciences and how they are used in the field of human-computer interactions and interaction design. In particular, various approaches have been developed to evaluate lived experiences of people. Methodologies range from observational to self-reporting techniques using e.g. semantic differential scales, (cf. Ross, 2008; Desmet, Laurans & Hekker, 2009; Kaye, 2007).

I worked with three techniques to gather a rich dataset for qualitative evaluation of the experiments: video documentation, response forms and notes from semi-structured interviews after the event.

Video Documentation
In order to be able to observe the experiment in detail afterwards, it was recorded using three video streams. One wide-angle camera was placed high up at the back of the audience aimed at the stage, framing the largest part of the audience, the stage and the projection screen. This perspective allows for reviewing the general situation in the room and movements of audience members. The second video stream
came from a professional camera, aimed at the presenter on stage. This stream provides the clearest audio from the presenter, as well as the presenters’ facial expressions, movements and posture. The third video stream was the same as the projected image on the screen in front of the audience. This stream documented the actual crowd representations projected and in many of the experiments allows review of the facial expressions of audience members.

Response Form
In social sciences, in particular in attitude research, one way to gain insight in people’s feelings is using semantic differential scales to measure connotative meaning (Osgood, Suci, & Tannenbaum, 1957).

I am interested in aspects of people’s experience related to being involved in group dynamics. For this experiment, I developed seven scales based on concepts related to the aspects that I thought would most prominently discriminate between the different visualisations; Seven to limit the time asked of the participants. The scales have 12 points, thus there is no obvious middle position, implicitly forcing a response in one or the other direction.

Scales developed:

1. In control – Out of control
2. Achieve - Play
3. Free – Imposed
4. Individual – Collective
5. Engaging – Un-engaging
6. Boring – Funny
7. Confusing – Clear

In addition to the scales, the response cards have a space for any remarks a participant might have.
Semi structured interview
Semi-structured interviews were conducted to gain insight and to allow for aspects not foreseen when setting up the experiment. Observations of people interacting with the system, during the live event as well as by reviewing the video footage, provided a basis for the semi-structured interviews. Interviews were recorded (audio only) and I took notes during the interviews.

The basic questions I used to conduct the interviews were chosen to get people to talk and describe their experience in general. The last two questions were targeted more explicitly at experiences of the relation individual-group and individual-system.

- What did you think? – Open question.
- What do you think it is about? – Overall conceptual question.
- What did you feel part of? – Explicit towards individual-group relation.
Designing ‘Mirror’

The basic structure for the technology of this augmented audience mirror system consists of a camera aimed at an audience facing a stage and an image presented to this group in real time on this stage. The presented image is generated by a computer based on the camera feed. This computer can detect specific colours in the camera feed and generates graphics based on the location and amount of colour in the feed. The detection is based on a simple grid, for which the amount of a chosen colour in each grid-square is determined. The generated graphics can be mixed with the original camera feed and sent to a projector to display the resulting dynamic images.

Initially I worked with a detection system based on infrared light, reflectors and a modified digital camera, hoping that way I could eliminate the influence of people’s clothes and apparel interfering with the detection of people’s actions. Even when flood-lighting the audience with levels of a specific wavelength of IR light above legal norms, detection results were disappointing. It turned out that current HD cameras have sufficient colour discrimination and consistency to work with some specific colours that people are less likely to wear. Detection was actually more reliable and less cumbersome with this natural light than with the IR based system. I decided to work with pure magenta (in the CMYK colour system) as it is quite bright and it seemed to be a colour not in fashion at the time. Hence it would easily contrast with the average pallet of hues present in audiences at that time.

Camera

The camera used was a Logitech HD USB webcam, positioned just below the projection screen in front of the audience, approx. 4 meters above the conference room floor at the front. A higher position angled down would have been preferable, but was not achievable with the limited resources and access to the space beforehand. The camera position provided a framing of most of the centre of the audience, with quite a strong perspective, which means capturing relatively few people in the front, and many people in the back. This keystone effect is an issue for the visibility and relative influence of people’s actions in the overall depiction of group. My interest was with experiential qualities of different crowd visualisations. Even if it would have been possible to alleviate this to some extent in computation or fully with differently positioned or multiple camera’s, I decided not to spend resources on solving this issue, reasoning that the keystone effect would be the same in all visualisations, hence not interfering with the comparison between them.

Computing

The Mirror system was implemented using a 2012 MacBook Pro. The image processing and generation was handled by software programmed in Java using Eclipse.

Interactive Graphic Variations

For the experiments at the TEI’15 conference, I prepared 4 basic variations for the graphics generated by the Mirror system.
1. Live Detection Grid
The detection grid is visualised showing boxes filled with the detection colour for boxes in which more than certain amount of that colour is found. In other words, by holding up a card, an audience member can control the display of one or several ‘pixels’ of this grid.

2. Simple Pong
A variation on the classic computer game Pong. On the left and right edges of the screen a rectangular paddle is displayed and a simple ball is displayed moving horizontally. The ball bounces off the paddles as well as off the top and bottom edges of the screen. When the ball leaves the screen on either side, a point is scored by the opposite side.

The vertical position of the left paddle correlates linearly to the number of cards held up by the left half of the audience, or rather, to the amount of colour detected on the left half of the camera image. Similarly, the vertical position of the right paddle correlates linearly to the number of cards held up by the right half of the audience, or rather, to the amount of colour detected on the left half of the camera image.
3. Bounce
Another variation on the classic computer game pong. In this variation no paddles are displayed, but similarly to visualisation 1, a grid is displayed. The computer-generated ball bounces off each filled grid-box and with each bounce its speed increases slightly. When the ball leaves the screen on either side, a point is scored by the opposite side.

4. Flock
A flock of boids (a number of small triangles, resembling a flock of birds or a school of fish) is generated. Each boid is attracted to the others as well as to where cards are held up, or rather, where the card colour is found in the video feed. The background is black and shows small dots of a size that corresponds to the live detection of colour in that area.

In all these variants both the display of the camera feed and of the detection grid can be toggled on and off independently.
Performance
Conference
The ACM conference Tangible, Embodied and Embedded Interaction describes itself as a “multidisciplinary venue for research that addresses issues of human-computer interaction, design, interactive art, user experience, tools and technologies. Focus of the conference is how computing can bridge atoms and bits into cohesive interactive systems (sic)” (“About TEI,” n.d.)

Venue
The TEI15 conference was held at Stanford University, in the Cemex auditorium. It is a wide space with a mezzanine at the back, above the technical booth. The floor of the auditorium has a slight slope up towards the back. A wide stage, one meter high, lines the front of the room and a large projection screen covers the largest part of the front wall. The projector is positioned high up in the middle of the room. The room can hold up to 600 people. At the peak (opening keynote), the TEI15 conference had approximately 320 attendants.

Cards
Each audience member received an A5 card upon entering the conference hall. On one side the card had a pure magenta graphic depicting a resemblance of a flock of birds. The other side was the response form: Three columns, each with the set of seven semantic differential scales and an area intended for writing comments.

Sessions
The total experiment consisted of two sessions each on a different day, which allowed me to adjust the functionality of the system to correct an issue that became apparent in the first session.
The first session was introduced as relating to research on Mediated Group Experiences and participants were asked to complete the response forms. In this session, the audience interacted with three visualisations:

- **Simple Pong** for approx. 3 minutes,
- **Bounce** for approx. 3 minutes,
- **Live Detection Grid** for approx. 2 minutes.

Each visualisation was briefly introduced for its basic functionality. In Simple Pong, there was a mismatch in the mapping of colour detection to position of the bats. This resulted in the pong bats not reaching the full height of the screen. The third part of this session, using Live Detection Grid, at first the audience was asked to generate the game of pong by themselves, but as this seemed too complex, they were then asked to generate a circle.

The second session, a day later, did not include a short introduction to the research. The audience interacted with three visualisations:

- **Simple Pong** for approx. 6 minutes,
- **Bounce** for approx. 5 minutes
- **Flock** for approx. 3 minutes.

The first two visualisations were again briefly introduced for their functionality. The third was only introduced as “a different kind of game”. During and at the end of each session I reminded the participants to fill out the response cards. At the end of each session the completed response cards were collected at the exits.
Session 1
This is a Detailed report on how the experiment was performed on:
January 17, 2015; approx. 12.30-12.45

The first experiment session was conducted immediately following the first paper session of the conference just before lunch. This was the same morning as the opening keynote, a peak day in the conference with respect to attendance. Over 300 people were in the room, roughly half were seated in the centre area that the mirror-camera covered.

Initiating the experiment
The response cards were handed out by student volunteers after the morning coffee-break, as people entered the room for the first paper session. At the start of the paper session, an announcement was made for people to stay in the room for a surprise moment right after the session, that would involve the pink cards people had received. Towards the end of the last paper presentation, I moved on stage to connect the computer and started the Mirror system up and started the recording of the video. When the last paper presentation and questions were done, the moderator of the session introduced me and the experiment.

On the screen in front of the audience the mirror-camera feed was projected. Before introducing the experiment or myself, I asked people to move into the middle of the room as much as possible. I say that if they wanted to be part of the experiment they should be able to see themselves on the projected image. While attempting to herd people along a bit, I gave some time for people to settle down and locate themselves on the screen. After briefly thanking the organisers, I introduced myself and my research with the 4 slides above.

This introduction was intentionally minimal and meant to explain in basic terms why it took place, without revealing too much about my interests, to avoid skewing the outcomes.
Training the system
To get the system to recognise the colour on the cards it needed to be trained. I asked everybody to hold up their cards. By clicking on one of the cards with the mouse, the system was trained to recognise the colour. The result of this training was that on the projected image semi-transparent squares were overlaid in the areas where the system detected the colour. Then I asked everyone to hide the cards, to see if there was any spurious detection and to tune the detection ‘gain’. As there were some spurious detections, I made a joke about it while I tuned the system.

Simple Pong
I switched the system to show the basic pong visualisation, in which the right half of the audience controls the bat on the right side and the other half the other bat. I left the camera feed itself visible, so the game was shown superimposed over the image of the audience. I briefly explained the game and as I was doing I quickly realised that the mapping in software between the amount of colour detected and the position of the bats resulted in the bats not reaching the full height of the screen. There was some control and I let it run for about 3 minutes to capture how people behaved. I explained the error and promised to correct it for a possible later repetition of the experiment. Before switching the system to the next visualisation mode, I mentioned that in this visualisation individual actions were combined into one movement.

Bounce
I switched the system to the next visualisation mode and explained the difference with the previous version of the game. I warned the audience not to make the ball bounce too often, as this would increase the speed. I let the audience play in this mode for about 3 minutes while commenting on what happened. Halfway through I reset the speed and score of the game. At the end, I mentioned the importance for my research of people filling out the response cards for each section of the experiment.

Self-Organising: Circle
I then began a rather complicated explanation of wanting the audience to perform pong themselves, without ball or bats generated by the computer. As I was explaining, I realised this would be rather difficult as a first task of this kind. I asked the audience
to generate a circle. It was clear that people tried, but the result hardly resembled a circle, probably due to the spread of people and the granularity of the visualisation. After a minute or so, one participant asked if it had to be a filled circle or not. I responded that what I saw tended to a filled circle. I let this visualisation run for about 2 minutes.

End
Ending the experiment, I reminded people the importance to fill out and hand in the response form and thanked them for their participation. The moderator of the session took over and closed the morning. Student volunteers were positioned at the doors to receive the response cards from people leaving the auditorium.
Session 2
This is a Detailed report on how the experiment was performed on:
January 18, 2015; approx. 12.30-12.45

This experiment took place again at the end of the morning, before lunch. The total number of people in the auditorium was approximately 200; after asking people to move into the frame that the camera could capture, about 170 people participated. The response cards were again handed out at the beginning of the conference session, and the experiment was announced to take place after that session.

Simple Pong
I did not introduce my research as I had done the day before. I only referred to the previous experiment and explained I corrected the mapping error. I again asked people to move into the frame but there were not as many as the day before. As soon as I had the system trained to detect the colour of the cards, I put the Pong visualisation up. The mapping was better; on one side of the screen the audience could get the bat to reach the full height of the screen; on the other side, they could not get the bat to reach all the way to the top. The total time the audience played with the system in this mode was around 6 minutes. First the system showed the pong game overlaid on the camera feed, after that I turned on the visualisation of the live detection grid. From 3 to 4 minutes I turned off the camera feed. Throughout, I gave less comments that the day before, but did cheer the audience along.

Bounce
When I switched to the visualisation where the pong ball bounces against each detection grid box, I again warned about the speed increase with each bounce. Throughout, the projection showed the camera feed with the live detection grid overlaid. I let this visualisation run for about 5 minutes. I cheered the audience along, and at some point, suggested that people could also move around to fill the gaps. At the end of the session I reminded people to fill out the response form.

Flock
When switching to this version of the visualisation, I introduced it as ‘a very different kind of game’ and didn’t elaborate any further. The projected image showed the flock of boids on a black background, in which the live detection grid was replaced with small dots of a size relating to the live detection of colour. This visualisation ran for about 3 minutes.

End
Ending the experiment, I reminded people the importance to fill out and hand in the response form and thanked them for their participation. Student volunteers were positioned at the exits to receive the response cards from people leaving the auditorium.
Results
In this chapter I present some of the results of the experiments based on the three kinds of data gathering: response cards, observation and video footage and interviews. As I present the results, I discuss aspects of these results that I find most interesting and relevant for this thesis.

Video / Observation
The first session yielded a total of approx. 34 minutes of video footage, the second session a total of approx. of 37 minutes.

In Social Sciences, such video documentation is usually transcribed and coded by at least two independent researchers which results in abstracted descriptions of behaviour. Then models and explanations for this behaviour are proposed and discussed. I did not go to such lengths. I here discuss my observations of the event more generally and in the overall discussion of this experiment I elaborate on this decision.

Most striking from my direct observation and in reviewing the video, is the general level of engagement of the audience with the experiment. Particularly during the different versions of Pong, people laughed a lot; the atmosphere was playful. People cheered and booed, shouted instructions and small applauses occurred when a point was scored.

Presented with an image of the crowd, there was also some behaviour not related to the visualisations per se, e.g. people made bunny-ears over the head of the person in front of them. There was a lot of experimenting with how the system detected the cards. Many people waved their cards, probably hoping the system would detect them better. Once I had mentioned that people could also move around in the space, some people started running around, particularly for the Bounce visualisation. Most interesting behaviours were during the Bounce visualisation. For example, there was a moment where two people on either side of the middle bounced the ball between the two of them several times, which excluded the rest of the audience from the game for a while. Another example: A group of 7-8 people on one side started collaborating directly with each other by forming a long strip of the response cards to form a wall in the visualisation.

A few notes on my performance
Several times I may have skewed people’s conception of what was happening by revealing my interests, for example when I mentioned that in Simple Pong the system aggregates individual actions to a single movement. The second day I made sure not to make such remarks. Several times throughout the experiment I switched the visualisation to include or exclude the live camera feed. Several times I moved the window with the visualisation so I could see some system logging data. Such actions may have contributed to confusions.
Interviews

Five interviews were held immediately after the experiments took place and three several weeks later by means of video conference. Interviews were between 3 and 15 minutes long.

Questions used to guide the semi-structured interviews:

- What did you think? - Open question.
- What did you do? - Descriptive question.
- What do you think it is about? - Overall conceptual question.
- What do you think you interacted with?
  - Explicit towards individual-system relation.
- What did you feel part of?
  - Explicit towards individual-group relation.

All people I approached to discuss the experiment were very open and willing to talk. It was not difficult to engage them in a lively discussion about their experiences.

The people interviewed all said to have been engaged and enjoyed the experiments, though many also expressed concerns with the technological implementation. Most people spoke of the system as an interface to a computational system and many of their remarks had to do with the effectiveness of control of the visualisations. I received much advise on how to improve the system, e.g. by placing the camera differently or to resolve the keystone effect in some other way. Some people were bothered by the delay in the response of the system in detecting the cards. One respondent had created similar systems, but in that case using the movements of people as control input to the system, yielding better individual control.

One of the interviewed expressed concerns with the semantic differential scales on response cards and was curious about how I would go about analysing the results. These concerns related to the scales not being independent and pointing to underlying concepts. This respondent had a lot of advice on qualitative and attitude research methodology.

People discussed the experiments as a whole, and used the different visualisation versions to talk about different aspects of interface efficiency. When I asked people about their experiences relating socially to others in the audience, I often heard my own terms back; it seems I was leading their thoughts. When asked about what they thought they interacted with, respondents mostly talked of the experiment as a game, and playing a game together with the conference community. So they were interacting with a computer, which made them feel part of the community controlling the computer. Two people explicitly mentioned that they thought the performance “brought the people of the conference together” and that the experiment changed
the general atmosphere of the conference. One of these respondents thought that this was because the experiment highlighted aspects of individual contributions to community results and drew parallels to the basic peer-review mechanisms of academia and collective knowledge development.

**Response Cards - Semantic Scale Data**
The number of returned and completed response cards after the first session was 109; after the second session 64. Some people made use of the comments box or wrote comments next to specific scales.

**Differential Scale Data**
Each semantic differential scale was numbered, and the response was coded from 1 to 12. If a mark was made e.g. in between the two left most positions, it was coded as 1.5.

<table>
<thead>
<tr>
<th>Left-most:1</th>
<th>Right-most:12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In control</td>
<td>Out of control</td>
</tr>
<tr>
<td>2. Achieve</td>
<td>Play</td>
</tr>
<tr>
<td>3. Free</td>
<td>Imposed</td>
</tr>
<tr>
<td>4. Individual</td>
<td>Collective</td>
</tr>
<tr>
<td>5. Engaging</td>
<td>Un-engaging</td>
</tr>
<tr>
<td>6. Boring</td>
<td>Funny</td>
</tr>
<tr>
<td>7. Confusing</td>
<td>Clear</td>
</tr>
</tbody>
</table>

There may have been a difference in general attitude of people between the sessions of different days, so a second plot shows the same data but normalised to the average response to all scales combined of one day’s session.
Spider plot 1

Spider plot 2
Comments on cards

In the first session, a total of 21 comments were written on the cards; 5 for Simple Pong, 4 for Bounce and 12 for Live Detection-Circle.

Simple Pong 1
- Cam didn’t reach
- Crowd distribution wrong
- Too fast instructions
- Didn’t get enough experience to really control pong, not sure I could predict cause and effect
- Probably mostly due to technical implementation problems

Bounce 1
- Great balance of individual and collective towards goal
- It was fun that the whole audience sighed together and you felt that you were contributing since you had direct feedback
- Felt easier to coordinate with crowd
- BOTH (this was marked next to scale 4, individual-collective)

Live Detection - Circle
- Resolution disparity, top more than bottom
- There is maybe a thing with the seating and the body movement. Could we move to make a circle?
- Clear but difficult
  (change perspective so each pixel is equal, e.g. On ceiling)
- Depends a lot on your seat in the audience, my seat was not very useful/strategic
- System didn’t seem to respond predictably
- Probably will work better if people are asked to move around with their pink cards
- If the camera was hanging on the ceiling it might have been better
- ??? (sic)
- BOTH (this was marked next to scale 4, Individual-collective)
- (all) the scales (rating) is totally dependent on the verbal instructions, not the visualization
- (all) for all I needed to see myself better or have a way to relocate where I was as the camera(?)
In the second session, a total of 21 comments were written; 6 for Simple Pong, 5 for Bounce and 9 for Flock.

Simple Pong 2
- Needs keystoning
- It became boring quite soon
- (for all) the individual blocking game seems to be the most direct mapping that everyone can relate
- Instead of % use position of cards to move racket
- Fun take on a classic, I would do the second
- System seemed very unresponsive and wasn’t clear that it was behaving as intended, not clear if system responded to feedback from yesterday

Bounce 2
- Favourite experience
- I was seated in the middle
- Pong game is familiar but individual influence seemed less so direct and harder to control, perhaps longer time might have more coherent move
- Collective and individual, well done
- (5 and 6 similar concepts)

Flock
- Not sure what effect my actions have
- Questions 5 and 6 are the same
- Didn’t understand this at all, visually interesting
- Too slow what is happening
- Didn’t seem very clear how we were controlling it. Beautiful visuals though
- The attraction of the fish flow is engaging differently than the previous two, which allows more speculation than just movement
- Too slow… like the reminiscence
- I was here (middle, 3/4)
- Beautiful but unclear. But enjoyed exploring (can’t go wrong aspect)


**Discussion**

The basic intent for this experiment was to gain insight in *if* and *how* different visualisations of audience ‘input’ actions influence people’s individual experiences of interacting in the system, on the one hand in terms of social experience and on the other in terms of interacting with the system.

The data collected can be evaluated in terms of the original experimental set-up. However, the for my inquiry the most salient outcomes of performing this experiment, lie in reflecting on the event and its setup as a whole.

Thus, I here discuss this experiment in two ways. First I elaborate on the original experimental set-up and its hypothesis. Second, I take a step back to consider what people’s responses to the experiment point to in relation to my interests in this thesis.

**Evaluating the Hypothesis**

The two basic questions I sought to answer were *if* and *how* (in what way) experiences of the situation would be different with different visualisations. The hypothesis underlying these questions is:

> An individual’s experience of an audience interface will vary with the kind of representations of the overall audience behaviour that the system provides.

Semantic Differential scale data is usually reported in profile plots of average responses for each scale, as presented above. Statistical analysis of the data can provide quantitative evidence based on which the different visualisations can be validly confirmed as different or similar. Further statistical analysis can provide insight in relations among scales that can lead to deduction of core concepts underlying them.

I consulted with an expert in statistical analysis of this kind of qualitative results, who advised against statistical analysis of the data. It could possibly yield insight in core factors underlying the scales and provide a quantification of the differences between appraisals of different visualisations. However, this expert’s biggest concern was with other factors of the performance playing a much bigger role in the appraisal of the visualisations than the actual visualisation itself. Statistical analysis would not likely give a more valid evaluation or insight, than a discussion of the visual comparison of the plotted profiles.

Judging from the plots of averages of responses on the respective semantic scales, the different visualisations seem to indeed all have distinct profiles in these charts. Particularly relevant is the similarity of the profiles for Bounce 1 and Bounce 2. There was no difference in the way the system reflected people’s actions in those two experiments, the response data reflects such similarity. The profiles of SimplePong 1...
and SimplePong 2 look quite different. This is likely due to a difference in how I altered the way the system was calibrated. That seems to be reflected in the data of people reporting to feel more in control and to find it clearer. It corroborates the assumption that differences in plotted profiles relate to particular aspects of interacting with the visualisations.

Based on these findings, I conclude that the basic if question can be answered positively:

Interacting with different visualisations expressing overall audience behaviour that I presented, do indeed result in different individual experiences. Thus, the hypothesis cannot be rejected.

The experiment was not set up to find causality between specific visualisation properties and particular scales of appraisals of the experience. Looking at the analysis above, however, the data seems to suggest correlation between one visualisation property of Simple Pong and experience appraisals on two scales: when I improved a system-property relating to the control of the pong-bats, the data reflects an experience of Simple Pong that is appraised as more Clear and In Control. Though these appraisals may also have been influenced by me presenting Simple Pong 2 as ‘improved’. Based on the appraisal data I do not see reason to try and deduce other such correlations.

In general, the most distinct difference I intended between the different visualisations, was the extent to which you can identify your individual actions in the visualisation. This aspect of each visualisation seems to relate most strongly to the differences in appraisals on the scales 1 Control and 2 Clarity.

The appraisals did not reflect as clearly other distinctions I had intended to address with the different visualisations, e.g. It is difficult to conclude a difference in goal-oriented vs open-ended experience of different visualisations, reflected in different appraisal of Scale 2 (Achieve-Play) and 3 (Free-Impose). An interesting feature in this light is the difference of Pong and Bounce on scale 4 (Individual-Collective), which seems to reflect my intended difference.

Evaluating the Experiment
This experiment works with the capacity for an audience to self-organise (a.k.a. hive-mind phenomenon). I was interested in participant experience of different ways of representing the self-organisation, not so much in the performance aspects of the interface. The experiment leads to people discussing mostly performance aspects of the ‘interface’ implementation in relation to the systems representation (the visualisations), rather than how they experienced being present in relation to others.
The evaluation of the data, leans towards aspects of interacting with the system that relate to the usability of the system, rather that the experiential qualities of interacting with the system with others. The remarks on the cards and the feedback from respondents in the semi-structured interviews generally point to such usability aspects as well. Initially this was disappointing for me, as I was aiming to gain insight particularly on interaction properties related to more qualitative aspects of social experiences. This leads to a quite fundamental insight: I thought the qualities of the visualisations would influence experiences of being together in the audience. However, and obvious in hindsight, the whole setting of an audience, and one at an HCI conference in particular, already establishes a particular form of being together and a particular perspective on what such an interactive system is about. This is visible in what I paid attention to in building the system, but clearly also in feedback of people participating.

Thus, this experiment engaged with creating forms of being together more in its basic set-up, then in the properties of the crowd-interface implementation. Nevertheless, I have also presented some insights that can be gleaned from the data, pertaining to how basic ideas of collectiveness come to expression in particular couplings of an individual to a group representation.
Blood in the Mobile

In this thesis, I look into how design can bring the many to expression for the one. I have presented several experiments (Sliders, DiffractMe!) that approach mediated group interaction from the perspective of individual experiences at an individual touchpoint, working with qualities of direct perception, particularly the reciprocity of touch. In the Mirror experiment I approached the mediation with emphasis on expressions of the collective. There I worked with larger numbers of people and I was interested in the experience of individual actions in relation to live visualisations of (emergent) collective behaviour.

Here I present two experiments that bring elements of these two approached together: my intention was to make an interaction medium that would easily scale to large numbers of people, while maintaining ideas of direct perception and experiential qualities at an individual touchpoint.

For these experiments, I decided to work with the mobile phone as a platform that relatively easily scales to involve a large number of people. Smart phone apps allow exploration of mediated physicality and the illusion of presence through the meagrely tangible interaction that touchscreen-devices provide. It allows for quick iterations and variations of how the touch-activity of one person is mapped to that of many others and vice-versa. Thus, making explorations of individual experiences of expressions of the crowd possible.

The Spots experiment focusses on developing the basic technological means for this kind of remote touch between many people. The Varramie experiment emphasises the expression forms, the graphical and interaction aesthetics, that establishes a context for social encounters in such a platform.

At the time that I was developing the experiments described here, I was immersed in philosophical discourse that engages issues of complexity and relations of the individual and the social. Particularly inspiring were the visual metaphors (or images of thought) often used to present complex ideas. For example, Latour writes about networks in his Actor Network Theory (Latour, 2005); Sloterdijk expands the nodes of such networks into spheres that together form foam (Sloterdijk, 2008; Sloterdijk, 2016); Guittary and Deleuze work with the botanical image of the rhizome (Deleuze & Guattari, 2013); Merleau-Ponty writes about flesh (Merleau-Ponty, 1968). The title for the set of experiments that I present here plays with this last image: Blood in the Mobile.

I appropriated the ‘images of thought’ quite superficially as a source of inspiration for developing the look and feel of the interactions in the mobile phone apps, particularly in the Varramie experiment.
Spots

This experiment consists of the development of an experimental mobile phone app named Spots. Main focus was creating the basic technological platform that would enable a group of people to interact with each other at the same time. I worked with a very minimal representation of individual actions on local and remote screens. I programmed Spots myself. Similar to how I conducted the explorations with Sliders and DiffractMe!, my approach was to iteratively work with the ‘material’ of the technology to get to grips with how that material pushes back and feeds into my basic ideas around mediating interactions.

Results

Spots Platform
In terms of the system built, this experiment resulted in an app that can be installed on mobile phones running on the Android operating system and a server (running on a desktop computer) to which these apps connect.

When you start Spots on your device, you see an empty grey screen. When you drag your finger across the screen, a spot of approximately the size of your finger follows your finger. These actions are broadcast to other people running the Spots-app via the Spots-server.

When other people with the app come ‘online’, a vaguely visible spot appears with a soft sound and their touch actions leave fading traces. When your spot and one of theirs overlap, a vibration can be felt and a quickly fading ripple is visible, showing a trace of your touch.

Interacting with Spots
When I had the basic functionality as described above implemented and running stable, I announced the availability of the app in a blog post on my research blog and to students at UID. I had created a client for my laptop that notified me when someone started the Spots-app, so that I could interact with them or observe others interacting together.

I never initiated a session with a large number of people. The server logged 63 sessions. The largest number of Spots-apps connected at the same time was 9. Sessions mostly lasted between 1 and 3 minutes. The session with 9 people lasted 6 minutes.
Several people came to talk to me after having tried the app and commented on their experiences. Some people requested versions of the app for the Apple’s iOS. When people interact with Spots, they alternate between ‘touching’ each other and chasing each other on the screen. This seems the same for any number of people interacting in the sessions I analysed.

Several people reported being startled the first time they felt the vibration upon ‘touching’ another spot. Some people said they felt a strong visceral response when interacting with another person. Several times people mentioned that they felt like they were really touching someone, and that it was strangely intimate. Some people found the vibration unpleasant, and that it made them not want to touch another spot. A few suggested to make the phone constantly vibrate and go silent when you touch another spot.

In the session with 9 people, the screen was quite cluttered with spots. Most of the time you would be touching at least one other spot, so there was constant vibration. As it was not possible to find out who these people were, I never got to discuss individual experiences with them. Observing the dynamics of interactions in this case, there were moments that spots moved around more slowly, exploring. When one of the spots started to move more wildly, all spots would erupt in faster and more chaotic movements.

I experienced one individual session myself and observed another between two others, in which the fading traces of moving spots were used to draw characters and pictograms to communicate.

Many people found their interactions initially interesting, but they did not see any point in sustained interactions with the app. Most people tried it a few times. When they did not find any other spots in the app, they sometimes asked a friend to join them, but mostly didn’t try it again. Some people mentioned that they did not like the anonymity of other spots, whereas others said they did like the tension between the intimate experience and the anonymity of meeting with a stranger.
Discussion
While programming Spots I had to make decisions on when a remote spot is made visible and touchable on the local screen. When remote Spots are always visible, you can observe the actions of others without them becoming aware of that. This does not fit well with the basic reciprocity that I looked for in much of my earlier explorations. As also observed in some interactions with Spots, this enabled use of the app for more symbolic exchanges, by taking turns drawing and writing.

The subtle probing behaviour and the playful chasing behaviours observed seem to indicate that the system allows for individual expressions beyond basic co-presence. Judging from the reported intimate and visceral response, it seems that even with the basic visualisations and quite crude vibration functions of most mobile devices, people do experience the overlap of their spot with another as a form of remotely touching someone else.

When many people interact with spots, the screen becomes cluttered and it is difficult to distinguish if vibrations relate to you meeting or others meeting. I can only speculate how people would have (inter)acted when 100 people would be involved, what that would have looked like and how people would have experienced that. But I think it is safe to say that cluttering would actually inhibit large group behaviour to emerge in any meaningful way.

People did not engage for prolonged periods and hardly returned to it. This may have been due to the low chance of meeting others. People lamented that the anonymity in Spots does not allow to build or sustain relationships with particular individuals beyond a session or even beyond an individual meeting of spots. As some people mentioned, there is no goal or motivation to use this app and the experience was too minimal to become meaningful in any sense beyond curiosity or novelty.
Varramie

Varramie is the name of a social medium in the form of an app for smartphones. It was developed in the context of ‘Blood in the Mobile’, the title of a business development project focussed on the market feasibility of some ideas from my research. From a research perspective, this experiment consisted of a more elaborate and detailed design iteration of the mobile phone app Spots. If Spots establishes a minimal form of mutual presence in a virtual interaction space, in Varramie I sought to provide more elaborate and rich forms of remote presence in the shared interaction space accessed through the app. Similar to ideas in Mirror, I sought to explore the aesthetics of the mediated meetings and the space in which they take place within touch screen devices.

Context
Varramie was developed as part of project conducted in the context of an incubator for research outcomes at Umeå University: Uminova eXpression. In the Spots experiment I had encountered my limitations as a programmer to be able to develop Spots further and work with more elaborate graphics and interactions. Discussing such issues in the context of business incubation, it seemed that the interest of the incubator and my research interests aligned to large extent. This resulted in a funding application for a business verification trajectory led by the incubator. The basic business idea was to develop a social media app based on remote social touch. As required for the funding, two business students were recruited by the incubator to assist in the business development trajectory. To be able to create a stable and working app, one software developer/programmer was recruited.

Approach
The overall trajectory of activities around Varramie was that of developing and verifying a business model for outcomes of academic research. The business verification path we followed built on ‘lean startup’ methodology (Ries, 2011): based on initial market research and user feedback, the design and development of the product is focussed on making a minimally viable version with a minimal set of distinctive features as quick as possible. At the same time a user base or community is developed for the product. In iterative cycles of developing and user testing, both user community expectations and product features are intended to converge, aiming for quick market introduction.

This approach seems to fit well with my research interests in this development project. I wanted to explore interactions between large numbers of people. But how to get a large number of people to engage with my experimental designs? We set out to grow and shape a potential user base around the initial research ideas, while at the same time drawing ideas from that community to feed the design. This design approach is different from the business oriented ‘lean startup’. That approach is driven by quantitative analysis of behaviour, whereas from a design perspective we were interested in qualitative evaluation and development of people’s experiences.
Designing Varramie

I here report on the development process mostly from the perspective of designing, more than the business development aspect.

The central question in designing this app is to develop a look and feel that fits well with the initial target users. As I mentioned before, the basic approach both to design of the app and the business development involves the target users from the start, to develop the community, the functionality and design of the app in parallel, aimed at developing a minimal version of the product as quickly as possible.

An initial market scan suggested that the most interesting group of social media users to target for early adoption, are university students roughly between 18 and 30 years old: they are very active and are willing to spend money on this activity.

We started the development in workshops that explored this target group’s experiences of interacting physically together in interaction spaces of different material qualities. Based on insights from these workshops we developed an identity and character for the the social media strategy. This character was articulated in a website and social media presence on major current social media (e.g. Facebook, Google+, Instagram, Twitter). To give a basic idea of what the app could be like we made Spots available for download through these
channels. We also sought feedback from potential users on the character and style of our communications.

Insights from these activities were used to define the basic functionality and look and feel to be implemented by the programmer.

**Interacting with different materials**

We recruited participants for the workshop through social media, targeting students from Umeå University that are active social app users. Two groups of 6 people explored meeting and interacting with each other in media of different kinds.

One table was set up with a 5 cm deep basin filled with soapy water. Participants received a straw and were asked to explore meeting each other blowing bubbles. Another table was set-up with a similar basin, filled with fine-grained sand.

Each group explored each medium for about 10 minutes in silence. Afterwards the groups were asked to discuss their experiences of meeting and being together in the context of the medium.

According to the participants, in terms of meeting, the soapy bubbles yielded the most meaningful interactions. Participants explored blowing their bubbles to a size that it touched another bubble, or they created smaller bubbles and explored bumping them into each other, forming foam.
then explored how their bubble became part and deformed the combined structure. Using the straws, they could change the size of their bubble and move it around to some extent.

The sand invited more towards collaborations on it. It was considered to offer the most symbolic forms of acting together. It was less a form of meeting and more a form of acting on the sand together and seeing the traces that someone had left.

**Character of the medium**

Central to the responses of participants in our workshops and to our interactions through social media, was people’s excitement in the physical intimacy of our basic proposal of remotely touching others. Based on these responses and the result of the physical workshop we developed imagery to articulate the character of such intimacy. This character imagery ranged between gritty and dreamy.

Feedback through social media showed preference towards the dreamier character. With these insights, we decided that the feel of the interactions in the app should reflect the bubble interactions that the soapy-table offered and we used the dreamy imagery for the graphics. From a business development perspective, it seemed that emphasising our location in northern Sweden could give a competitive edge, so we developed a
name for our app based on the Sami language, indigenous to this area.

Creating the App
The basic interaction-functionality for the Varramie app was very similar to Spots. Different was that the ‘spots’ representing a person touching the screen are deformable when meeting other spots. The Varramie app further makes use of the Facebook log-in API to identify individual users. This makes it possible for people to invite their Facebook friends to join them in Varramie. We implemented the possibility to send people questionnaires through the app, and the Facebook log-in makes it possible to link questionnaire responses to logged interaction session. This minimal version of Varramie was developed for Android and made available for free on the Android Play Store.

Preparing for launch
A social media strategy was developed by the business students. Once the app would be available, the strategy aimed to promote the app through social media groups and online media related to social apps, social networking and innovation.

Appearance
The name varramie is a combination of Sami words for blood (varra) and network (viermie)

A logo was designed and graphic identity was developed and implemented in a website and across various existing social media, e.g. Twitter, Instagram, Facebook, Google+. On these social media images and movies of the app development were shared, alongside links to online materials that relate to group interactions and social media.
Results
The project resulted in the Varramie app with basic features and a functional back-end for logging people’s actions with the app and to administer questionnaires. Identity and character for the Varramie app was developed based on target user feedback. A social media strategy was planned and a business plan was constructed.

The social media strategy to achieve pilot testing with large numbers of people was never executed, due to time and resource constraints. The project ended because the basic requirements of the funding were met with the business development report that did not need to include the pilot test. From a research perspective, that means that I cannot report on people’s experiences of interacting with large number of others in this app.

Some interaction sessions happened with up to 5 people during the development. The responses of people were very similar to those to Spots. What was different is that the blobby behaviour of the representations of touch activities, invites to a more playful and subtle interaction explorations between people. This is very similar to what I found when exploring different qualities of meeting dynamics in the slider systems.

Discussion
This project did not lead to a pilot test that may have given insights in the design of Varramie as an interaction medium for groups of people. It is not possible therefore to say much about how people perceived or experienced their interactions with it.

There are some aspects of the setting of this project in the context of business development that are relevant to my inquiry, as it exposes a dimension of mediating roles that I had not thought of before. For my research working with large groups of people is important. For evaluating feasibility of a business idea, market research is equally important. There is a striking similarity between the lean startup methodology and design approaches such as co-design and participatory design in its structure, but different in intent and thus in what is considered relevant information for analysis. Particularly relevant is the aspect of forming the user-community in parallel with the design of the product. This emphasises the mutual influence between a design and the situation it will be used in. Classic design approaches analyse a situation and propose a new design for that situation to change it, but the fact that the very introduction of that design will change the situation is often not part of the analysis or the design process. More recently, co-design and participatory design approaches are intended to engage with this basic circularity issue.

In the Varramie project, making use of social media provided an effective means to engage with groups of people and it seems to have worked, both for shaping people’s perception of the proposed product and for providing insights that helped steer the design and development of the product.
Acquiring the funding required to define the basic concept of the proposed product early on. The goal of the business development project meant that my research questions relating to the look and feel of an interaction space were transformed to issues regarding the way this character would be staged for people as value propositions, and for investors in the context of possible revenue models. It oriented the concept articulation towards a contrast with current social media, yet it framed it in conventions of apps and phone use, in terms of value propositions and revenue models.

From a research perspective, this experiment was focussed on developing character of an interaction space and staging this character. It did not question the very concept of encountering other people as an interaction space. Working with the basic functionalities of the phone and conventions about its use, led to me making a 2d interaction space, and vibration replacing touch. I did not give much thought to the conceptual implications of making Spots or Varramie such a meeting space.

The context of business development introduces a perspective on the designed artifact as a value proposition in terms of financial gain, which leads to aspects of its design related to generating revenue. Developing Varramie in this context invites existing conventions of apps, mobile phone use and commercialisation, which implicitly constrain the directions of development towards the business goals rather than the research interests. In the case of Varramie a minimal viable product in terms of my research interests, concerns the development of experiences of co-presence. From a business perspective, a minimal viable product focusses on the extent to which the design can generate revenue, through pay models or advertising. This introduces elements into the basic experience of interacting with others that get in the way of that experience by mediating interactions between an individual and the owner of the service.

Developing Varramie as a research vehicle similarly pivots the role of the app to that of a mediator between me as a designer and people using the app, rather than a role as a mediator between groups of people. In particular, the possibility to push surveys to people interacting with each other, casts them as research subjects rather than social beings.

Clearly, basic conceptions that frame the design space are entangled with the context in which the design activities take place.
Towards an Aesthetic of Being Together
In this section I string the insights local to each experiment together, to articulate a notion of Aesthetics of Being Together.

I first develop some structural mechanisms of such a notion from my experiences and observations of building and interacting with the experimental designs. These mechanisms relate to decisions a designer makes about the kind of social experiences that can come to expression in mediated interactions. As such they can be seen as quite material elements that give a concrete, particular shape to an abstract notion of Aesthetics of Being Together.

I then discuss how these mechanisms point to basic elements that interaction design works with and how these elements begin to look different in the context of mediated social interactions, essentially posing the question: What is designed?

That leads my discussion to an issue with how in current interaction design these elements are brought together, giving rise to the question: What does aesthetics refer to? This complicates the frame of reference from which such questions can be addressed and I propose the notion of an Aesthetic of Being Together as a transitional theory that opens up interaction design for addressing these questions in ways that current framings cannot.
Structural Mechanisms

My research concerns the design of technological systems that mediate group interactions. In particular, it explores expressions of group dynamics in and through individual interactions with such a medium. Simply put I am interested in exploring and locating basic elements of bringing the many to expression in/to/for the one.

The experiments I presented are a set of probes or lenses that helped to explore and shifted the initial proposition of this thesis. Each experiment articulated these ideas in particular ways, in which my perspective on what my program is about and how that may be approached becomes visible.

In this chapter I discuss the conceptual shifts visible in and leading to the series of experiments by articulating different models of what shapes experiences between the many and the one. None of these cover the full picture, as models tend to be abstractions with particular perspectives and not others, yet through these shifting perspectives on the same area we can begin to indicate what lies between the many and the one. A clearer picture emerges of what designing mediated group interactions deals with.

My proposition that set the series of experiments in motion looks for experiences of the social in individual, embodied interactions with the touchpoint of technology that connects many remote others. Therefore, my experiments do not explore why people would orient themselves to form a group or what the social can be thought to be from an analytical perspective. I simply assume that mediated interaction constitutes a group. I am interested in the design of technology that establishes a relation between a group member and this group. I am looking for a basis and basic form factors for such relations.

The following paragraphs outline models and perspectives that articulate and locate such basic elements, structural mechanisms, that form an aesthetic of being together in my series of experiments.

Basic structure

The way I approached what the mediating technology does in this situation is to separate aspects of the technology that relate to an individual’s action and perception capabilities and aspects of the technology that relate to aggregating the many. The former is what I call the touchpoint. The latter is what for now I call the mode of the medium.
The reason to separate these is to allow talk about qualities of interacting with the touchpoint on the one hand and, on the other, about how the group comes to expression at the touchpoint. This gives some handles on different kinds of decisions that the designer makes to establish a relationship between the many and the one. In the following paragraphs, I discuss several perspectives on or models for these kinds of decisions that I see in my series of experiments.

**Point of summation**

Point of Summation (POS) relates to where the group can be said to come to expression. In the Sliders experiment two versions of the mode of the mediating system lead to very different expressions of the group in the touchpoint. In one mode, each individual is expressed as a bump that can be felt by each other individual, in the other mode the group is expressed as an average position and a force towards it.

In the former mode, a kind of flocking behaviour occurs around a common position. Aggregation happens in the perceptual activity of the individual at the touchpoint. Through explorative actions with a first-person perspective, the individual to some extent gains a subjective third-person perspective on and role in the group behaviour.

In the latter mode, an individual acts on, or to stay with the image: herds, the flock as a whole. Aggregation happens ‘behind’ the touchpoint. An individual is confronted with an induced (non-subjective) third-person perspective on and role in the group behaviour.

In the Haptic Intersubjectivity course in two of the resulting installations the point of summation seems to be ‘behind’ the touchpoint: actions of others result in a combined effect at the touchpoint, it is hardly possible to interact with individual others. Another aspect of how the technology aggregates interactions of the many begins to emerge here. In the Achievement Billow installation, each billow is directly connected to only two other billows. This means that billows are also indirectly connected to other billows via what happens with the billows in between. Here the summation is not a global aggregation by the technology that is reflected at all touchpoints. What an individual interacts with at the touchpoint is a local aggregate of neighbouring local aggregates, that are modulated by other people's interactions with those local aggregates and so on. It is a bit like: I see you seeing someone that I don’t see but you do. It seems that what I called the mode of the medium has aspects of topology (what is connected to what) and propagation (to what extent actions on one touchpoint propagate through a second touchpoint to a third).

The point of summation here cannot be said to be at the touchpoint, nor completely behind it. It shows that those two extremes are merely points in a continuum that relates to where and how the group forms in the system.
In the Tradition Walkway an individual walking across it interacts with a rhythmic expression, rather than a spatial expression. Here the point of summation gains a temporal dimension. Even if there is no mutual interaction between two people across two points in time, you could say there is mutual interaction between an individual and an aggregate of interactions over a past period.

In the Mirror experiments at TEI’15 I presented an audience with different aggregations of their individual actions in a visualisation projected in front of them. What varied between the visualisations was the extent to which an individual could see her influence on the visualisation. In the grid visualisation, when a participant held up a card, this results in a pink square on the screen. There is a direct coupling of their action to a change in a particular location in the visualisation. In the classic pong visualisation, holding up a card contributes to the position of the pong bat. The coupling is less immediate, in the sense that you cannot see the bat jump when you flash your card. Clearly people coordinated showing their cards to position the bat to bounce the ball. In the flock visualisation, the coupling is even less immediate. Holding up a card causes the flock to be attracted to it, but the flock has inertia and is attracted by any cards held up. The influence of holding your card up can only become apparent over time. With the coupling becoming less immediate, the relation between action and effect becomes more abstract. Thinking of the POS as something conceptual, one could say the point of summation moves away from the individual. Thinking of the point of summation as something structural, the field of view and orientation of the camera determines who is included in the group.

In the projects resulting in mobile phone apps Spots and Varramie, the point of summation is at the touchpoint: when interacting with the app, you see spots that each represent individual others. An issue is potential clutter and saturation of the interaction space when many people use the app, particularly with every meeting of two spots resulting in a visual ripple and a physical vibration.

When the point of summation is at the touchpoint, expressing each individual in the touchpoint, there is a potentially overwhelming complexity that an individual is confronted with especially when large numbers of people are involved. When the point of summation moves away from the individual, behind the touchpoint, the individual is confronted with increasing abstraction. Expressions at the touchpoint become less complex but ultimately an individual increasingly interacts with an aggregate, anonymous entity. The role of individual others and the role of the aggregating algorithms is essentially hidden.
Inside-out | outside-in

The idea of Aesthetics of Interaction in interaction design seeks to bridge properties of artifacts and the overall experience of interacting with the artifact. In the case of these mediated interactions between people, a layer of complexity is added as people interact both with the artifact and with each other. Thus, interaction design needs handles on and vocabulary for how interaction attributes, qualities of experience at the touchpoint and qualities of social experience come together. There is a kind of layering here that design navigates to develop alignment between these layers; it works from intended qualities of social experiences, via qualities of the experience of interacting with the artifact, to attributes of the touchpoint, and back; from outside-in to inside-out.

When talking about interactions in a group it is counterintuitive to talk about inside and outside of the group. In the case of mediated group interactions, we have a situation where an individual takes part in the mediated group with a touchpoint. The touchpoint forms a kind of outer boundary to the mediated group for a person interacting with it. Thus, what happens between an individual and the touchpoint can be considered to have a direction of outside-in, from the individual into the group. Inversely, what is expressed at the touchpoint has a direction of inside-out, from the group towards the individual. This should not be confused with a model that equates the separation of input and output to the separation of action and perception. In that case, you talk about sending a signal into a system, and that system sending a signal out.

What I point to here has to do with the relation of two layers of experiences; the experience of what happens between a person and the touchpoint and separate that from the experience of what happens beyond the touchpoint, the social dynamics. This is useful to begin to tease apart what qualities of the quite sensorial experiences at the touchpoint relate to qualities of the social experiences that come to expression with them.

Above I made a similar distinction between qualities of interaction at the touchpoint and the mode of the mediation. Here I make a distinction between qualities of the experience at the touchpoint on the one hand, and the qualities of the experience of interacting with what lies beyond, the experience in the mediated group, on the other, bracketing the mode of the medium into that.

In the Slider experiment I brought forward that the technology of the force feedback is not transparent. It introduces modulations on what passes through and in doing so it affords particular interactions with what lies beyond the touchpoint. I talked about this as the quite material qualities that affect our experience of interacting with others through it. It seems that the materials of this boundary layer, at the touchpoint, influence our interactions with what happens in the medium:
outside-in; starting from qualities of the experience at the outside, the qualities of the experience of the inside are affected. But what are those qualities of social experiences, how do we talk about them?

Drawing a parallel with the physical properties of a handshake and their relation to our impression of the other person, in the Haptic Intersubjectivity course we explored the other direction, inside-out; Starting from motivational values as qualities of relating to others (the inside), we looked for qualities of interactions in haptic touchpoints of mediating systems (the outside).

In DiffractMe! we worked outside-in. Starting from subjective, embodied understanding of individual skills we worked towards how they influence our experience of interacting with others. This project surprisingly led to a shift in thinking about what is included in the inside. The physical and social context in which the installation is placed is not technologically connected to the touchpoint, yet the experience of the technologically established relations did have a performative relation to that context.

Mirror is a little harder to discuss with this model. On the one hand the experiment explicitly starts from visual metaphors of the group and explores how participants experience their relation with that through minimal qualities of interaction from the outside perspective. In that sense, it works from inside the group out to the individual interacting with it, from visual metaphors expressing the group to how a participant experiences relating to that. What people interact with is maybe not as much the group as it is the visualisation that is controlled by the group. Thus, the group is not as much constituted by interactions with the visualisation as it is by being together in a conference hall. Their relation with the visualisation then is more about the extent to which the group that people already take part in has control over the visualisation.

The mobile phone apps Spots starts from similar ideas as the Slider experiment, in that it seeks to establish some form of remote touch between multiple people using a mobile phone with a touch screen. This approaches the relation between experience at the touchpoint to experience in/of the group from the touchpoint, thus from outside the group into it. With the development of Varramie at the same time I sought to introduce a visual and verbal language intended to frame the social experience in a way that would resonate with the physical, bodily character of touch and tangible interaction. This foregoes the idea that social experiences emerge from the experience at the touchpoint or vice versa, and seeks to approach both at the same time (sideways :)

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Signal | Relation

In the previous paragraphs, I often use words like pass-through, mediate, give access to, outside-in and inside-out, conduit, channel. Such words imply that there is something travelling, something moving, quite physically, through or in the medium.

When you think of people interacting as a form of communication, and you model that communication as the transmission of information from one person to the other (as the classic Shannon model of communication (Shannon & Weaver, 1964, p.7), you need a set of concepts like: information source, message, transmitter, signal, channel, noise, receiver, information destination, encoding, decoding, information rate, bandwidth, channel capacity, etc.

When we look at my experiments, many of the basic concepts of the Shannon model do not make sense or gain another meaning. Quite central to these issues is that the classic model assumes a direction of transmission that identifies a sender and receiver and implies a unit that is transmitted, a message. It does not seem useful to break things up like this when relating to others is something reciprocal, as in a handshake. Once interaction happens, it becomes very difficult to separate action and reaction, as they mutually shape each other. It does not make sense here to talk about a message as a package that is encoded, transferred and decoded. Talking about what is exchanged in the sense of intent and impression probably does more justice to what goes on.

Interaction as communication makes a basic assumption of the directional dichotomy sender to receiver. What people experience in mediated group interaction is shaped by all participants at the same time. Cutting things up in what is sent and received focusses on the properties of the channels and at the same time loses attention for what happens across and in them. It seems to make more sense to shift focus from what is transmitted to what comes to expression, what is experienced and the kind of relation that unfolds.

Much of human-machine interaction, CMC, CSCW and by inheritance our social media, build on the Shannon model. In these fields the ideal for the medium (or interface) is to become transparent. From my explorations, I conclude that transparency is an illusion if it means that the medium is imperceptible or has no influence. It may be that the medium shifts into a role that is more in the background of the experience of interacting with others, but that does not mean it does not take part in it. On the contrary, it is the very medium that frames the kind of relation that can develop with it. I have elaborated on the issue of the relation of signals and bandwidth with experiences of presence, in a the paper (Lévy & Kuenen, 2011).
Channels, spaces and things
Throughout this thesis, I talk about (technologically) mediated group interactions. As a designer, I am interested in the role the technology, the medium, plays in shaping the interactions between people. While working on the different experiments I conceived of and characterized this role in different ways.

Above I have talked about the touchpoint as something through which something passes, like a channel or tube. When working on Sliders I drew diagrams of nodes connected by lines, where the lines stood for exchanges of bits between different electronic modules that controlled the movements of the sliders. I talked about how the properties of the medium influence (modulate) these exchanges, where the medium is thought as a conduit, a channel.

When describing the different modes of the slider system I talked about the different kinds of interaction spaces these modes constituted. One can be thought a meeting space in the force domain, the other can be thought a one-dimensional meeting space of the linear actuator. Both these spaces are quite invisible, you can only become aware of the interaction qualities of those spaces by engaging in them. When beginning to work on DifractMe! one starting point was to make such qualities of the interaction space quite visible, while at the same time talking about bringing the role of this space as a kind of channel through which people interact with each other to the forefront. One could also argue that the array is more of a shared object, a thing, that people interact with, and -again- through the object, as a kind of conduit, with each other.

In the mirror experiment, the moving pong-bat clearly is a shared object. In the flock visualisation, the flock is the thing that participants act on, but it is more problematic to call that a shared object (or even a thing at all).

The screen of the mobile phones running Spots/Varramie is a 2D interaction space in which the touch actions of others are represented. The spots are minimal avatars in that 2D space, exploring and meeting other spots elicits a surprisingly intimate feeling of being co-present. In that way, the app can be thought a conduit of presence. Some people use the 2d space as a canvas to draw pictures and letters, using the medium more as a classic communication channel.

These different conceptions of what the medium is, relate to different roles that it plays in (mediating) our experience of others. The experiments illustrate that these are not static designations. In our mediated experiences of others, the way the role of the mediating technology can be described seems to shift depending on what kind of aspects of the mediation receive emphasis.
Conceiving of the medium as a channel, induces a conception of another person’s presence as a unit that can somehow be objectively transferred and leads design to consider properties of the channel such as bandwidth and transparency. Conceiving of the medium as a space shifts conceptions of presence to something more active and subjective and leads design to consider action possibilities towards others, how those interactions are staged and programmed in architectural sense. Conceiving of the medium as a thing, emphasises presence as action potential towards the thing and leads design to consider the purpose of shared action or function of the thing.

In the discussion above on the point of summation, I talked about the ‘thing’ that is the aggregation of actions of many others. In this ‘thing’ both the medium and the actions of others are present. This ‘thing’ comes to expression in our interactions with the touchpoint, we become aware of it at the same time we take part in it. Clearly when design engages with experiences of mediated social dynamics it deals with a quite fluid conception of what is designed. Thinking of the mediating technology in terms of a channel, a space and thing leads designing to different aspects of experiencing presence and how they relate to the quite material decisions that design is familiar with.
Summary

If the interaction media we use have agency in our social world, we need to get to grips with how design approaches that agency and explore how to open-up mediating technologies for the ways they shape our being with others.

The structural mechanisms I have outlined in this chapter pertain to different kinds of conceptions designers work with and decisions designers are confronted with when designing relations between the many and the one. They can be seen as dimensions of the design space in a quite structural sense, but also point to conceptual, more abstract aspects of designing mediated interactions.
Towards an Aesthetic of Being Together
The Whole

The Objects of Social Mediation
The structural mechanisms I presented, portray the mediating technology in a particular way, i.e. by what means the medium brings the many and the one in relation. Thus, the medium is conceived of as a kind of instrument or tool for social interaction. Yet, these mechanisms imply another issue in designing interactions that requires a slightly different framing: What is it that an individual interacts through|in|with|on? What is the object (the thing) in this interaction? On one hand an individual interacts with (a group of) other people: the relation is through the medium and in the group, or through the medium on the group. On the other hand (and at the same time) the individual interacts with the medium itself, which includes mediated others: the relation is with the medium on the group (or with the medium in the group).

In this thesis, I ask the question of what an individual interacts with from the perspective of that individual. This is a question about what that thing is for this individual. This question concerns a kind of ambiguity or circularity.

The structural mechanisms I discussed before (Point-of-Summation, Inside-Out|Outside-In, Channels|Spaces|Things, Signal|Expression) are all different ways of looking at what lies between the many and the one. It is not the case that when designing mediated group interactions, we can work with any one of these alone; the relation of the many and the one is not defined by one of these. What we need to deal with is a constant shifting between these perspectives, yet they all target the same. Furthermore, as I have attempted to point out in their discussions, there is a similar shifting within each of these mechanisms.

What I point to here is similar to the basic figure-ground relation between tool and task or the object and the experience of engaging with the object that is familiar to design. Yet in the context of technologically mediated group interactions there is a difference. Design typically deals with shifting between shaping the object and shaping the acts people perform with them in terms of tool-task duality; oscillating between paying attention to the hand and paying attention to the tool, design resolves how the artifact mediates person-world relations. The structural mechanisms I discussed of course relate to the figure ground duality in the mediating role of technology between people and world. In the case of mediated group interactions, it is the precise qualities and structure of the medium that on the one hand determines what ‘the one’ can be thought to be in the context of the mediated group, and on the other what ‘the many’ can be thought to be, in the context of the mediated individuals. To be sure, in each of these assemblies, the medium itself is of course present, it has agency in constituting the person-tech-world relation.
What is not trivial here is that the duality between what the person is in the context of others and vice versa, is an additional ambiguity to oscillating between tool-task orientation. In the case of mediated group interaction, the ambiguity pertains to being together in addition to doing things together. Design then also oscillates between attending to the individual and the group she takes part in. The experience of being together, of presence, of one other is already quite different and much more specific than experiences of performing certain tasks. Think of the experience of someone watching you, or the experience of seeing that someone sees you seeing them. Then compare that to the experience of hitting a nail on the head. If you then think of experiencing presence with many, this obviously has qualities that are hard to capture in terms of basic tool-task mediation alone.

Thus, the question of what it is that an individual interacts with, when the many and the one are brought into relation through technology, has no singular answer. Answers to this question can be of different kinds that point to different perspectives on what that question is about.

We can answer that question pointing to the relation between a person and the technology. Much of my experimenting deal with this. It’s about how the medium becomes an object in our experience. This leads to asking the question from the perspective of what the objective is of that interaction. The answer to that question has to do with the kind of relation that is established with others and what that means to an individual.

We can also take a kind of inverse articulation of the question. What is it that the medium expresses? How do we express ourselves with the medium? Or similarly, how do we get expressed by/in the medium? What seems to be the most difficult is to get a grip on what the central target is of these questions. The kind of answer to that issue seems to lie at the level of ethical, political, societal conceptions of what being human is about, and this is qualitatively different from asking about task performance.

Through the collection of experiments, I have approached ‘the what we interact with’ issue mostly looking at the ‘micro’ experience at the touchpoint, which has led me to some insights in how that relates to the ‘macro’ experience. In some ways, I looked to overload the micro-experience with aspects of the macro-experience that do not necessarily come to expression in that way. In the description of the individual experiments I discuss such basic expressive mechanisms that bridge the micro-experience and macro-experiences. Here I iterate only a few: In the Slider experiment, there seems to be inherent basic meaning in the exact dynamic of perceptual crossing, and we saw how technological properties can influence that dynamic; In the DiffractMe! experiment some of the relation between micro and macro came to the surface, in that the micro-experience of interacting with the installation became ‘instrumental’ to develop skilful acting together as performers.
Apart from these basic elements, it seems that micro-experiences gain meaning at a macro-experiential level through prolonged use and staging or narrative around them. My last experiments began to explore this aspect. I would conclude that both micro- and macro-experiences over time influence and are influenced by what we believe (and are ‘led’ to believe) the medium does and thus is for.

‘The Social’ | The Medium
Throughout my experiments and this thesis, I have used the word social to indicate quite generally other people. In each of my experiments the other people this concerns, varies in scope.

In Sliders the social indicates those people in contact with touchpoints of the medium. The social dynamic is confined to what happens within the system, and the focus is on how that relation is quite technically constituted at the touchpoint. In DiffractMe! the relation with the touchpoint starts entering into a relation with what is outside of it, and inversely, that outside relation starts entering the experience of the relation with the mediated others through the touchpoint: Skilfully acting together establishes a relation performer-spectator. Here I see two ways of talking about ‘the social’, people in contact with the touchpoints and people outside of that system.

In Mirror, we also see how the already present social context, the audience as a group, gives a particular meaning to the relation between the individual and the mediation system. The qualities of interaction with the touchpoint that I varied are experienced from the perspective of individuals that are part of that already established group. The reported experiences of the visualisations are more in terms of control of the visualisation, and less in terms of interacting with other people. There are at least two ways I talk about the social here: there is the already formed group, the audience, and there is the group as delimited by the technological system, in particular the camera. In this experiment these two coincide, but it’s not the system that constituted the group in the first place. Yet, within these coinciding delimitations, e.g. in the SimplePong experiments, the audience is split into two separate groups each controlling one of the bats.

In the app Varamie the intent was to begin forming the user-community and the expression of the app (the medium) in parallel. Even if we were not successful in rallying lots of people or completing a full product development cycle, the project leads to the realisation that different kinds of social contexts have mutual relations with the expressions of the social medium, or at least there are different perspectives on the relations between an individual and the medium that are of mutual influence. For example, the app as a generator of business revenue, casts a light on the experience of relating to others as a resource with monetary value; the app as a research tool casts a light on people as test subjects.
What I emphasise here are several ways of talking about the social. There is the quite structural way, that separates ‘the social’ as delimited by who is included in the interactions within the technological medium from ‘the social’ context that is outside of this delimitation.

There is also a more conceptual way of talking about the social that has to do with the meaning of relating to others, that is intertwined with such more structural perspectives. When we want to talk about such intertwining we need to look at structural elements and how they come to be conceived of as a whole.

**Assembling and Framing a Whole**

The structural mechanisms that I presented previously are not an analysis of what the mediating role of technology in general can be thought to be about. I have no pretence to portray them as theoretical elements of a philosophy of technology or science and technology study, though they clearly resonate with (post-) phenomenological ideas in those fields of studies. I present them to give insight in some of the theoretically informed concepts that led to realising the series of design explorations that is at the heart of this thesis. Through these explorations, I attempted to open up ‘what lies between the many and the one’ in order to be able to design technology that operates in that chasm.

Central to my process of opening up and to the structural mechanisms I present is a quite materially oriented drive to find basic elements or components, the building blocks for the technological medium that forms and shapes the relationship between the one and the many, an individual and a mediated group.

My approach is rooted in a way of doing constructive design research in the field of interaction design that responds to and extends interaction design discourse originating in HCI and CSCW. This approach assumes the structure depicted here and proposes design strategies and ways of working that can help bridge these levels.

```
| basic responses of an artefact to a person’s actions      |
| (interaction attributes)                                  |
| <->                                                      |
| qualities of experience of interacting with artefact     |
| (qualities or aesthetics of interaction)                  |
| <->                                                      |
| qualities of the experience of others                     |
| (aesthetics of being together)                             |
```
In the following paragraphs, I first zoom in to show that breaking things up in this way has yielded valuable building blocks that contribute to the shaping of relations between people through technology. But as I zoom back out to look at experiences of being together as a whole, I will point to a central issue of this approach for my project: it essentially presupposes a very particular way of framing the ‘whole’.

**Interaction attributes**

When I talk about interaction attributes (or physical properties) I mean things that are close to the artifact that have to do with immediate action-perception loops when interacting with it. Things that can be described and evaluated in design terms as how things *feel* in terms of our physical senses. They respond to the design question ‘How’ in material terms. In my Slider experiment I thought of the properties of the force-feedback system in such terms. Similarly, in the Haptic Intersubjectivity course these are the aspects dealt with in the context of sensitising towards haptics. In DiffractMe! these are salient qualities of experiencing a skill.

The frogger framework points to such attributes through the designed mapping between a person’s action and the response of the artifact. This framework serves to structure interaction attributes; it describes the basic dimensions that make up a ‘feel’ (Wensveen et al., 2004).

**Qualities of interaction in use**

If we take the other direction, towards the expressions of a particular interaction attribute, we move towards the *what or why* question of designing a particular feel, what experience we try to elicit in the design. How an individual experiences a particular feel of course cannot be designed directly, but a particular ‘feel’ does shape such experiences and the designer can work with interaction attributes that contribute to intended profiles or characters of the interaction.

As we start moving closer to an overall individual experience, interaction attributes gain a conceptual dimension towards meaning, in how they bring intended function to expression in using the product. Particular interaction attributes then relate to qualities of the use experience.

In the context of interacting with everyday products like alarm-clocks, camera’s, lamps and blenders bridging these two conceptual levels is starting to be consolidated in the discourse. Some heuristics, in the form of an Interaction Vocabulary, have been suggested to relate particular attributes (generally) to particular experiential qualities (Lenz et al., 2013). Attributes and qualities here pertain to use experiences, and expand ideas in interaction design from a purely utilitarian and cognitive orientation to emotional, ethical and social aspects of use and skills of people.
“Aesthetic Interaction consists of four principles: Aesthetic Interaction (1) has practical use next to intrinsic value, (2) has social and ethical dimensions, (3) has satisfying dynamic form, and (4) actively involves people’s bodily, cognitive, emotional and social skills.”
(Ross & Wensveen, 2010)

The frame of analysis in that discourse is at the level of overall aesthetics of interaction, where the scope of the aesthetics of experience is constrained to what an (interactive) product can be used for: A lamp gives light, aesthetics of interaction is in the experience of directing the light.

What I find interesting in these approaches is that the designed qualities of interaction are clearly shown to intervene with and shape the behaviours of people using interactive products. As I discussed in the chapter Aesthetics of Interaction, several approaches to designing for qualities of interaction have been developed that are productive and successful in shaping behaviours that elicit particular emotional, ethical and social aspects of the use experience. (Ross & Wensveen, 2010; Trotto, 2012)

Purpose and Expression
As I have discussed in the context of the Haptic Intersubjectivity course, it proved difficult for designers to work with shaping social dynamics without a reason for people to interact other than the experience of interacting with each other. This is an issue that permeates all experiments.

One could argue, based on basic phenomenological perspectives on relating to the world, that experiences start from intentional actions, as such it is indeed senseless to think about and design interactive technologies without a purpose in terms of practical use in mind. I see a fundamental chicken-egg problem here: How do we come to recognize this practical use of something? Furthermore, what is practical use when referring to social interactions?

When design engages with mediation of social interactions, we effectively replace the natural with the artificial. On the one hand, we can then strive to transparency of the artificial to arrive at (an illusion of) the same natural situation, on the other hand, we have an opportunity to make use of our natural dispositions to explore how they relate to this artificial situation and what meanings and behaviours may arise.

To stay with the phenomenological perspective on this meaning making, what my project is not about is to embrace ethical or social aspects of using a hammer to arrive at a richer, more fulfilling experience of using a hammer on a nail, and to
possibly ‘nudge’ people, influence people’s behaviours, to not use it to hit another person’s cranium.

What my project is about is to explore how design can engage with people’s sense-making of the artificial world of mediated social interactions, in particular of the dynamics of many people interacting. It is about finding out what that might mean and what we learn in the exploration. This may seem a bit like making a tool and then figuring out what it may be for. And yes, it is exactly that. However, what my work addresses is that the very concept of what use, purpose or tool is in the context of social presence has a different meaning.

I have leaned heavily on approaches to aesthetic interaction that revolve around a specific use or purpose of a product and they provide methodological insights and footholds for my project and what emerges from it. In hindsight, this has proven to be a limiting scope or perspective for my own efforts. From the outset, I have been looking for basic aesthetic qualities that relate to other forms of being together than current social media offer. With that orientation, I ended up with much more detailed ideas regarding basic, structural mechanisms that shape expressions at the touchpoint that we can work with when designing mediated group interactions.

Though myopic in its original framing in hindsight, my exploration leads to quite fundamental questions about what the medium can be thought to be, what roles it has in shaping the experience of relating to others. The question of purpose or practical use in the context of bridging the many and the one leads to the issue of what the whole of mediated group interactions can be thought to be and how those conceptions are formed. This points to an issue in the models for aesthetics of interactions that I built on: they do not account for conceptions of the usefulness of things that are formed by the expressions of things, when the use concerns being social itself rather than performing an instrumental task in a socially oriented way.

Breaking things up in properties and attributes that lead to qualities that lead to experiences, seems to work in the case of a known and fixed practical use, which frames ‘the whole’ of human-product interaction in one way. The whole I am trying to approach seems to need a different, to some extent inverted, framing: the social meaning of interaction media points in another direction than the social meanings of use-acts. This is similar to considering aesthetics as a notion that orients designing to the existential presence of artifacts as developed by Redström and Hallnäs (cf. Hallnäs & Redström, 2002; Hallnäs & Redström, 2006,p.137-140). That notion originally has a scope of an individual and an artifact. For this thesis, it seems relevant to extend it to pertain to the existential presence of collectives in the context of artifacts that shape interactions between people.
Summary
In “The Objects of Social Mediation” I have discussed two fundamental questions that arose through the series of experiments. The first question concerns how wholes come to be present in our experience, how do we come to conceive of something in a particular way. The second question is a different way of asking that same question, but emphasises what we interact with in the case of mediated social interaction.

I presented some of the basic elements of a social medium that I found in my series of experiments that form its basic structure and in turn how those order the relation of the many and the one that it mediates in particular ways. They contribute to answering the first question, of presence of wholes, with ways that the many come to expression at the touchpoint quite technically; how the many can be made present at the touchpoint. They contribute to answering the second question, what we interact with, with the different ways of conceiving of the wholes that such ordering reflects and brings to expression.

These ways of addressing the basic questions do not immediately contribute to answering the questions from a perspective of meaning. That would be like trying to answer a question like the meaning of green, or the meaning of a line-segment. Or, more relevant in this thesis, what for example is the meaning of aligning one’s actions with those of many others?

What emerges in ‘Assembling and Framing a Whole’ is that current notions of aesthetics in interaction design address these questions in a particular way that does not seem to support orienting interaction design to the meaning of social interaction.

The frame of reference for current notions of aesthetics assumes a way of assembling properties, attributes and qualities of interaction in an aesthetic experience that has a scope, a framing, of the individual-with-artifact with an instrumental objective. That frame of reference addresses the question what we interact with from the perspective of its instrumental, practical use in terms of task performance. At the same time, it addresses the question of the whole in terms of the quality of the instrumental presence of the artifact.

The way that this thesis addresses the questions of what we interact with and the conception of a whole that that corresponds with, clearly requires another frame of reference than is present in interaction design today. The notion of Aesthetics of Being Together is a transitional theory intended to provide such a framing. It is a frame of reference concerned with the presence of things, not in terms of practical purpose, but in terms of the presence of the collectives that they bring to expression.
An Aesthetic of Being Together
I began this journey with an interest in relations between one person and many people using technology. In particular, I sought to explore how interaction design brings experiences of being together with others to expression.

What I experienced as my work progressed is that current interaction design practices are not conducive to such an orientation. Examining the friction, I experienced, what I found is that basic conceptions of foundational elements of current interaction design practices actually inhibit interaction design to approach any experiences that cannot in the first place be conceived of as useful in the sense of instrumental task performance.

The question then is what enframes interaction design in such a way, and what does it take to escape it? And here the trouble starts. What enframes is a frame of reference, and as such it is an assemblage, a composition of concepts, perspectives and approaches, that is not easily referred to as a whole.

But we are in luck: designing is all about making compositions, and it has found a way to indicate and talk about what brings such assemblages together in the notion of aesthetics. Whereas in design practice such a notion generally refers to what comes to expression in a particular designed artifact, what I point to in this thesis is what comes to expression in a particular design practice. Such a notion of aesthetics is similar in kind, but in the context of design practice it is intended to more urgently address how a particular notion of aesthetics enframes what designing is about, which we encounter in its foundational elements and what it refers to.

Thus, in what follows I seek to indicate the whole that comes to expression in my design research practice. This is still a notion of aesthetics that indicates a composition, but it indicates an assemblage of concepts, ways of working and objectives that emphasise what happens between people, while providing handles on what happens between an individual and a designed artifact.

In this chapter I first seek to give as clear an image of the composition this thesis points to, i.e. the notion of an aesthetics of being together, through the trajectory and elements that compose it. I then briefly discuss its relevance for interaction design and implications for industrial design in general. I conclude this thesis pulling on some of the loose ends and projecting them into future research threads.
Assembling an Aesthetic

Aesthetics and Design
Design deals with matters of aesthetics. It does not answer the question what Aesthetics in general is. Instead, in giving form to artifacts, it develops and expresses particular notions of aesthetics that guide the design practice. This practice is oriented towards people and their experiences, while it works with properties and features of stuff. Particular notions of aesthetics provide a logic of expression for bridging that gap in particular ways. Design thus shapes the presence of the artificial in our life, guided by the notion of aesthetics it brings to expression through artifacts.

Particular notions of aesthetics in design thus reflect basic conceptions of key elements of design practice, i.e.:

• what the object to design is (e.g. a tool),
• what a person is (e.g. a user),
• what the role or task of the designer is (e.g. bringing clear messages about intended use to expression), and thus
• what the relation is between the designed and the person engaging with it, what its objective is (e.g. task performance).

Research that looks into how these elements come or are brought together in design practice inherits a structure from such basic conceptions in a similar way that the act of designing relies on them. Particular notions of aesthetics set design research practice up to investigate these issues in particular ways, in a particular form.

Clearly, basic concepts, ways of working and objectives are completely intertwined. Notions of aesthetics allow design to address this intertwining, this assemblage, constructively by making things to bring such a notion to expression.

The arc of my inquiry starts from one such assemblage in interaction design to explore a particular interaction situation and objective. My series of design experiments leads to the need for another assemblage that can configure interaction design and its research practice in that situation and objective.
Unfolding

Whereas interaction design is generally oriented towards the experiences of interacting with a computational artifact, in this thesis I look into what interaction design is about when that practice is oriented towards experiences of interacting with people using mediating digital systems. In particular, my inquiry concerns how interaction design can engage with experiences of being present with many others.

I conducted my research by designing and building systems that in some form or other mediate interactions between groups of people. Relying on particular approaches to interaction design that focus on the experience of interacting with an artifact, I sought to probe into social aspects of the experience of interacting with networked artifacts that mediate interactions between groups of people. Thus, my experiments built on a particular logic of expression for bridging material properties and experiential qualities; as such, the experiments bring theoretical concepts to concrete expression.

As my inquiry progressed from one experiment to the next, I experienced a growing tension between what I saw coming to expression in the experiments and articulating that within the conceptual configuration that I relied on.

Through the series of design experiments, I found what I identify as structural mechanisms in the designing of mediating systems that order the relation between the many and the one in particular ways. These can be considered as quite material elements for designers that shape mediated collective experiences. Yet, they are different from the kinds of material elements considered in the notion of aesthetics of interaction that I initially relied on.

If these design examples are concrete expressions of a conceptual configuration, this begs the question what these theoretical concepts are that come to expression in these experiments. It seems basic conceptions of key elements in interaction design get pushed beyond their comfort zone. What emerges here is a need to reframe what the logic of expression is that these elements give form to.

Evidence vs Potential

My experiments do not yield evidence in the way that experiments in social or natural science may provide proof of a hypothesis. Rather, individual experiments propel my design inquiry and, as a series, show potential towards resolving fundamental issues in a design proposition. Thus, I do not claim that my experiments provide evidence for the structural mechanisms I developed from them. While these mechanisms are meant to be useful for designing mediating systems oriented to the kinds of collective experiences they bring to expression, they also point to fundamental issues in notions of aesthetics in interaction design that formed an initial basis for the series of experiments.
The difficulty here is to not only draw attention to the things that are pointing, such as my experiments and their positioning in this thesis, but to articulate the potential they hold and what this thesis as a whole points towards.

**Conceptions of Aesthetics**

In the Framing section of this thesis I have outlined how my inquiry is a next step in trajectories in interaction design that show a growing concern for matters of aesthetics, in particular when interaction design is pushed to address the roles computational systems play in shaping our everyday experiences now that they permeate our social interactions with others.

In the chapters explicitly dealing with aesthetics in (interaction) design, what stands out is that different notions of aesthetics in design refer to different things. Conceptions of aesthetics have a character of referring to some elusive whole that is hard to make fully explicit, yet they serve to structure and orient the design activity in particular ways, and they come to expression in the designed artifacts. In my experiments and in my articulation of the structural mechanisms that interaction design encounters when oriented to mediated collective presence, we see the same basic question: *what is it that aesthetics refers to?* What is aesthetics about when we do interaction design oriented in this way?

Clearly aesthetics here is something else than when we are doing products in the sense of classic industrial design. Aesthetics here also refers to something else than the experience of using a digital artifact, as it generally does in current aesthetics of interaction. Aesthetics here even refers to something else than the existential presence of the artifact itself. Without doubt I am not able to answer the question of what aesthetics refers to in the context of designing digitally mediated interactions, but my work points to the kind of whole that interaction design oriented to social experiences works with.

What I found in the course of my research is that current conceptions of aesthetics in interaction design are not very supportive to orienting its practice towards social experiences. On the contrary, current notions of aesthetics in interaction design actually hinder (research) practice to be able to explore other qualities of social presence of others. While current notions of aesthetics of interaction orient towards the experience of using an artifact, they do not (cannot) address the notion of the artifact as a useful thing, or the notion of interaction as use. Thus, even when such notions include orienting interaction design to social aspects of interacting with an artifact, they somehow remain anchored in instrumental conceptions of people, artifacts and interaction. This limits the kinds of social experiences that interaction design can be oriented towards when building on such conceptions of aesthetics for designing mediated interactions between people.
A notion of aesthetics as referring to existential presence allows interaction design to address the very conceptions of an artifact, what the artifact is (e.g. a tool), and what interaction is about (e.g. task performance). Such a notion of aesthetics provides a logic of expression that can guide the design of an artifact towards the expressions of use-acts and thus to the existential presence of the artifact (which may very well be as a useful thing in terms of its instrumental purpose). Such a notion does not negate a notion of aesthetics of interaction that targets the qualities of interaction between a person and a useful thing. Instead it provides a reframing of what aesthetics refers to in addition to such a particular framing as in aesthetics of interaction. This opens interaction design up for other kinds of such framings, expanding the kinds of expressions it gives form to in interaction. When interaction design engages with artifacts that mediate interactions between people, the notion of aesthetics needs to extend to how the presence of others comes to expression in the presence of an artifact (and vice versa). That notion then configures what the artifact is and at the same time what people are to each other. The notion of aesthetics of being together that I propose in this thesis reaches for such an extension, to orient the design of interactions with artifacts to the role they play in bringing people to expression for each other.

At the beginning of this book I pointed out that design works with particular ideas of aesthetics and how that is different from what Aesthetics is considered to be in general. My work should be seen in relation to the particular conceptions of aesthetics that design works with, yet the fundamental question of what aesthetics refers to is as relevant for the particular as it is for the general. Though it is beyond the scope of interaction design research to address that question in general, the research I present here indicates particular aspects of addressing that question in general, i.e. how do conceptions of Aesthetics in general reflect and frame ideas about e.g. people as social beings or the presence of things and people. These are theoretical issues other fields of study are better equipped to develop, while design practice continues to explore how they come to expression.
Concluding Remarks
Contributions

Design is always about the design of some thing. What it is that is being designed is not available until a thing has been designed. It works with pairs such as problem-solution, question-answer, program-experiment. These are conceptual circles, that design resolves by making things; by working with instances it increases the resolution of what the conceptual circle is about.

As a form of design practice, this thesis works with the conceptual circle of mediated social experiences. What I offer with this thesis is a particular assemblage of concepts, ways of working and objectives, that express what interaction design is about when engaging with that conceptual circle.

From a methodological perspective, this thesis exemplifies how design research practice, when considered in terms of its programmatic structure, leads to a form of fundamental knowledge contribution that is congruent with doing design. The dialectics between the proposition of mediated experiences of being together and the experimental designs seeking to instantiate that, lead to a fundamental question:

What does aesthetics refer to in interaction design?

What I contribute with this thesis to the field of interaction design is a whole of concepts, approaches, objectives and expressions, that addresses this question in a way that is different from the way it has been addressed. Notions of aesthetics in design refer to such wholes.

My work points out that current conceptions of aesthetics of interaction enframe the kinds of experiences that interaction design can engage with, enframing what interaction design is about in one way, while inhibiting others.

As an example of another conception of aesthetics, I contribute the proposition of an aesthetic of being together. This particular conception of an aesthetic sets interaction design up to engage with experiences that address social presence itself, rather than its use in terms of the instrumental purpose of being together that current conceptions lead to. As such, this proposition opens up the possibility for interaction design to explore different kinds of experiences of social presence, and to bring other meanings of being together to expression.

The quite structural mechanisms of mediating systems that I articulated, provide interaction designers handles on how the experience of being present with others takes shape.
Relevance and Implications

Though it may seem obvious that interaction design oriented to social experiences requires a framing of aesthetics in what it means to be social, it still has far reaching implications.

When design is called upon to give form to interactions with digital systems, it necessarily engages with artifacts that mediate interactions between people. Oriented to what happens between artifacts and people as well as between people and people, I have elaborated how basic conceptions of some of the key elements of design practice are pushed outside of their comfort zone.

A central question in that dynamic is how things become useful to us (people). Whereas that is a basic question that design has always worked with, a consequence of what I point to in this thesis is the need to examine how notions of usefulness frame designing in particular ways. Useful in context of performing tasks obviously means something different than useful in context of social presence, and this points to a difference in frames of reference that such conceptions come from.

If it is the case, as I exemplify in this thesis with an aesthetics of being together, that there are other notions of aesthetics possible that orient interaction design in particular ways, this begs the question what yet different notions of aesthetics would reveal about interaction design practice concerning its basic conceptions, its ways of working and its objectives.

This thesis is relevant not only for designing systems that mediate interactions between people per se, such as the social media we use today, but for all design of interactions with networked artifacts. As soon as part of what we encounter in interactions with these systems has a component that depends on the interactions that others have with that system, we need to consider similar -if not the same- issues.

For example, an online music service or shop aggregates individual interactions of many people to offer suggestions. At least, that is the user oriented motivation. How an individual’s actions relate to those aggregates, how the algorithms are meant to influence behaviour and what other uses that information may have, is only beginning to receive public attention.

Clearly, what the thing is that we interact with is fundamentally fluid, for the person interacting with it, for the organisation managing it and -not in the least- from a
design perspective. It is not only hard to grasp what the thing is we interact with; what that interaction is about is similarly fluid depending on the perspective you take on it.

To some extent this is quite familiar terrain for design, as in general it is geared towards negotiating between multiple stakeholders and interests. What seems to be different in these digital systems is that what is designed itself is a potential for dynamics whose consequences are inherently out of grasp. How can design work with such fluidity? It seems this calls for a framing of aesthetics, a logic of expression of the whole, that brings these different perspectives together in a particular way that is of a similar kind as the notion of aesthetics of being together provides for mediated social interactions.

The question what it means to be social implies much bigger existential questions concerning what being human is about and how we conceive of each other. It leads to questioning basic ethical and political perspectives on how we structure and give shape to society as it develops, and the role of design in that.

With its roots in industrial production and capitalism, and infused with modernist perspectives on people, society and the role of design in it, current conceptions of aesthetics in interaction design enframe it in individualistic and instrumental attitudes towards people, artifacts and interaction. Not only does this limit the kinds of issues interaction design can address, it causes interaction design to perpetuate and reinforce those value systems. As digital infrastructures, services and products continue to permeate and extend into global societies, we need to carefully consider what value systems come to expression, intentionally but clearly also unintentionally, when we do interaction design.

If interaction design has inherited its frames of references from industrial design practice in general, an open question is how notions of aesthetics of a similar kind as an aesthetic of being together, would enable (industrial) design in general to reorient its practice to address issues that currently remain outside its grasp. Consequently, designers are confronted with the question what it takes to make such a reorientation and development.

Surely, these are systemic issues and it is not the sole responsibility of designers to engage with these questions. However, designers are positioned and equipped to probe what it means to address these issues and to begin to give shape to what is not yet there; It is positioned between realisation and objectives and it is comfortable making instances that bring multiple perspectives to expression, articulating and performing an aesthetic. As designers give concrete form to interactions, they cannot escape considering the work that their notions of aesthetics do in their practice and it is their responsibility to develop that.
Future Research Directions

This thesis reflects on what it takes to approach the initial questions in this thesis. It exposes a fundamental question of what aesthetics refers to in interaction design, the answer to which constrains how the original research questions may be answered. As such, it opens up for a host of research directions implied in such an outcome, from the more concrete to the more abstract. I here begin to outline a few potential research programs, far from defined or exhaustive, to illustrate that spectrum.

**Aesthetics of Intentionality**

In the experimental design work in this thesis I briefly touched on the notion of perceptual crossing as a mechanism in experiences of mutual presence. Whereas the question of what such a mechanism may be in group settings is unresolved from a more theoretical perspective, from an interaction design point of view a promising area of inquiry are qualities of perceptual crossing beyond basic experience of presence. Not only does interaction design need to get a better grip on how experiences of presence come to expression in general, but more specifically we need to be able to work with aspects such as mutual expression and negotiation of intentions, thinking of qualities in terms of e.g. rigidity and flexibility, forcefulness and forgiveness, dominance and submissiveness.

This would be relevant not only for the design of mediated group interactions as in the case of this thesis, but also very much for interaction design engaging with intelligent systems, from home automation to self-driving cars. This research program would aim to get to grips with the presence and intentionality of the intelligent system itself, as well as the presence and intentionality of the mediated social component that is inherently part of such systems.

**Aesthetics of Design Doing**

I started from a particular and personal perspective on the kind of being together I wanted to bring to expression, using imagery such as flocks of birds. This is reminiscent of a designer imposing a particular (narrow) aesthetic notion, such as a modernist form language in the design of a radio. In my later experiments, I touched on the question of a more emergent approach to a particular aesthetic. Participatory design methodologies aim to involve people in the objectives of the design process. What seems to be underexposed is where particular form languages and logics of expression come from. Not only is this problematic for the basic democratic principles of participatory design, it becomes a crucial issue
when we talk about a notion of aesthetics that enframes a particular design practice as a whole. This warrants a methodological research program into how such enframings emerge in design practice. At UID, current research targets these issues in the context of design education and social innovation.

**Aesthetics of Futuring**

If to design is to devise courses of action aimed at changing existing situations into preferred ones (Simon, 1996, p.130), we need to carefully consider what that value judgement entails. As design is always about approaching what is not yet there, it also navigates us towards what it imagines. The current aesthetic of futuring in design casts a particular perspective on development, with specific meanings to growth and progress, to what is preferable. It propels a narrative of one convergent future that can be made to come true by design.

Whereas the future is always just ahead of us, we never actually live it the way it was imagined. People in the world are highly complex and development never linear nor singular. It is a modernist dream that we can have full knowledge and control to achieve some kind of static ideal situation, or that it will be ideal from all perspectives. Instead of a science of the artificial aiming to constrain the potential of the desired change towards what it deems to be better, I see design as a practice geared towards navigating the kind of potential that its action sets in motion.

Thus, I would propose a design research program concerning the practice of continuous, reflective imagining on plural societal, local and global levels. An aesthetic of futuring refers to the ways that designers orient the development process of artifacts to what lies ahead and how to navigate by feeling around the corner. Similar to different strategies in activism, from Ghandi to Anonymous, from journalism to terrorism, an aesthetic of futuring for design would deal with the shapes and expression of design practices as constructive forces towards open ended futures.

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1. Though William Gibson would say: the future is already here, just not very evenly distributed.
Epilogue

This thesis emphasises the role that notions of aesthetics play in doing design.

Traditionally, aesthetics in industrial design refers to the object as is. In that context, what is good and what is beautiful design is often considered the same thing. In interaction design, there is a similar connection between value judgement and aesthetics visible, for example, in the idea that beautiful things work better, and this extends to interacting with a digital artifact. For design engaging with artifacts that mediate social interactions, this thesis shows how ideas in current design for what is ‘better’ confine it to particular social experiences; its notions of aesthetics enframe the notions of ethics it can bring to expression (and vice versa).

What I see here in a quite applied way is the intimate relation between aesthetics and ethics also visible in the philosophical concept of το καλὸν from ancient Greek philosophy. το καλὸν there has meanings that bring together both physical and moral qualities, referring to the good and beautiful at the same time.

In this thesis, I argue for a notion of aesthetics in interaction design that pertains to what happens between people with mediating technologies. The way I have approached aesthetics in this thesis, exposes the need to address basic ethical positions on what it means to be social and the moral consequences of doing design based on them. It is one thing to expose the need, and another to address it. The scope of this thesis is to develop scaffolding for how foundational notions of aesthetics configure what is considered in the practice of giving form. It requires a different research programme to address how notions of ethics figure in that. Opening up the foundations on which we do interaction design in this way makes it possible to explore how το καλὸν can come to expression in different ways, providing the material to address it analytically.
References


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