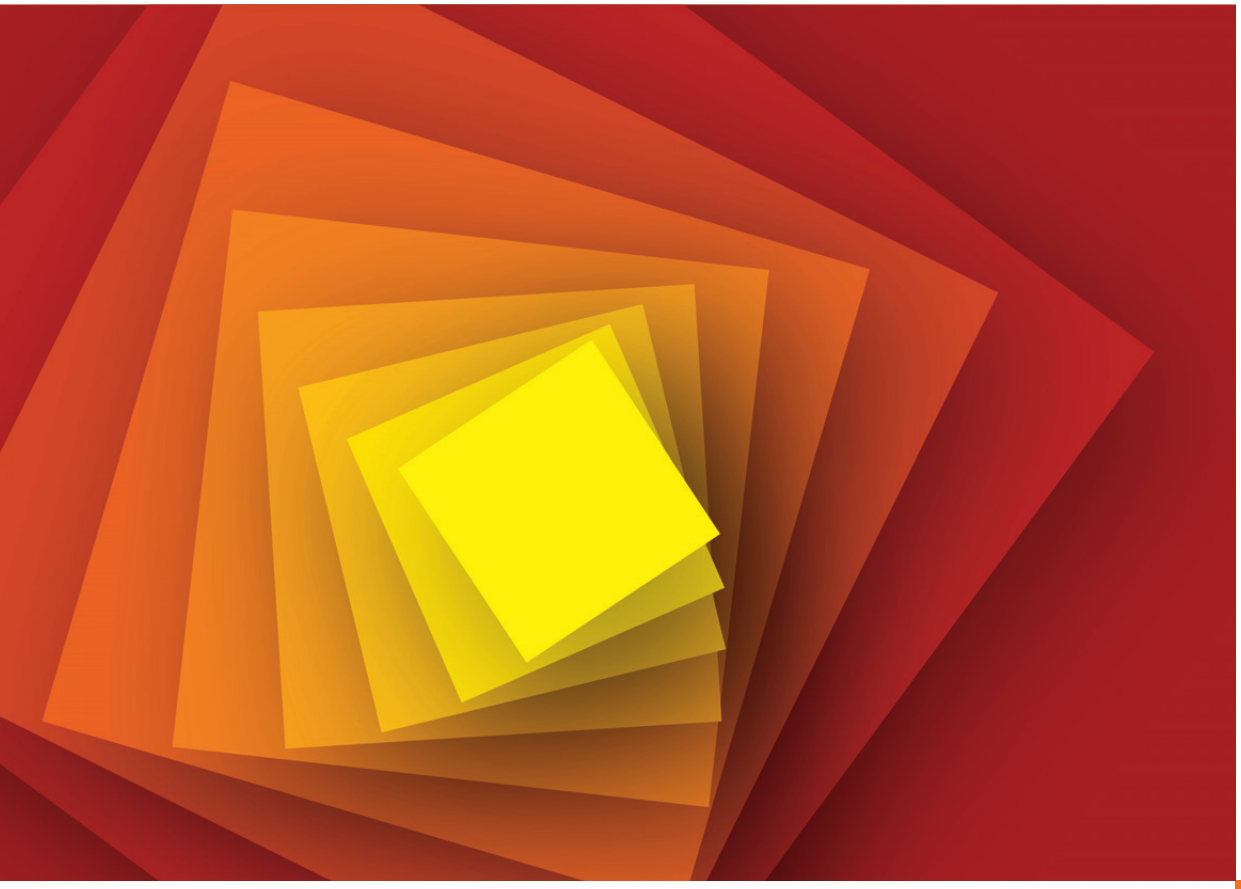
Jon Olav Husabø Eikenes

Navimation

A sociocultural exploration of kinetic interface design



Arkitektur- og designhøgskolen i Oslo
The Oslo School of Architecture and Design

PhD thesis 48

arkitektur · urbanisme · landskap · design

Jon Olav Husabø Eikenes

Navimation

A sociocultural exploration of kinetic interface design

ISBN-13: 978-82-547-0235-2
ISBN-10: 82-547-0235-7

CON-TEXT
Avhandling 48

Akademisk doktorgrads-
avhandling avgitt ved
Arkitektur- og
designhøgskolen i Oslo

UTGIVER:
Arkitektur- og designhøgskolen i Oslo

ILLUSTRASJON OMSLAG:
Jon Olav H. Eikenes

TRYKK:
Unipub forlag AS

DESIGN AV BASISMAL:
BMR

Contents

Acknowledgements

The work behind this thesis is not mine alone. A range of people have supported me throughout this project. I am deeply thankful to all of you.

First and foremost, I would like to express my gratitude to my supervisor, Andrew Morrison. I could not have asked for anyone with a more appropriate research background, knowledge and teaching skills. He has stretched, pushed and pulled me to go places I would never have imagined going. He has pointed me to concepts and theoretical frameworks that have turned out to be essential in my work, and thought me the tricks of the trade in academic writing. Andrew is generous and patient, and has more than once provided me with strange metaphors allowing me to see the world from new and different angles.

The Norwegian Research Council funded the RECORD research project, and Simon Clatworthy believed in me from the start. He offered me the position as a PhD student in the RECORD project, for which I am grateful. Soon after I joined the project at AHO, Jonathan Romm became the project leader as well as the institute leader for the Institute of Design. His positive attitude and solid management skills has been crucial for this project to succeed. Jonathan was also the one who first came up with the term 'navimation' – and I am grateful to him for allowing me to use it. Jørn Knutsen has been a great collaboration partner, and has supported me through theoretical as well as practical design challenges.

AHO has supported me throughout the project, and the Research school provided me with a solid foundation. I would like to thank my fellow PhD students for contributing to a pleasant and interesting learning environment.

Opinion AS has successfully administrated the RECORD project, while SINTEF has been an excellent research partner. I would especially like to thank Asbjørn Følstad from SINTEF, who has coordinated the research efforts in RECORD, as well as facilitated various activities and meetings related to the design experiments and the business partners.

I would also like to thank the companies that have allowed me to experiment freely with the possibilities of kinetic interfaces: Pearse Connolly from Telenor, Morten Skogly from NRK Urørt, and Jan Standal and Knut-

Jørgen Rishaug from Opera Software. Morten Solem offered useful assistance in designing the interfaces for Telenor.

A range of anonymous reviewers have commented upon the three publications I have written, and Ramia Mazé and Gunnar Liestøl have been the readers of the thesis. Synne Skjulstad and Martina Keitsch provided useful comments to the draft of the first article. They have all provided valuable critique as well as useful suggestions for improvements. I am thankful for their constructive feedback, and hope they will see the improvements their comments brought.

A special thank to Jay Lemke, who commented upon two of the publication drafts. I have been lucky to engage in interesting discussions with him in London, Oslo and San Diego.

I would like to thank all my colleagues at the Institute of Design at AHO who have contributed to a pleasant working environment. The research seminars at IDE have provided a space for discussions and feedback. Mosse Sjaastad and Birgitta Cappelen got me involved in master's level teaching and allowed me to carry out exciting student workshops on motion sketching. Further, I would especially like to thank Lise Hansen and Judith Gloppen for pleasant coffee breaks, discussions and feedback on publication drafts, and Kjetil Nordby and Monika Hestad for enriching discussions.

I am also thankful to the generous people in the Nordcode network, and their inspiring seminars. It was lovely to meet likeminded people that also provided useful feedback on my work.

The librarians at AHO deserve praise for always being friendly and efficient, and for ordering (and renewing) a large number of books for me. The people at Halogen, who were kind enough to offer me a job, have showed great flexibility during these hectic last months.

Last, but not least, I would like to thank my family and friends for their support throughout the project. I express my deepest gratitude to my husband Åsmund, whose continuous support and patience during these three years has been crucial. He makes me remember that a PhD is not the most important thing in life.

Samandrag

Digitale produkt er ein stadig viktigare del av kulturen vår og er knytte til aktivitetar i arbeid, leik og fritid. Mange av desse aktivitetane skjer gjennom skjermbaserte grensesnitt, som dermed spelar ei viktig rolle i å aktivere og engasjere folk i deira daglege liv. Skjermbasert, visuell bevegelse er eit stadig meir framståande kjenneteikn ved mobiltelefonar, dataspel, operativsystem og nettsider. Denne avhandlinga presenterer 'kinetiske grensesnitt' som eit sentralt omgrep for å analysere skjermbaserte digitale produkt som er prega av visuell bevegelse. Av fleire konsept som er innførde for å forstå kinetiske grensesnitt, refererer 'navimasjon' til navigasjonshandlingar som er knytte saman med bevegelse.

Skjermbaserte grensesnitt er konstruerte produkt, og må utformast av nokon. Design av grensesnitt spelar ei viktig rolle i å forme meiningar og aktivitetar som vert mogelege via digitale produkt. Det er underskot på designforsking og litteratur som tek føre seg kjenneteikna til kinetiske grensesnitt. Korleis kan vi forstå bruk av bevegelse i kinetiske grensesnitt, og kva er kjenneteikna og det kommunikative potensialet til slike grensesnitt? Korleis kan vi undersøke eit slikt fenomen som kontinuerleg er under utvikling, i og gjennom design? For å forstå desse nye mogelegheitene er det behov for studiar som fokuserer på det kinetiske grensesnittet som ein medierande og kulturell gjenstand i seg sjølv, og erkjenner at desse er situerte i sosiale og kulturelle kontekstar.

Denne avhandlinga inneheld tre publiserte forskingstekstar, derav to rapporterer om mine eigne designeksperiment som er utført saman med ulike partnarar innan eit større forskingsprosjekt kalla RECORD. I tillegg er ein metarefleksjon ('kappe') lagt fram for å plassere og bygge vidare på desse publikasjonane. Ved å nytte 'forsking gjennom design' kombinerer studien tekstanalyse og tekstkonstruksjon gjennom eksperimentell designproduksjon. Nye analytiske omgrep og konsept er genererte ved å kombinere analyse og design; desse omgrepa er nødvendige både for å forstå og utforme kinetiske grensesnitt.

Avhandlinga tek utgangspunkt i eit sosiokulturelt syn på design og analyse av grensesnitt, og nyttar sosialsemiotikk og omgrep frå

aktivitetsteori. Dette synet understrekar verdien av det sosiale og kulturelle i menneskeleg aktivitet og meiningsskaping. Avhandlinga argumenterer for at kinetiske grensesnitt spelar fleire roller i moderne kultur og bruk, gjennom *semiotisk mediering* og *instrumentell mediering*. Grensesnitt er meiningsfulle og kulturelle gjenstandar som nyttar teikn eller semiotiske ressursar for å kommunisere gjennom utforming og bruk. Samtidig gjer dei det mogeleg å utføre aktivitetar og handlingar gjennom instrumentell mediering, på ein måte som liknar verktøy eller instrument. Eg kallar sambandet mellom desse rollene for *dobbel mediering*.

Forholdet mellom instrumentell og semiotisk mediering er komplekst, og denne avhandlinga legg fram ein ny modell for å forstå det kinetiske grensesnittet som både verktøy og teikn. Dette synet er komplimentert med ei utgreiing om den dialogiske utvekslinga som skjer mellom brukarar og kinetiske grensesnitt, kalla *dialogisk interaksjon*.

Det viktigaste bidraget til avhandlinga er ei rekke nye omgrep som er innførde for å analysere og konstruere kinetiske grensesnitt, for eksempel for sosiale media og surfing på Internett. Studien gjev kunnskap om kinetiske grensesnitt, og demonstrerer at det er mogeleg å konstruere teori og analytiske konsept ved å kombinere designeksperimentering og analyse.

Abstract

Digital artefacts pervade culture and social life in work, play and leisure. Many of these activities are carried out through screen-based interfaces, which therefore take on an important role in enabling and engaging people in their daily life. Screen-based visual movement is increasingly a key characteristic of mobile phones, gaming platforms, operating systems and websites. This thesis presents 'kinetic interface' as a key concept for analysing screen-based digital artefacts that are characterised by visual movement. Among several concepts introduced for understanding kinetic interfaces, 'navimation' refers to actions of navigation that are intertwined with movement.

Screen-based interfaces are constructed artefacts; they have to be designed by someone. Interface design plays an important role in shaping mediated human activity and enabling meaning making. There is a lack of design research and literature on the features of kinetic interfaces. How can we understand the employment of movement in kinetic interfaces, and what are the features and communicative potentials of such interfaces? How may we investigate such a phenomenon that is still emerging, in and through design? In order to understand these emerging potentials, there is a need for studies that focus on the kinetic interface as a mediating and cultural artefact in its own right, recognising its situatedness in social and cultural contexts.

This thesis includes three published research texts, two of which report on my own design experiments carried out with business partners within a larger research project called RECORD. In addition, a meta-reflection is presented so as to situate and extend these publications. Taking a 'research by design' approach, the study combines textual analysis with textual construction through experimental design production. New analytical concepts are generated by combining analysis and design; these are needed for understanding as well as designing kinetic interfaces.

The thesis adopts a sociocultural view on the design and analytical study of interfaces, informed by social semiotics and concepts from activity theory. This view emphasises the importance of social and cultural contexts in human activity and meaning making. The thesis argues that kinetic interfaces play multiple roles in modern culture and use, in terms of *semiotic mediation* and *instrumental mediation*. Interfaces are meaningful and cultural artefacts that employ signs or semiotic resources to communicate through their design in use. At the same time they enable activities to be carried out through instrumental mediation, much like tools or instruments. I call these related aspects *double mediation*.

The relationship between instrumental and semiotic mediation is complex; this thesis suggests a new model for understanding the kinetic interface as both tool and sign. This view is complimented with an account of the dialogic exchanges taking place between users and kinetic interfaces, referred to as *dialogic interaction*.

The main contribution of the thesis is a range of concepts that are introduced for analysing and constructing kinetic interfaces, for example in web browsing and social media. The study builds knowledge of kinetic interfaces, and demonstrates the possibility of constructing theory and concepts through design experimentation coupled with analysis.

Part I: Framings

Chapter 1. Introduction

Figure 1. This is a screengrab from the website of the graphic designer Jonathan Yuen. Visual elements appear and change through movement as the user navigates to different parts of the website, with visual reference to artistic watercolour painting. From www.jonathanyuen.com

KINETIC INTERFACES

Professional and leisure activities are increasingly enabled and supported by digital technology. Each day we engage with a range of digital artefacts and screens as users and consumers. We do not see much of the digital bits and bytes of computing; rather, we are presented with text, images, sound, videos and movement. As we push the buttons and screens of our mobile phones or enter various websites, visual elements on the screens respond to our actions through movement: sliding, zooming, fading, expanding, scaling, and

rotating. There is movement in the interface, where 'content' as well as menus and other interface elements move (Skjulstad & Morrison 2005). This is becoming more and more prevalent across a range of digital devices, from web interfaces (Figure 1) to mobile ones (Figure 2). These are kinetic interfaces that are characterised by visual movement, and move in response to our own moves and actions. Designers employ kinetic features as a means for engaging and persuading us as users and consumers, to communicate values and ideas, and to facilitate our dynamic use of digital artefacts. How do these kinetic features affect the 'meanings' of interfaces, and what activities do they enable? This is a question that is relevant for designers as well as academics in a variety of fields.

Through the screen-based interfaces of our mobile phones, gaming consoles and laptops we work, play, communicate, socialise, produce and consume information. We imagine ourselves as navigating and moving through 'information space' (Benyon 2001). Still, animation and movement in the interface has often been considered as a violation to usability and efficiency. This is changing. Screen-based interfaces are now becoming more dynamic due to technological developments and cultural innovations; digital devices are getting smaller yet more powerful, enabling more sophisticated screen-based interfaces to be developed. Navigation in information space may now be intertwined with movement and animation, a phenomenon I have referred to as *navimation* (Eikenes & Morrison 2010). This also connects to the proliferation of social media, in which users produce, collaborate and share information and media content. Social media are here broadly understood as media systems or computer applications that support social activities (Mayfield 2006). Navimation may also be employed for supporting activities in social media; this I have described as *social navimation* (Eikenes 2009).

The Apple *iPhone* (Figure 2) arguably represented a paradigm shift for screen-based interface design. It was introduced a few months after I began my PhD studies in 2007, and during this time has been an important point of reference in the project. Not only did it introduce new services and business-models through its *AppStore* and integration with *iTunes*; nor did it merely integrate a telephone, camera, GPS, media player, gaming platform and web browser in one device; the *iPhone* introduced a mobile multi-touch screen-based interface in which movement is an integrated part of the interface, and most important - it worked. Further, applications could quite easily be developed and distributed, resulting in a great number of experimental interfaces. Other mobile devices had provided similar functionality and employed movement before, but the *iPhone* set new and higher standards for kinetic interface design. It may not be a coincidence that Steve Jobs, the co-founder and chief executive officer of Apple, previously was the chief

executive of Pixar Animation Studios and has been a member of the board of The Walt Disney Company since it acquired Pixar in 2006.

Figure 2. The Apple *iPhone 4*, the latest model of the iPhone, launched in 2010. The first model of the iPhone was launched in 2007 and arguably represented a shift in screen-based interface design. Image from www.flickr.com/photos/bas-boerman/4679838650/

I will refer to interfaces in which movement is a key characteristic as *kinetic interfaces*. This term was introduced by Synne Skjulstad (2004) for describing websites made with the Adobe (then Macromedia) *Flash* software, in which 'kinetic features' are employed. In this thesis, however, a kinetic interface is understood widely as a screen-based interface characterised by movement, regardless of technological platform; this may include interfaces that respond to physical movements and gestures performed by a user of the interface. For example, in Tangible User Interfaces (TUIs), physical body movement and manipulation of tangible objects through movement may play an important role (e.g. Ratti, et al. 2004; Ullmer & Ishii 2000). Movement on screens increasingly appear in conjunction with physical body movement and gestures, such as in the gaming platforms of Nintendo *Wii* and Microsoft's *Kinect* for the Xbox (Figure 3). Much attention in design research is currently given to gestures, 'tangible interaction' and the role of the body (Hummels, et al. 2007; Loke, et al. 2007). However, there is still a need for focusing on movement on screens; 'new' screen-based interfaces continue to be introduced, and there is no reason to believe that screens will disappear any time soon. Still, there is not much research literature addressing such kinetic interfaces. Therefore, I focus on movement presented through the screens of digital artefacts. This movement appears much like the constructed

movement we know from animation and motion graphics. This kind of movement is composed and constructed through digital technology, as opposed to the presentation of recorded 'live action' video. Consequently, kinetic interfaces are screen-based artefacts that make use of movement as a mode of communication, ones that also respond and change when acted upon.

Figure 3. Microsoft's *Kinect* for Xbox is a gaming platform in which movement on the screen is coupled with physical movement. Here, the participants play by moving their bodies, which is detected by a camera. Still from promotional video at www.xbox.com/en-US/kinect

It has been argued that the visual has assumed a more prominent role with the emergence of digital technologies, and that this places design at the centre stage (Kress 1998). Here, design may be seen as mediating between technology and culture, as well as between use and meaning. The 'screenspaces' (Verhoeff 2008) of digital artefacts such as the *iPhone* and the *iPad* are designed to move. Therefore, I have previously referred to movement in the interface as *motional form* (Eikenes 2010), to bring attention to the fact that it has to be designed and shaped by someone, much like physical materials are shaped into physical form. Motional form in the interface presents challenges for design as well as for analysis, and has not been studied much from the point of view of interaction design and interface design. The kinetic interface is a designed artefact that we can and should study in its own right (Mazé & Redström 2005; Skjulstad 2004). There is a need for interaction design theory to critically engage with kinetic interfaces, their features and workings, and their communicative and persuasive potentials.

KEY QUESTIONS AND APPROACH

How can we understand the employment of movement in kinetic interfaces, and what are the features and communicative potentials of such interfaces? How may we investigate such a phenomenon that is still emerging, in and through design? These are the main questions I try to answer in this thesis. Consequently, the thesis reports on an exploratory study that is oriented towards exploring and finding out 'what might be' rather than testing or evaluating 'what is'.

The thesis adopts a sociocultural view on the design and analysis of interfaces, informed primarily by social semiotics, but also drawing on concepts from activity theory. Such a view sees meaning as constructed and located in specific historical, cultural and social contexts. Drawing on social semiotics, the kinetic interfaces may be seen as multimodal text (Kress & van Leeuwen 2001) – a meaningful artefact that communicates through various modes such as sound, images, and movement (Figure 4). Importantly, multimodal texts are part of wider cultural contexts, and are interpreted in specific contexts, with and against other texts and interfaces. Social semiotics offers a range of concepts and tools for analysing multimodal texts; such a framework is both suitable and necessary as it provides a solid theoretical foundation for understanding visually rich texts such as kinetic interfaces. Activity theory offers concepts that are helpful for understanding how kinetic interfaces play an important role in enabling and mediating human activity. These two approaches are not often connected, especially in design, but offer complementing perspectives (Morrison, Stuedahl, et al. 2010). For example, they share a common interest in mediation and signs.

Taking a 'research by design' approach, I combine the construction of texts with textual analysis, and thereby also construct concepts for understanding kinetic interfaces. Textual construction is carried out through my own experimental design production. This is a way of linking construction and analysis, practice and theory. Being a professional interaction designer, I am able to use my own skills in constructing texts, drawing on a range of design methods. By choosing to analyse interfaces as multimodal texts, this study does not cover actual use of interfaces. Therefore, such a study needs to be complemented with other studies that are more concerned with testing and evaluating actual use. However, unless we know what kinetic interfaces are and what they can be, the value of evaluating them may be limited. Further, there is a need for interaction design to better understand interfaces in their own rights as multimodal texts and cultural artefacts, not only as technical artefacts. As cultural artefacts, interfaces are shaped by culture and in turn shape culture (Johnson 1997).

Figure 4. This is the website of the French singer Camille Dalmais, at www.camille-music.com. Seen as a multimodal text, it combines movement with images, sound (music), verbal text and typography, colours, and video into a coherent multimodal composition (Morrison forthcoming 2010). Importantly, the composition changes and responds as the user interacts with the site; there are even small 'games' that visitors can play. Designed by Fleur de papier, www.fleurdepapier.com.

This thesis adopts an analytical, rather than a prescriptive or normative framework. Consequently, I will not provide any 'rules' or guidelines for designing kinetic interfaces. In being joined, activity theory and social semiotics offer a powerful framework for analysing kinetic interfaces. From within this framework, a number of new questions emerge: what is the historical background of kinetic interfaces, and how have they developed? Is a kinetic interface to be regarded as tool/instrument or sign/media? How may movement in the interface play a role if we consider the interface to be a tool or instrument in human activity? How may we understand kinetic interfaces as cultural, semiotic artefacts? What kind of interaction or exchanges may take place between a user and a kinetic interface? These questions are important for understanding as well as designing interfaces. As design is the main context for the study, it is necessary to position the thesis within design research. I now turn to this in the following section.

DESIGN RESEARCH

This thesis is located within design research. It presents a designer-researcher's view on kinetic interfaces and their design, located between the fields of interaction design and communication design. In addition, it draws on a range of fields such as animation studies, Human-Computer Interaction (HCI), the digital humanities, new media and communication studies.

There is a growing body of research in and on design (Laurel 2003; Michel 2007), including interaction design (Bagnara & Crampton Smith 2006; Löwgren & Stolterman 2004; Mazé 2007; Redström 2006) and graphic design (Noble & Bestley 2005). Design research was long equivalent to the study of design methodology. In recent years, however, design has opened up to investigate other aspects of design, including the study of the products of design - the artefacts themselves (Bayazit 2004).

Research on interface design (e.g. Laurel 1990) is usually not considered an independent area of study, but has largely been carried out in the wider field of Human-Computer Interaction (HCI), with strong roots in computer science and cognitive psychology. Here, some studies have addressed the use of animation in interfaces (e.g. Baecker & Small 1990; Chang & Ungar 1993). HCI has to a large degree focused on evaluating existing interfaces. From the perspective of design, it is possible to take a more explorative approach, to use design practice as a means to investigate a phenomenon that is still emerging. This is also necessary in order to find and analyse potential features that are not yet fully realised. Through design experimentation it is possible to concentrate in a systematic way on features of artefacts, such as their communicative potentials. Doing research through design may also ensure closeness to the challenges and potentials of design practice.

There is a need for theory in design to understand the features and workings of artefacts, including kinetic interfaces. This is needed for critical analysis, teaching and practice. For example, Kaptelinin & Nardi (2006) propose two criteria for theory in interaction design; it should be a) "rich enough to capture the most important aspects of actual use of technology", and be b) "descriptive and generalisable enough to be a practical, useful tool in interaction design" (2006: 24-25). From the view of social semiotics, Kress (1998) points to the need for theory that deals adequately with the production/making as well as the consumption/reading of multimodal texts.

In order to build theory in interaction design, it may be useful to look to other fields that are more established in terms of theoretical and analytical approaches. This includes the 'digital humanities' (Schreibman, et al. 2004) and studies of 'digital media' (Liestøl, et al. 2003) and 'new media' (Lister, et al. 2009; Manovich 2001). In the digital humanities, text construction is already used as an approach in research, in addition to analysing already

designed texts (Drucker 2009; Liestøl 2003). Design research is still at an early point in taking up such approaches from the humanities. My study is linked to these approaches by incorporating design, textual construction and analysis.

To summarize, this thesis is an exploratory study of the general phenomenon of kinetic interfaces, which are here understood as screen-based digital artefacts that make use of movement on their screens. How can we understand the use of motional forms in kinetic interfaces, and what are their features and potentials? How might such features and potentials be investigated in and through design? The thesis adopts a sociocultural view on interfaces and design, informed by social semiotics. In this view, meaning is seen as constructed and situated in a cultural, historical and social context. This allows me to analyse kinetic interfaces as meaningful cultural artefacts and multimodal texts. Further, I draw on terms and concepts from interaction design, activity theory, the digital humanities, HCI, media and communication studies, animation and film. As such, it is an interdisciplinary study. Taking a 'research by design' approach, I employ methods of experimental design production in order to construct texts for multimodal textual analysis. Combining textual construction with textual analysis allows me to construct new concepts that are needed for understanding, designing and analysing kinetic interfaces. In the next section I will provide an outline of the thesis.

OUTLINE

The thesis contains four parts. The first three parts form an overview and meta-reflection that situates and extends the three publications included in Part IV. Part I provides overall context and theoretical background. In Part II the contributions of the thesis are developed, and in Part III the findings and conclusions are presented. Part IV contains the three published research texts that are part of the thesis, as summarised below.

Part I: Framings contains three chapters that provide the overall context and background for the thesis. In Chapter 1 the general phenomenon of *kinetic interface design* is introduced, and the study is positioned within design research. Further, I provide summaries of the three publications that are the foundations on which the thesis is built. In Chapter 2, I start by identifying the notion of *interface* and give an account of the fields that are most relevant for the study, and provide a short historical background of kinetic interface design. Further, the sociocultural view that the thesis adopts is introduced; I give an account of the two main research traditions I draw on

- *social semiotics* and *activity theory*. Chapter 3 introduces and discusses the research methods applied in the thesis as well as the publications. The thesis makes use of *research by design*, which involves experimental design production alongside conceptual analysis. The methods are categorised under the labels of 'design experimentation' and 'textual analysis'. Lastly, a reflection on the research process is provided.

Part II: Developments contains four chapters in which the contribution of the study is developed. In Chapter 4, I argue that kinetic interfaces can be considered to work as both *signs* and *tools*. This opens up the notion of *instrumental mediation* (interface as tool/instrument) and *semiotic mediation* (interface as sign/medium), which are developed further in Chapter 5 and 6, respectively. Chapter 5 explores how movement in the interface may play a role when an interface is used as an instrument in activity by drawing on activity theory, and connecting the concept of *interface actions* to *motional form*. Chapter 6 focuses on how the interface works as a *semiotic artefact*, drawing on social semiotics. Here, I suggest that the concepts of *connotation*, *experiential metaphor*, and *intertextuality* are useful for analysing how meaning is made in kinetic interfaces. Finally, Chapter 7 addresses the much-debated notion of *interactivity*. I argue that the exchanges between kinetic interfaces and their users can be studied as a dialogue, drawing mostly on social semiotics. Further, I discuss the common ground between double mediation and dialogic interaction, which links to a wider debate on interface transparency.

Part III:Conclusions draws together the contribution of the study, based on the previous chapters. In Chapter 8 I highlight the concepts I have extended and constructed throughout the study. I also point out the implications for sociocultural theory, social semiotics, and the field of interface design in particular.

Part IV: Publications contains the three publications that are part of the thesis. Two of the publications have been published as articles in peer-reviewed journals, while one is a peer-reviewed conference paper. A summary of the publications can be found in the next section.

This thesis includes three publications, which form the basis for the overall thesis and its meta-reflection. Therefore, it is necessary to briefly summarize these publications.

SUMMARY OF PUBLICATIONS

This thesis includes three publications (Part IV: Publications), including one conference paper and two journal articles, all of which have been published

after international peer review. The three publications are presented in the order in which they initially were developed, if not published. This order best reflects the argumentation across the publications. All publications study kinetic interfaces. The first article examines existing interfaces, while the two remaining publications are based on my own design experiments. These experiments are carried out in projects with business-partners within a larger research project called RECORD (described in detail in Chapter 3). All publications are digitally published and available online. Although they are written as traditional 'page'-based documents, they include screengrabs, colour images and access to videos.

Publication 1

Eikenes, J.O. and A. Morrison (2010). Navimation: exploring time, space & motion in the design of screen-based interfaces. *International Journal of Design, 4*(1), 1-16.

Available at:
http://www.ijdesign.org/ojs/index.php/IJDesign/article/view/622

This article, co-written with my supervisor Andrew Morrison, sets out to explore the general phenomenon of visual movement in screen-based interfaces and websites. How can we understand the phenomenon of movement intertwined with activities of navigation? We see this as an emerging phenomenon that creates new demands for the reading, use and design of interfaces. To account for this particular phenomenon, we introduce the term *navimation*. The article is framed within a socio-cultural perspective on design. Interfaces are analysed as multimodal texts, drawing on social semiotics and concepts from motion graphics, animation studies, new media, interaction design, and human-computer interaction. Relevant literature on navigation and screen-based movement is also presented. Three core concepts are introduced for the purpose of analysing selected interfaces. The first concept is *temporal navigation*, which denotes how navigation at a micro level can become continuous and durable when intertwined with movement, as opposed to the stepped, discrete and discontinuous navigation as typically experienced in traditional hypertext. The second concept is *spatial manipulation*, which refers to how motion may create and manipulate the sensation of space, for example by mixing two-dimensional and three-dimensional elements. Here, the notion of the interface as a 'virtual camera' was also discussed. The third concept is *motional transformation*, which refers to the (gradual) transformation of visual elements over time. The three

concepts are then applied to three different interfaces: a website by *Leo Burnett*, a web browser plugin called *Cooliris*, and the Cover Flow interface of the Apple *iPhone*. Through these examples, we argue that the interface is not only a flat layer between a user and the computer, but a rich, complex and dynamic semiotic environment.

Publication 2

Eikenes, J. O. (2009). *Social navimation: engaging interfaces in social media*. Paper presented at Engaging Artifacts. The 3rd Nordic Design Research Conference (NORDES). 31 August-1 September.

Available at:
http://ocs.sfu.ca/nordes/index.php/nordes/2009/paper/view/246

This is a full peer-reviewed paper for the leading Nordic design research conference, and builds on the concepts developed in the article presented above. The aim of the paper is to investigate how navimation can be used in the interfaces of social media applications, in which activities of production, sharing, and collaboration are central. How can navimation enhance or be employed in social media applications? The investigation was carried out through combining design production with textual analysis. Through design and analysis, features of social media are identified and coupled with features of navimation. The term *social navimation* is introduced to refer to the employment of navimation in assisting activities in social media applications. Social navimation is realised by connecting features of navimation to features of social media.

The investigation is carried out through two design cases carried out with external business partners. In the first case, in collaboration with the Norwegian company Telenor, four interfaces were developed for an online service. The aim of this service was to allow users to create, explore, and share media content related to football, across diverse devices and technological platforms. In the second case, in collaboration with The Norwegian Broadcasting Corporation (NRK), a more elaborate interface demonstration was developed for an existing service called NRK *Urørt*. The aim for this service was to allow users to explore music made by other users in a fun and engaging way. In the analysis, the three concepts from the previous article are applied. In addition, two new concepts are developed: *indexical compositing* and *virtual kinetics.* Indexical compositing refers to how a kinetic interface composition may allude to a specific external context, place or event. Virtual kinetics refers to the sensation of visual elements on

the screen exhibiting magnetism or possessing mass in an environment providing elemental forces like gravity. All in all, the five features of navimation are connected to six features of social media. These 'connections' are offered as semiotic resources available for designers as well as users of social media. Through this investigation, it became apparent that social navimation could visualise the action space available for users at a particular moment, as well as making visible some of the underlying dynamics of social media.

The interfaces designed and analysed in this publication are available online, presented through videos. This allows the readers to see the interfaces for themselves and thereby better follow the analyses.[1]

Publication 3

Eikenes, J.O. (2010). Connecting motional form to interface actions in web browsing: investigating through motion sketching. *FORMakademisk*, *3*(1), 80-100.

Available at:
http://www.formakademisk.org/index.php/formakademisk/article/view/67

What are the potentials for employing movement in web browsing interfaces? This article investigates the potential for employing movement in web browsing – or more specifically, how *motional form* may be connected to *interface actions*. Here, the term motional form is introduced to describe designed changes in visual appearance over time. The notion of 'form' is introduced so as to bring attention to the fact that motion has to be shaped and designed, much like physical materials are shaped into products. The concept of interface action is introduced to refer to actions that a user performs with an interface, following the classification of activity by Leont'ev. I argue that the notion of action (instrumental mediation) needs to be connected to the notion of motional form (semiotic mediation) to account for the complex mediation that takes place at the interface. The investigation is carried out through design experimentation and analysis, in collaboration with a world-leading web browser company, Opera Software. First, a new service for the web browser is envisioned. The service, named 'Opera Media Collection', allows users to collect, manage and share media content within the web browser. Then, a number of small-scale design experiments are carried out using design techniques labelled as *motion sketching*. These

[1] http://www.navimationresearch.net/design/

include the sketching of motional form by using animation techniques such as 'stop motion' from animation, video recording, computer animation and written code. The experiments investigate how motional form may facilitate and be connected to interface actions in the proposed service. In the analysis, I draw on the concepts of *experiential metaphor* and *connotation* from semiotics to account for the potential meaning of motional form. Further, ten provisional principles for how motional form may be used in web browsing are suggested. This suggests that motional form may have an important communicative 'function' in the interface, which may challenge prevailing distinctions between form and function in interface design.

An online version of this paper is available on my website, in which the videos are embedded directly into the text.[2] The PDF-version of the article available from *FORMakademisk* only has stills from the videos.

In this thesis, I will take up some key issues from these publications. In particular, I will look more into the notions of instrumental mediation and semiotic mediation that were suggested in the third publication. These notions allow me to investigate kinetic interfaces from different perspectives, while they also relate back to the various concepts developed in the publications. Therefore, in Part II, I will continuously make reference to the various concepts developed in the three publications.

The concept of 'interface' is central to this thesis. However, it is not always clear what is meant by the term. It is necessary to 'find' the interface before investigating its kinetic features. I now turn to this in the next chapter. There, I will also discuss in more detail the fields that are relevant to the study of interfaces, present a genealogy of kinetic interface design, and describe the sociocultural approach I have taken.

[2] http://www.navimationresearch.net/motion_sketching.htm

Chapter 2. Contexts

In order to study the potentials and features of kinetic interfaces, it is necessary to provide some background on interface design as well as the research approach taken in this study. In this chapter, I identify the concept of *interface*. I give an account of the research and design fields that are most relevant for the study, including literature on interfaces, and argue for the importance of studying interfaces as cultural artefacts. Included is also a short historical background to kinetic interface design. Further, I introduce the sociocultural view that the thesis adopts, its underlying theoretical assumptions, and its literature relevant to the study of kinetic interfaces. I then introduce the two main research traditions I draw on - *social semiotics* and *activity theory*. These are needed in order to study the interface as a cultural artefact.

FINDING THE INTERFACE

The concept of *interface* is central to this thesis. The concept is widely used in discourses on computers and their users, in theory as well as design practice. In sociocultural theory, which is mostly applied in studies of psychological development and learning (e.g. Erstad, et al. 2007), the relationship between people and the world is seen as mediated by symbolic as well as physical tools and artefacts (Wertsch 1991). These tools are 'mediational means' that are created and developed by human culture over time. In this view, the interface may be seen as a symbolic and cultural artefact as well as a physical tool that mediates human action. In addition, by drawing on social semiotics, the interface may be seen as a multimodal text, that is, a meaningful artefact that communicates through various communicative modes such as linguistic text, colour, images, sound, and movement (Kress & van Leeuwen 2001). Importantly, meaning is not fixed in the interface; rather, meaning is as much located in the social, historical and cultural context as it is in the text itself (the sociocultural view as well as social semiotics will be introduced later in this chapter.). For example, we

always ‘read’ an interface against all other interfaces and texts we have previously seen and used (see discussion of intertextuality in Chapter 6).

According to Johnson (1997), we do not take the interface seriously due to the lack of a critical vocabulary; the concept is ambiguous and has been conceived and approached in different ways and in various fields. I will therefore give an overview of some ways in which the interface may be conceptualised. This is important when trying to understand the interface from a sociocultural and semiotic perspective.

Defining the interface

The interface is commonly referred to as the meeting point or surface between a user and a computer system, and has therefore also been referred to as the *user interface*, or the *human-computer interface*. However, according to Jørgensen and Udsen (2005), there is no universally accepted definition of the term, partly because it has been studied from diverse fields, and partly because the interfaces themselves have changed drastically over time.

According to Cramer and Fuller (2008), the term ‘interface’ has been borrowed from chemistry, in which it was seen as a surface forming a common boundary of two entities. The term was introduced to computing in the 1960s by engineers to describe the points of interaction between independent electronic circuits as well as between computers and external devices such as printers. Only later has the interface come to signify the points of interaction between a user and a computer system. Cramer and Fuller’s (2008) typology of interfaces demonstrates the different meanings of the term in computing:

1. Hardware that connects users to hardware (input/output devices)
2. Hardware that connects hardware to hardware
3. Software, or hardware-embedded logic, that connects hardware to software
4. Specifications and protocols that determine relations between software and software
5. ‘Symbolic handles’ that makes software accessible to users.

In interaction design and HCI, the interface is most often seen in terms of (1) and (5), as the physical and symbolic meeting points between a person and a computer system. For example, Bagnara and Crampton Smith describe the interface as "the component of the interactive system by which it and the user communicate with each other" (2006: xxiv). Following this line of thought,

the interface may be reduced to a physical *output* and *input* device[3] for transferring information, such as screen, speaker, mouse and keyboard. However, the concept of interface as input and output has been criticised. For example, Laurel (1991) finds it problematic for what it leaves out:

> The working definition of the interface has settled down to a relatively simple one – how humans and computers interact – but it avoids the central issue of what this all means in terms of reality and representation.
>
> (Laurel 1991: 14).

Laurel describes the interface as a "shared context for action" (1991: 4) in which both the user and the interface are agents. Here, the interface is seen as a conceptual and abstract space containing a human being and a computer. This is an interesting and provoking view, but risks making the concept too slippery and general, as almost everything (an apartment, a language) could be regarded "a shared context for action".

Selfe and Selfe (1994) see interfaces as 'cultural maps' of computer systems, which "order the virtual world according to a certain set of historical and social values that make up our culture" (1994: 485). Selfe and Selfe argue that interfaces may be seen as non-innocent borders – not only between the physical and the virtual, but also as cultural borders, in that they reproduce certain cultural values on the expense of others.

There seems to be a common understanding of the interface as that which enables people to understand or 'read' as well as affect and manage digital information and computational processes. Communication between a person and a computer (and ultimately between people) happens at the interface through various communicative modes, such as visuals, sound, and touch. From a sociocultural view, the interface may be understood as a cultural artefact and a multimodal text. As a cultural artefact, it works both as a symbolic artefact as well as a tool in mediated action. As a multimodal text, the interface communicates and becomes meaningful to us through multiple modes of communication, situated in a cultural and historical context. These views will be introduced more fully later in this chapter. In the following section I will discuss why it is important to study interfaces.

The importance of interfaces

Why are interfaces important to study? As computers increasingly mediate our activities of work and leisure, we spend many hours each day working with and against the interfaces of our mobile phones, computers, ticketing

[3] For example, Abowd and Beale (1991) build on Donald Norman in order to provide a model of interaction between user and system through an interface, in which input and output is central.

machines, and a variety of digital consumer products. As argued by Alan Kay, for the user, the interface *is* the computer:[4]

> The user interface was once the last part of a system to be designed. Now it is the first. It is recognized as being primary because, to novices and professionals alike, what is presented to one's senses *is* one's computer.
>
> (Kay 1984: 42)

What is presented to users is not computation itself, but constructed representations of computation and data.[5] Laurel (1991) compares the computer to the theatre, and argues that the technical magic that supports the representation happens behind the scenes, as in the theatre. For theatre audience and computer users alike, "*representation is all there is*" (1991: 17). A similar argument is provided by Kirschenbaum:

> Computers compute, of course, but computers today, from most users' points of view, are not so much engines of computation as *venues* for *representation*.
>
> (Kirschenbaum 2004: 525)

It is clear that the interface plays an important role in enabling people to engage with digital technology. If we accept that digital information and computing technologies are accessed through interfaces, and that the interface thereby provides a cultural map of these 'virtual worlds' (Selfe & Selfe 1994), issues of representation, meaning and interpretation become highly important to deal with for understanding and designing kinetic interfaces.

There are several ways of conceptualising interfaces. For example, according to Holmqvist (1993), there are at least three inherited metaphors of the interface, or in her case, an 'interactive fiction': the interface may be seen as a *dialogue partner*, a *tool*, and *media*:

[4] This is not to say that the interface and the computer necessarily must be co-located; the computing device may be physically located at a different place than the interface. This is increasingly the case in 'cloud computing', where computation is largely done on networked computers and not on users' local computers.
[5] From a social semiotic perspective, representation may be described as "a process in which the makers of signs … seek to make a representation of some object or entity, whether physical or semiotic" (Kress & van Leeuwen 2006/1996: 7). Kress and van Leeuwen argue that representation is always partial, driven by the interests and social, cultural and psychological history of the sign-maker.

> You manipulate objects on the screen as when using a tool, you interact with the fiction as you would in a dialogue, and you interpret the events as you would in a film or in other traditional media.
>
> (Holmqvist 1993: 224)

Andersen, et al. (1993) provide a similar assertion that there are three inherited and very different metaphors for interaction in interactive media: action (tool metaphor), interpretation (media metaphor) and dialogue (dialogue partner metaphor). These views are not often integrated, and different disciplinary interests may be the motivation behind the employment of different metaphors. However, there is a need for linking these different views. I will take up the three notions from Holmqvist and Andersen in Part II of the thesis.

Interestingly, it seems that there are less discussions on interfaces and interface design now than some years ago. The reason may be, as suggested by Rettig and Wright (2009), that the term interface design has given way to notions of 'user experience' and 'experience design'. However, as argued by Mazé & Redström (2005), the shift from object to experience does not diminish the reason for studying the object. On the contrary, they argue that "taking the object as a subject of enquiry can lead to a better understanding of the emerging problematics" in interaction design (Mazé & Redström 2005: 8). There is still a need to focus on the interface in order to understand the processes and interactions in which it plays a role, and to understand it as a cultural artefact. In order to focus on kinetic interfaces, it is necessary to consider the different domains and traditions that are relevant to the study of interfaces, and what they offer. I now turn to this in the next section.

INTERFACE DESIGN

What fields are involved in the study of interface design, and how have they traditionally conceptualised the interface? In this section, I will consider the fields and traditions that are most relevant to the study of kinetic interfaces, and some historical background on kinetic interfaces.

Interface design is not an established or delimited disciplinary area, and there are several overlapping fields that make the interface a complex and contested object of study. For example, Manovich (2001) argues that the 'cultural interfaces' of new media are shaped by three cultural traditions: that of print, cinema, and human-computer interface. Interfaces have been approached and studied from fields as diverse as computer science, cognitive psychology, media and communication studies, literary studies, gaming

studies, and interaction design. The approaches sometimes seem incommensurable. For example, Crawford describes this challenge for what he calls 'interactivity design':

> Interactivity design lies at the juncture between arts/humanities and science/engineering. The chasm between these two cultures explains the dismal state of interactivity design. This chasm must be bridged.
>
> (Crawford 2003: 331)

In his *Manifesto for a Digital Bauhaus*, Ehn (1998) made a similar argument promoting a vision of a 'third culture' that could provide the meeting point between art and technology through digital design. From the perspective of design, there is a need to regard interfaces as complex cultural and artistic artefacts as much as technical and functional ones. In this thesis, I aim to do so by looking at the interface both as a cultural artefact and a functional tool.

I will now sketch out three important fields that interface design relates to. This is not to provide an exact review, but to sketch out a broad overview of the diversity of approaches to kinetic interfaces and to clarify some of their underlying motivations. Although I follow a sociocultural approach to interfaces and interaction design, I acknowledge that the field of Human-Computer Interaction has had a major influence on the study of interfaces. Therefore I turn to it first.

Human-Computer Interaction

Much of the literature on interfaces are categorised under the label of Human-Computer Interaction (HCI). HCI emerged in the early 1980s, mainly from the traditions of cognitive science and computer engineering. According to Carroll:

> Human-computer interaction (HCI) lies at the intersection between the social and behavioral sciences on the one hand, and computer and information technology on the other. It is concerned with understanding how people make use of devices and systems that incorporate or embed computation, and how such devices and systems can be more useful and more usable.
>
> (Carroll 2003: 1)

From the beginning, HCI focused on evaluating ease of use and efficiency in workplace settings through testing and evaluating existing interfaces, for example through lab experiments (e.g. Card, et al. 1983). As such, the

interface was mostly seen as a utilitarian tool for solving tasks. In recent years there have been attempts to move HCI "from standard usability concerns towards a wider set of problems to do with fun, enjoyment, aesthetics and the experience of use" (Blythe, et al. 2003: vii). However, the focus on evaluation seems to remain a central doctrine. For interface and interaction design, there is a need to consider design potentials as much as evaluation, and also to consider a wide range of aspects of interfaces in addition to productivity and ease of use. The sociocultural approach coupled with research through design may therefore provide a complement to existing approaches in HCI.

Interaction design

Interaction design is in some sense the 'design equivalent' to HCI, and has been more concerned with artistic experimentation and aesthetics, with close connections to traditions such as graphic and industrial design. Bill Moggridge, a designer and co-founder of the design firm IDEO, coined the term in 1984. Moggridge (2007) defines interaction design as "The design of the subjective and qualitative aspects of everything that is both digital and interactive (2007: 660). For Moggridge, an important aspect of interaction design is its focus on use-related aspects of artefacts and interfaces. However, this definition does not say what he means by 'design' and 'interactive'. Löwgren and Stolterman provide a more comprehensive definition:

> *Interaction design* refers to the process that is arranged within existing resource constraints to create, shape, and decide all use-oriented qualities (structural, functional, ethical, and aesthetic) of a digital artifact for one or many clients.
>
> (Löwgren & Stolterman 2004: 44)

Hallnäs & Redström (2006) also focus on use and digital technology when they state that "Interaction design is design of the acts that define intended use of things" (2006: 23), and "Interaction design is product- and systems design where computational technology is a basic design material" (2006: 24). Further, they point out that the focus on use has existed from the beginning of industrial design, before computers came about.

Interaction design is still a young field, and characterised by a variety of approaches, many of which are borrowed from other disciplines and traditions. Researchers draw extensively on HCI as well as other fields, including various design professions (product, graphic, architecture) and the humanities. The result is diversity, but also a lack of shared concepts and

frameworks. For example, there is no agreed-upon definition of the concept of 'interaction' (this will be addressed more fully in Chapter 7).

In recent years, there has been a shift towards focusing on 'experience' and 'embodied interaction'. For example, *The International Journal of Design* recently had a special issue on the 'Aesthetics of Interaction', in which the editors, Hummels and Overbeeke (2010), clearly take a phenomenological stance on interaction design. This thesis does not adopt such an approach, though I acknowledge the need and relevance for such studies. Rather, I will argue that it is necessary to complement such studies with a sociocultural approach that can account for how meaning also is constructed and developed between people in a cultural context over time. Further, I will argue that textual analysis can be combined with experimental design as a means for investigating features of interfaces as cultural artefacts.

My own professional training is from industrial design and interaction design. The training focused primarily on craft, and less on theoretical aspects of interaction design. My motivation in this study has therefore been to build a better theoretical understanding of kinetic interfaces and interaction design, as well as to contribute to the field.

Humanities and digital media

The interface has also been addressed in the humanities - especially in media and communication studies, in what is referred to as the 'digital humanities' (Schreibman, et al. 2004), 'digital media' (Liestøl, et al. 2003) or 'new media' studies (Lister, et al. 2009; Manovich 2001). Here, the interface is mostly interrogated critically as medium and as cultural artefact.[6] According to Bolter (2003b), the underlying purpose of the humanities is not necessarily to affirm or enhance practice, but rather to critique it or to deconstruct it altogether. Consequently, the focus is not so much on enhancement and ease-of-use, but rather to critique the interface as a communicative artefact or text, on the same footing as music, literature or movies. Here, research increasingly involves design production as well as analysis (Liestøl 2003). However, kinetic interfaces have not been widely studied in the humanities (Skjulstad & Morrison 2005).

The borders between these fields are not always as clear as presented here, as researchers and research projects that address the interface often work interdisciplinarily. However, there is a need to recognise the different fields

[6] The term 'medium' is contested. For example, Espen Aarseth (2003) states that it is a problem that the term medium itself is often not defined in new media studies. For one example, Bolter and Grusin (1999) define medium as 'that which remediates', drawing attention to how different media appropriate techniques and forms from other media.

and their underlying purpose and focus. For example, HCI has traditionally seen the interface as a functional and utilitarian tool, while the digital humanities has investigated it as a medium. Within the sociocultural frame, and through research by design, I aim to integrate some of the views from the fields presented above and see the interface as a cultural and expressive artefact as much as a functional tool or instrument.

A genealogy of interface design

A history of screen-based interface design is closely connected to the histories of the computer.[7] Manovich (2001) argues that two distinct pictorial traditions meet at the screen-based interface:

> the older Western tradition of pictorial illusionism, in which a screen functions as a window into a virtual space, something for the viewer to look into but not act upon; and the more recent convention of graphical human-computer interfaces that divides the computer screen into a set of controls with clearly delineated functions, thereby essentially treating it as a virtual instrument panel.
>
> (Manovich 2001: 90).

The notion of the *Graphical User Interface* (GUI) is often used for describing interfaces that rely on computer graphics.[8] According to Negroponte (1995), Sutherland's introduction of the *Sketchpad* in the early 1960s was the "big bang of computer graphics" (Negroponte 1995: 103). Sutherland (1963) presented a system that allowed the user to control the computer in real-time by drawing on the screen using a 'light pen' (Figure 5). Among other things, his working system introduced the notion of the screen as a 'window' onto a larger canvas, the possibility to directly manipulate objects on the screen, zooming and scrolling. The system was also used for creating animations, or as Sutherland described them, 'moving drawings'. Movement in the interface is thus not a new phenomenon.[9]

[7] For a history of computing, see for example Rheingold (2000)
[8] For a history of the graphical user interface (GUI), see for example Kirschenbaum (2004) or Müller-Prove (2002). Darley (2000) traces the development of digital computing from the 1960s and its use in the production of visual digital entertainment. For a history of multimedia, see Rockwell & Mactavish (2004).
[9] Gere (2006) argues that the modern computer screen owes more to radar, which was introduced in the Second World War, than to television and the cinema screen. According to Gere, Douglas Engelbart, one of the important figures in the history of interface design, drew on his experience from radar and engineering training during the Second World War when envisioning how computers could augment the human intellect.

Figure 5. Ivan Sutherland with his *Sketchpad*, which made use of kinetic features such as scrolling and zooming.

Since the 1960s the development of computing technology and interfaces has been tremendous; the mouse, the Internet, windows and multi-tasking, mobile computing and multi-touch are some of the inventions that have been important for the development of screen-based interfaces. Many of these developments have first taken place in universities and corporate research labs (Myers 1998).

The prevailing interface paradigm has been based on the use of Windows, Icons, Menus and a Pointing device (WIMP), ever since these features were popularised in the 1980s. van Dam (1997) argues that the development of interface design has stagnated, and there is a need for what he calls *post-WIMP* interfaces that make more use of the different human communication capabilities, such as gestures and speech recognition. One could argue that some of these features have been implemented since van Dam wrote his provocative paper; consider for example the gesture-based gaming platforms of Nintendo *Wii* and Microsoft's *Kinect* for Xbox, and the Apple *iPhone* and *iPad*. Here, gesture recognition (on and off screen) and tactile feedback play important roles. Interfaces that rely on such 'tangible' controlling features beyond mouse and keyboard are often referred to as Tangible User Interfaces (TUI). Much attention is now given to such interfaces, focusing on human movement and gestures (Hummels, et al. 2007; Loke, et al. 2007).

It is impossible to predict the future of interface design. However, it is likely that screens (in combination with various modes of communication) will continue to play an increasingly important role in mediating our interactions with computers, digital information and each other. 'New' interfaces continue to be introduced, and it is necessary to study kinetic interfaces in order to facilitate as well as to critique this development.

Studies of kinetic interface design

Movement and animation in screen-based interfaces is not a new phenomenon; it was already an integrated part of *Sketchpad* in 1963. It has however received little attention in research on interfaces, except for some scattered attempts.

Already in 1969, Ronald Baecker handed in a PhD entitled *Interactive Computer-Mediated Animation* (Baecker 1969a, 1969b). He managed to build a system for real-time animation, called *Genesys*.[10] Since then, several studies have investigated how animation can be used in interfaces.[11] These studies have provided important insights into how animation may help users, for example by providing guidance and feedback, and visualise processes and structures through movement (Baecker & Small 1990).

For the most part, however, animation and movement has largely been neglected and considered harmful in HCI, much as a result of a one-sided focus on usability and efficiency, for example as preached by Jakob Nielsen. On the use of animation on webpages, Nielsen teaches that "in general, it is best to minimize the use of animation" (Nielsen 2000: 143). This is an argument that is based on efficiency, and also has to do with the limitations of the web. Nielsen acknowledges that animations have their place on webpages, but the attitude is negative and anti-productive: avoid movement if you can. I do not believe that such a focus on efficiency and usability is the most productive route for uncovering the potentials of animation. Ironically, it now seems like devices that integrate movement in the interface, such as the *iPad*, turn out to be easier to use than the older and static ones that have been refined over years through a series of usability evaluations. This can partly by explained as a result of better technology; it is now possible to make kinetic interfaces that was not possible to make earlier. However, it might also be argued that an approach of evaluation is not capable of predicting what might work in the future, and not capable of providing radical inventions. Evaluation is concerned with what already exists, while it is necessary to envision what could be in order to invent something new.

[10] Ronald Baecker later worked with the Human Interface Group at Apple (Baecker, et al. 1991).
[11] See for example Baecker & Small (1990), Baecker et al. (1991), Chang & Ungar (1993), Thomas & Calder (1995), Gonzalez (1996), Jeamsinkul & Poggenpohl (2002), and Petersen & Nielsen (2002).

Therefore, evaluation may be of limited value for radical or 'innovative' interface design.

According to Mazé (2007), there is a need for 'critical practice' in interaction design, to consider the social, cultural and political effects of design. The same is argued for by Morrison, Stuedahl, et al. (2010). Following this, there is a need to study kinetic interfaces in their own right, as cultural, communicative and aesthetic artefacts. Such studies could be labelled 'kinetic interface design studies' or the like, and should include diverse approaches and frameworks in order to investigate opportunities as well as challenges with such interfaces. Here, I also acknowledge the need for evaluating usability and efficiency; however, in addition to such an approach, which traditionally has been the mainstream approach in HCI, there is a need for a complementary approach. This is one that acknowledges that interfaces have moved from the office to the playground, from work to enjoyment, and may be studied as cultural artefacts in line with literature and music.

Designing interfaces involves the anticipation and determination of future use; it enables as much as it disables actions to be made by users. As cultural artefacts, interfaces are shaped by culture and in turn shape culture (Johnson 1997). Therefore, the design and development of interfaces needs to be studied within a culture-based framework.

Here, the notion of *discourse* is also important. The applied linguists and social semioticians Kress and van Leeuwen have defined discourse as "socially constructed knowledges of (some aspect of) reality" (2001: 4). Such knowledge has developed in a specific social context, according to the interests of social actors. A discourse may be seen as a system of meaning that regulates what can be said and done within a community, and is therefore closely related to ideology. Further, discourses may be studied in terms of how they are embedded in texts. Lemke points out the relation between text and discourse:

> The notions of text and discourse are complementary. When we want to focus on the specifics of an event or occasion, we speak of the text; when we want to look at patterns, commonality, relationships that embrace different texts and occasions, we can speak of discourses.
>
> (Lemke 1995: 7)

Discourse may be realised not only in words, but also through other modes, including images and artefacts (Kress & van Leeuwen 2001; Morrison forthcoming 2010; O'Halloran 2004). Therefore, we can assume that kinetic interfaces also embed and reinforce discourses and ideological

views through their design and employment of motional form. For example, when the designer decides what is to be static and what is to be kinetic, or what can be moved and what cannot be moved in the interface, he or she may be said to embed his or her own view on the world and impose it onto the users of the interface.[12] Therefore, it is necessary to be alert to how motional form may be used to realise discourses through the interface.

The way we choose to conceptualise the interface has implications for how we see it. Whether we choose to see the interface as a tool, a medium or a dialogue partner has implications for how we evaluate it. Therefore, it is necessary to employ different metaphors for investigating interfaces, and continuously challenge these concepts and metaphors. The notion of interface as tool, media and dialogue partner will be adressed in Part II of this thesis. In the next section, I will introduce the sociocultural view, which is informed by social semiotics as well as activity theory.

A SOCIOCULTURAL VIEW

This thesis adopts a sociocultural view on interfaces and design, which acknowledges that interfaces and design activities are situated in specific social, cultural and historical contexts (e.g. Lemke 1995; Morrison forthcoming 2010; Wertsch 1991).

> If we don't formulate explicitly our ways of making meaning in particular contexts, the meaning we make will be governed automatically, by default, by the limiting meaning systems of our narrow communities, even when we are not aware of this.
>
> (Lemke 1995: 157)

According to Lemke, the goal of theory is not to make an account of how things are, but to develop a critical way of 'analysing, doing and creating'. A theory is not a goal in itself, but a tool for analysis as well as for making. Theory in design should therefore help designer towards creating better artefacts for use, but also provide critical perspectives on the role of designers and the artefacts they produce (Norris & Jones 2005).

My conceptual framework is informed mainly by two research traditions, social semiotics and activity theory. *Social semiotics* has developed since the late 1980s and is based on the systemic functional grammar developed by the linguist Michael Halliday in the 1960s. *Activity theory* was founded by the

[12] Importantly, the work of the designer will in many instances be strongly regulated by external factors such as a client, employee, colleagues, formal regulations and technical demands. These may all contribute to the development of the interface.

Soviet psychologist Lev Vygotsky in the early 20th century. Activity theory and social semiotics share basic assumptions on the cultural and social construction of meaning (Wells 1994), but are not often employed in research on design, neither separately nor in combination (Morrison forthcoming 2010). However, a sociocultural view offers a well-founded alternative to other paradigms of conceptualising interface design, such as the cognitivist information-processing paradigm prevalent in HCI.[13] Importantly, the sociocultural approach is a dialogical one, which emphasises the interdependency of self and other, the mind and the world (Linell 2009; Vygotsky 1978; Wertsch 1991).

In Figure 6, I have provided a schematic view of the conceptual framework and the two main research traditions that this thesis draws on, including key authors and concepts. The terms *semiotic mediation*, *instrumental mediation* and *double mediation* are my own terms that are introduced in this thesis, and will be discussed later. They are included here so as to show how they are connected to the overall framework.

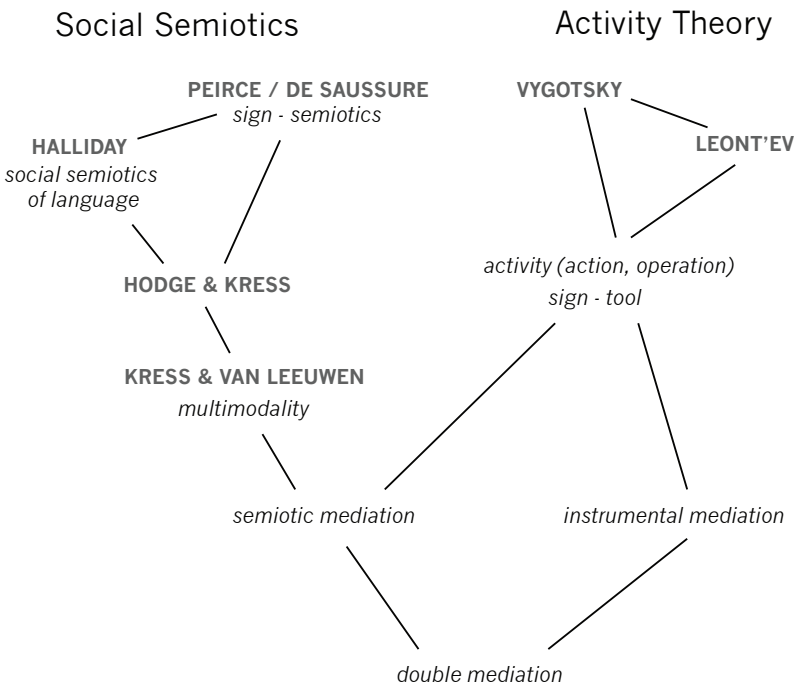


Figure 6. A schematic view of the conceptual framework and research traditions of social semiotics and activity theory.

[13] According to Kaptelinin and Nardi (2006), information processing is seen as the model for human cognition in the cognitivist paradigm. This view has been critiqued, also within HCI, as being too computational and limiting. Kaptelinin and Nardi position activity theory as a postcognitivist approach.

Social semiotics

How does the interface communicate so that we understand what is going on in the 'digital world'? How is meaning embodied in the interface? In other words, how does an interface function as a sign or medium for communication?

Interfaces are not only technological tools for achieving specific goals; they are also communicative artefacts in which meanings are inscribed (Eikenes & Morrison 2010; Selfe & Selfe 1994). In order to use a computer we must understand what it is and what it does by 'reading' its interface. Therefore, issues of learning and interpretation become important. Here, semiotics comes in as a useful resource.

Semiotics is the general study of meaning making and communication, and has historically been closely connected to linguistics and the study of language. The American philosopher Charles Sanders Peirce and the Swiss linguist Ferdinand de Saussure are regarded as the co-founders of semiotics (Chandler 2007; Kress 2010). de Saussure defined semiotics[14] as 'the science of the life of signs in society' and saw linguistics as a branch of this general science. Peirce, on the other hand, was not so concerned with language, and saw semiotics as 'the formal doctrine of signs', closely related to logic. Peirce and de Saussure worked independently of each other and developed similar but different theories of semiotics. Common to both traditions is the study of *signs*, that is, something that 'stands for' something else. For de Saussure, a sign, such as a word, consists of two parts: the *signifier* and the *signified*. The signified refers to the concept or 'meaning' the sign-maker wants to communicate (for example the concept of 'horse'), while the signifier refers to the physical phenomena (for example the word 'horse' written on a page, or a drawing of a horse). For Peirce, the sign is made meaningful only when someone interprets it, and this process of interpretation is referred to as *semiosis* (Kress 2010).

Semiotics has previously been applied in a range of fields, for example in relation to computers (Andersen, et al. 1993), product design (Krippendorff 2006; Vihma 2010), 'new media' (O'Neill 2008), as well as interfaces (Nadin 1988). However, it has not been applied much to kinetic interfaces (Eikenes & Morrison 2010; Skjulstad 2004). Consequently, there is a need to develop what we might call 'kinetic interface semiotics'. Here, it is useful to consider the approach of *social semiotics*, one that is based on traditional semiotics, and has developed since the 1980s.

Social semiotics explains communication and construction of meaning as a social practice. It draws on traditional semiotics (both Peirce and de

[14] de Saussure's term was *semiology*, or *sémiologie.*

Saussure), the systemic-functional linguistics of Halliday[15] as well as critical perspectives from a Marxist tradition. Hodge and Kress (1988) developed the general framework of social semiotics to construct 'a theory of communication and society'. They critiqued 'mainstream' semiotics for emphasizing structures and codes, at the expense of functions and social uses and interrelations of semiotic systems in social practice. According to Hodge and Kress (1988), meaning-making and semiotics must be analysed critically in its social and cultural context:

> We see communication essentially as a process, not as a disembodied set of meanings in texts. Meaning is produced and reproduced under specific social conditions, through specific material forms and agencies. It exists in relationship to concrete subjects and objects, and is inexplicable except in terms of this set of relationships.
>
> (Hodge & Kress 1988: viii)

Lemke (1995) argues that social semiotics reminds us that "all meanings are made within communities and that the analysis of meaning should not be separated from the social, historical, cultural and political dimensions of these communities" (1995: 9). This means that a semiotic analysis of interface design must acknowledge that the meaning of the interface is not fixed and located only in the interface, but is continually negotiated in its sociocultural and historical context. For example, Lemke (1995) argues that *intertextuality* is one of the most useful principles in social semiotics; each community has its own set of important and valued texts, which affects how other texts (in this case interfaces) are valued in that community. (The notion of intertextuality will be discussed in Chapter 6).

While traditional semiotics has focused on signs as codes or rules that people have to learn in order to communicate, social semiotic has developed the notion of *semiotic resources*. van Leeuwen describes semiotic resources as:

[15] See for example Halliday & Matthiessen (2004/1985) for an introduction.

> the actions and artefacts we use to communicate, whether they are produced physiologically - with our vocal apparatus; with the muscles we use to create facial expressions and gestures, etc. - or by means of technologies - with pen, ink and paper; with computer hardware and software; with fabrics, scissors and sewing machines, etc. Traditionally they were called 'signs'.
>
> (van Leeuwen 2005: 3)

Semiotic resources are not fixed, but have *potential meanings* that are socially constructed, continuously being negotiated and redefined as they are used over time in practice. Meanings are therefore "neither objective nor subjective, but *inter*-subjective. They offer ways of sharing subjectively experienced meanings, means for dialogue, even if the experience itself remains subjective" (van Leeuwen 1999: 194-195). The semiotic resources and their meanings are situated in the historical context of their communities. For example, as Norris (2004) points out, the same (body) movement may take on different meanings as it is located in different contexts. Further, semiotic resources gain their meaning potential in relation to each other; we make meaning by saying one word instead of another word, by using one colour instead of another colour. The possibilities of semiotic resources are sometimes mapped out in 'system network' diagrams, in which the semiotic choices for example may be set out as binary opposites or as matter-of-degree (e.g. Lim 2004; van Leeuwen 1999), drawing on the tradition of systemic-functional linguistics (Halliday & Matthiessen 2004/1985).

In design, semiotics has previously been applied under the labels of 'product semantics' (Krippendorff 2006) and 'design semiotics' (Vihma 2007, 2010). Krippendorff argues that 'design is making sense of things', and acknowledges that meanings of artefacts can change over time. Vihma (2007) critiques Krippendorff for making use of language as a metaphor for design; she draws on Peirce to describe how an artefact may signify as icon, index and symbol, and uses the concept of *sign vehicle* to describe how a product can carry meaning from a designer to a user (Vihma 2010). Consequently, meaning making is seen as one-directional transport of information from a sender (the designer) to a receiver (the user) through a physical product. Similar one-directional notions of semiotics and communication have also been applied in HCI, for example under the label of 'semiotic engineering', in which "interactive computer systems are viewed as one-shot messages sent from designers to users." (de Souza 2005: 317). A one-directional communication model for design is also presented by Crilly et al. (2008). Such a linear sender-receiver model of communication is rejected by social

semiotics and in contemporary media and communication research, and it may seem that product semantics often lack the critical and sociocultural views on meaning making that social semiotics has developed.

Admittedly, not everyone in design semiotics adopts linear models of communication. For example, some authors in *Design semiotics in use* (Vihma 2010) acknowledge the importance of the cultural and social contexts for describing the meanings of artefacts (e.g. Hussain & Keitsch 2010; Keitsch 2010). Hussain & Keitsch (2010) argue that the perception of physical objects is influenced by the individual, society, and culture, in addition to the physical properties of the object. However, they do not seem to be aware of - or see the relevance of - the large body of related work in social semiotics. In my mind, it seems that social semiotics can provide a useful contribution to 'design semiotics'.

In a social semiotic view, designers may be seen as professional producers and manipulators of semiotic resources. Semiotic production, and thereby the work of designers, is always *motivated* (Kress & van Leeuwen 2006/1996), it is driven by certain interests and values at all times when carrying out activities of design. This points to the need for a more critical view on design semiotics. However, social semiotics also emphasises the active and motivated role taken by the 'user' or interpreter of the artefact or sign:

> Sign producers use the semiotic resources available to them according to their interest at the moment of sign production. Exactly the same thing can be said of sign *interpreters*: they use the interpretative resources available to them according to their interest at the moment of sign interpretation.
>
> (van Leeuwen 1999: 193-194)

Social semiotics may be criticised for its linguistic heritage, but has successfully moved on to include other modes of communication. Kress and van Leeuwen (2006/1996) applied principles from social semiotics to images, based on the assumption that images can be 'read' in a similar way as verbal texts. Further, Kress and van Leeuwen (2001) developed the notion of *multimodality* to denote how multiple semiotic modes work together.[16] However, Fagerjord (forthcoming 2010) points out that Kress and van Leeuwen mostly focus on the various modes independently, and offer little

[16] Kress and van Leeuwen (2001) distinguish between mode and medium as follows: mode is described as 'content', and as "semiotic resources which allow the simultaneous realisation of discourses and types of (inter)action" (2001: 21). Medium is described as 'expression', and "media are the material resources used in the production of semiotic products and events, including both tools and the materials used" (2001: 22). The distinction between mode and medium is debated and not always clear, but this debate goes beyond the scope of this thesis.

understanding on the combinations of different modes. Morrison (forthcoming 2010) also stresses multimodality in terms of digital design and composition. Kress has been criticised for making a binary distinction between word and image, claiming that words are general and vague, in contrast to depictions and images, which are full of meaning and specific (McDonagh, et al. 2005; Prior 2005). Prior (2005) critisises Kress for neglecting semiotic practices such as design, and asks for more nuanced and less certain classifications of multimodal texts and their meanings. McDonagh et al. point out that "symbolic depictions are generally vague, and offer the possibility for multiple readings" (2005: 81). This points to the importance of seeing both images as well as interfaces as *polysemic* – that is, allowing for a plurality of interpretations and meanings. According to McDonagh et al., the capacity of images to simultaneously be precise and ambigious is their great power.

Social semiotics has been applied to a range of semiotic modes and media types to understand how they communicate, such as images (Kress & van Leeuwen 2006/1996), typography (van Leeuwen 2006), speech and music (van Leeuwen 1999), body movement (Martinec 1998), toys (van Leeuwen 2008) and architecture (O'Toole 2004).[17] For example, in analysing typography as a semiotic mode, van Leeuwen (2006) identifies features such as weight, expansion, slope, curvature, connectivity, orientation, and regularity. For each feature, he explains the possibilities for variation, and the potential meanings of these.

Social semiotics has not been applied much to interfaces, and especially kinetic ones. However, Skjulstad (2004, 2007, 2008, forthcoming 2010) has investigated websites as 'communication design', by drawing on social semiotics. This includes analysis of the websites' kinetic and dynamic features. This view allows her to see multimodal websites as communicative compositions, and as 'mediational sites' that are moving and 'on the move'. In *Movement in the interface* (2005), Skjulstad and Morrison investigate kinetic and dynamic features of an interfaces by analysing a website they co-developed in a practice-based research project. Kinetic features were also investigated when Morrison et al. (2007) analysed a website for a planned waterfront housing project.[18]

By drawing on social semiotics, it is possible to identify and explore features of semiotic modes and resources. This makes it a robust approach that can be applied to a range of different 'texts' and phenomena, as should be evident from the list above. However, there is still a need for social

[17] O'Toole analyses the Sydney Opera House through 'multimodal discourse analysis' (O'Halloran 2004). Such an approach is closely related to social semiotics; they both draw on semiotics and multimodality, and the systemic-functional theory of language developed by Halliday.
[18] See also the section on textual analysis in Chapter 3 for relevant literature.

semiotics to be extended to other modes and forms of communication, such as visual movement, interfaces and physical artefacts.

With its focus on texts and meaning making, social semiotics tends to focus on 'reading' more than acting. Interfaces are not only text for reading and contemplation; they are also tools that allow people to carry out various actions and activities. Meaning does not reside only in the text, but also in the "actions that people take with it" (Norris & Jones 2005: 4). Therefore, social semiotics needs a complementary approach in order to account for the role of kinetic interfaces as people use them in various activities. For this, I turn to activity theory.

Activity Theory

A sociocultural view on design also draws on activity theory, referred to as *cultural-historical activity theory* or *cultural-historical psychology*. Such a view rejects universalising and dualist theories of mind, and claims that our minds are formed by our social interactions in a community and a culture (Lemke 1995). In this view, human activities and development are mediated by the use of tools and signs, which shape the action in which they take part (Wertsch 1991). Here, artefacts can be seen as tools and signs. Activity theory therefore provides a frame for understanding the mediating role of artefacts, including kinetic interfaces. This approach is well established in developmental psychology and studies of learning. It has also been applied to interface design (e.g. Bannon & Bødker 1991; Gay & Hembrooke 2004; Kaptelinin & Nardi 2006). However, these studies are not integrated with a social semiotic view on kinetic interfaces. Rather, they often try explicitly to look *beyond* the interface (Bannon & Bødker 1991).

Two important figures in activity theory are Lev Vygotsky and Aleksei N. Leont'ev. Vygotsky (1978) is regarded as the founding figure of this tradition. His work focused on the psychological development of children, and he provided a theory of mediation in reaction to existing stimulus-response theories of behaviour. While the existing theories explained human development as a simple reaction to external stimuli,[19] Vygotsky found that language and signs played an important role in mediating and facilitating psychological development. According to Vygotsky, tools and signs mediate interaction between the human and the environment; we *construct* knowledge about the world by learning the habits, symbols and languages of a society.[20]

[19] Leont'ev explains the problem of 'stimulus-response' theories as follows: "The limitations of this approach lay in the fact that it assumed, on the one hand, things and objects and, on the other, a passive subject influenced by them. In other words, this approach ignores the significant element of the actual relations of the subject with the objective world; it ignores his activity." (Leont'ev 1977: 180)

[20] Vygotsky is sometimes regarded as the first social constructivist. Social constructivism focuses on how learning is a process of constructing knowledge rather than uncovering 'universal truths', and how meaning is constructed in a cultural context.

Learning and meaning making, including the meanings of artefacts, are therefore culturally situated and depend on interpersonal communication.

Leont'ev (1977, 1978) worked with Vygotsky, and expanded on the notion of activity.[21] For Leont'ev, human activities mediate the relationship between the human and the world. In his view, consciousness is not directly determined by surrounding 'things and phenomena', but determined by "the process of the *actual life of people*" (Leont'ev 1977: 181), that is, their activities.

Drawing on Vygotsky and Leont'ev, activity theory takes *activity* as its primary object of analysis. People, when engaged in activities, typically employ 'mediational means', such as tools or language (Wertsch 1991). Therefore, when artefacts are employed in activity, they are often referred to as *mediating artefacts* (Wartofsky 1979). Wartofsky proposes a three-level hierarchy of mediating artefacts, in which *primary artefacts* are seen as tools used in production, *secondary artefacts* are representations of primary artefacts, their production and 'mode of action', while *tertiary artefacts*, such as works of art, are autonomous and imaginative worlds that can change the way we see the actual world and thereby change our practices. Morrison, et al. (forthcoming 2010) suggest that wikis (such as Wikipedia) work as both primary, secondary and tertiary artefacts. Here, I would like to suggest that a kinetic interface could do the same; a kinetic interface may be used as a tool in producing or manipulating digital information. Further, it represents its own design and use through its multimodal composition. Finally, kinetic interfaces may create imaginative worlds that make us see the 'real' world in new ways. In social media for example, the border between the 'virtual' and 'real' world is blurred; as interfaces increasingly mediate social interaction they may affect the way we see these worlds (Eikenes 2009).

The shaping of mediating artefacts such as interfaces has implications for the activities in which they are used as mediational means. This has implications for what it means to design an artefact, as described by Bannon and Bødker:

> To design an artifact means not only to design the "thing" or device that can be used by human beings as an artifact in a specific kind of activity. As the use of artifacts is part of social activity, we design new conditions for collective activity (e.g., a new division of labor), and new ways of coordination, control, and communication.
>
> (Bannon & Bødker 1991: 247)

[21] For Leont'ev, activities are processes "that realise a person's actual life in the objective world by which he is surrounded, his social being in all the richness and variety of its forms." (Leont'ev 1977: 181). According to him, the notion of activity has the potential to connect the biological, psychological and social level of the human being.

From an activity theoretical perspective, interface design may be seen as an activity of producing mediating artefacts that are situated in a historical, cultural and social context. But how does the interface work as a mediating artefact? Does it function mostly as tool or sign in human activity, or both? Before answering these questions it is necessary to look more closely at what Vygotsky referred to as tool and sign.

Vygotsky argues that human development is achieved by *internalizing* the tool and sign systems that have developed historically in a culture over time, and compares the use of signs to the use of tools in solving problems:

> The invention and use of signs as auxiliary means of solving a given psychological problem (to remember, compare something, report, choose, and so on) is analogous to the invention and use of tools in one psychological respect. The sign acts as an instrument of psychological activity in a manner analogous to the role of a tool in labor. But this analogy, like any other, does not imply the identity of these similar concepts.
>
> (Vygotsky 1978: 52-53)

This indicates that signs may be used for solving problems, in a similar way as physical tools; they both function as mediational means in an activity. The similarity of tools and signs is that they mediate activity:

> As we have already noted, the basic analogy between sign and tool rests on the mediating function that characterizes each of them. They may, therefore, from the psychological perspective, be subsumed under the same category. We can express the logical relationship between the use of signs and of tools using the schema …, which shows each concept subsumed under the more general concept of indirect (mediated) activity.
>
> (Vygotsky 1978: 54)

To illustrate his point, Vygotsky provided a diagram in which sign and tool are subsumed under the same category of 'mediated activity' (Figure 7):

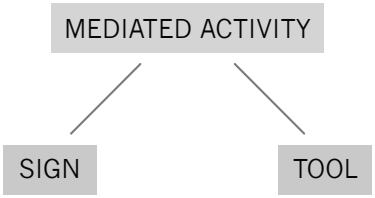


Figure 7. Diagram showing sign and tool subsumed under the same category of 'mediated activity'. Redrawn from Vygotsky (1978: 54).

Vygotsky compared the 'function' of the tool to the 'function' of the sign, but still made a clear distinction between them. For him, tools were physical and technological instruments for bringing about physical change. The sign, on the other hand, he saw as a psychological entity or instrument:

> The tool's function is to serve as the conductor of human influence on the object of activity; it is *externally* oriented; it must lead to changes in objects. It is a means by which human external activity is aimed at mastering, and triumphing over, nature. The sign, on the other hand, changes nothing in the object of a psychological operation. It is a means of internal activity aimed at mastering oneself; the sign is *internally* oriented.
>
> (Vygotsky 1978: 55)

Vygotsky distinguished between tools and signs, but argued that they worked in similar ways. For him, tools denoted physical artefacts used in labour, while signs denoted means for constructing meaning, be it physical or psychological ones.

In the interface, however, the distinction between tool and sign is not clear. Andy Blunden has rejected the clear dichotomy between tool and sign/symbol in activity theory:

> While 'tool' and 'symbol' have different meanings, there is no sharp line separating them. Consider the following series of cultural means of opening a door: crow-bar, key, swipe card, PIN code, password, smile to the doorkeeper. Isn't it clear that all are artifacts used as a means of gaining access, and psychologically speaking play much the same role? … So tool and symbol form a continuum. Whether tool or symbol, the artifact always entails a relation, direct or indirect, to other

> people, in the example, a relation between the person responsible for controlling access and the person seeking access.
>
> (Blunden 2010: 151)

I have previously suggested that an interfaces may function *both* as a semiotic artefact (sign) and as an instrument (tool) in mediating human activity (Eikenes 2010). On one hand, the interface enables activities to take place, much like a tool or an instrument; through the interface we send emails, access banks accounts, produce artworks, and write documents. This function of the interface I will call *instrumental mediation.* However, in order to work like a tool, the interface must be made meaningful through the use of signs. Conventions and signs are used in order for us to 'understand' the computer and communicate through it. The signifying function of the interface I call *semiotic mediation*. The double role of the interface I will refer to as *double mediation*. This will be taken up more fully in Part II.

To account for semiotic mediation, I draw mainly on social semiotics. For describing instrumental mediation I will draw on activity theory and the classification of the internal structures of activity as categorised by Leont'ev. He distinguished between activities, actions and operations:

> So, in the general flow of activity which forms human life in its highest manifestations (those that are mediated by mental reflection), analysis first identifies separate activities, according to the criterion of the difference in their motives. Then the action processes obeying conscious goals are identified, and finally, the operations that immediately depend on the conditions for the attainment of a specific goal.
>
> (Leont'ev 1977: 186)

According to this, activities are oriented towards certain motives or needs, actions are driven by conscious goals or purposes, and operations are automatic and conditioned by the tools of the action at hand. The model is sometimes presented like this:

Activity	–	motive
Action	–	goal
Operation	–	conditions

Motivated by a goal, a person makes use of the interface as a tool or instrument to achieve a specific outcome. I have referred to actions that a user carries out via the interface as *interface actions* (Eikenes 2010).

However, it is important to note that the relations between activities, actions and operations are dynamic and continuously changing; specific actions may for example take part in a network of several activities, and an action may become an operation when it is carried out unconsciously, or an operation may become an action if there is a 'breakdown'. Consider for example driving a car, an example used by Leont'ev himself. Initially, all operations, such as shifting gears, require attention from the driver. But normally, after learning to drive the car, shifting gears does not require much conscious attention:

> For the consciousness of the driver, shifting gears in normal circumstances is as if it did not exist. He does something else: He moves the car from a place, climbs steep grades, drives the car fast, stops at a given place, etc.
>
> (Leont'ev 1978: 66)

Leont'ev is aware that such operations may be taken over by a 'machine', but he argues that the model also accounts for operations carried out by machines, including computers:

> Even when an operation is carried out by a machine, it still realizes the action of the subject.
>
> (Leont'ev 1978: 66)

I see the interface as a mediating artefact through which a person can achieve specific goals when using a computer. It is not new to suggest an approach to interface design based on notions of activity and action. Activity theoretical approaches based on the work of Leont'ev has for example been applied to interface design by Bødker (1991), Nardi (1996), and Kaptelinin and Nardi (2006).[22] These are postcognitivist approaches that reject an information-processing paradigm as the model for human cognition, which HCI often has adopted (Kaptelinin & Nardi 2006).

Activity theory provides a general framework for analysing the mediating role of artefacts and kinetic interfaces in a historical, cultural and social context. The interface is here referred to as a mediating artefact that works both as sign and tool. However, activity theoretical studies of interfaces have focused mostly on activities of work, in which the interface is seen primarily as a tool. Activity theory has not engaged much with semiotics, and the 'sign'-function of interfaces has largely been neglected. Therefore, these

[22] A comprehensive overview of activity theory and interface design is beyond the scope in this thesis.

studies have not seen the interface as a rich semiotic and cultural artefact. It is here that social semiotics can offer a solid and complementing perspective.

CONCLUSION

This chapter has provided some context and background needed in a study of kinetic interface design. In addition, I have introduced the sociocultural approach that the thesis adopts.

The *interface* has been identified as a multimodal text and a 'cultural map' of the digital world, that enable people to 'read' and understand as well as affect and control digital information and computational processes. Importantly, for most users of computers or digital artefact, the interface *is* the computer. The design of interfaces therefore has great implications for how we use and understand digital devices, the information presented through these devices, and the activities they enable.

Kinetic interfaces are not new; they have existed from the 1960s, but have still received little attention in design research. The fields that I regard as most relevant to the study of interfaces are human-computer interaction, interaction design and the digital humanities. I have suggested that these fields have different and sometimes conflicting motivations for studying interfaces, resulting in different metaphors and conceptualisations of the interface. For example, it has been suggested that the interface can be seen as a tool, medium or dialogue partner.

For the design and study of kinetic interfaces in design research, it is necessary to link some of these different views. How do the different views relate to each other when applied to the kinetic interface? There is especially a need to see the interface as a semiotic and cultural artefact as much as a technical and functional one. For this purpose, I adopt a sociocultural view on interfaces, their design and use, drawing primarily on social semiotics and secondary on activity theory. This will allow me to investigate kinetic interfaces both as tools, signs and dialogue partners. Social semiotics and activity theory are not often linked, but provide a promising potential in complementing each other; they both see human interaction with the world as a mediated dialogical process, and share a common interest in 'meditational means' such as signs. Together, they can account for the complex mediation that takes place at the interface, as well as the dialogical interactions taking place between people and interfaces. There is also a need to take up kinetic interfaces in sociocultural theory from a design point of view, as this may provide new insights into the relation between tools and signs, and the role interfaces may play in human activity and development.

In the next chapter I will address *how* the potentials and features of kinetic interfaces can be studied in design research, that is, the research and design methods I employ in this thesis.

Chapter 3. Methods

The previous chapter provided contextual background and the theoretical approaches chosen for the thesis. In this chapter, I will address *how* the potentials and features of kinetic interfaces can be studied in design research. I will discuss how research may involve design production under the heading of *research by design*. In this thesis, textual analysis is coupled with textual construction through design, which allows me to generate new concepts for understanding kinetic interfaces. Therefore, I will give an account of textual analysis, and finally present how I have approached textual construction through design experimentation. Finally, I will provide some reflections on the research process and how it has developed during the project.

As pointed out in the previous chapter, kinetic interfaces have already existed for some time, but their semiotic potentials have not been extensively investigated. In addition, interfaces develop continuously and rapidly, especially as a result of technological advances. How are we to investigate a phenomenon that is emerging? How might we investigate potentials that have not yet been realised?

RESEARCH BY DESIGN

> Which are the available means of effective communication in the digital systems of communication? How are we to find them?
>
> (Liestøl 1999: 34-35)

In recent years, notions such as 'practice-led research' and 'research by design' have become popular in design research (Sevaldson 2010).[23] This PhD project has been part of a larger research project called RECORD,[24] a

[23] Rust, Mottram & Till (2007: 11) define 'practice-led research' as "Research in which the professional and/or creative practices of art, design or architecture play an instrumental part in an inquiry." See Sevaldson (2010) for a comprehensive overview.

[24] RECORD investigates social media and online communities, and focuses especially on how people produce, share and navigate in media content such as videos and images. See http://www.recordproject.org/

practice-based research project in which design production with external business partners was a precondition. Rust et al. (2007) state that if practice is to be employed in research, it must include an explicit understanding of how the practice contributes to the inquiry.[25] *Research by design* has been proposed as a term for research in which "the explorative, generative and innovative aspects of design are engaged and aligned in a systematic research inquiry" (Sevaldson 2010: 11).[26]

Research by design and practice-led research have often focused on the design process and methods, and the practice of the artist or designer (Jonas 2007; Mäkelä & Routarinne 2006; Sevaldson 2010).[27] Here, the work of Donald Schön (1983) has been important for seeing professional design practice as a knowledge domain.[28]

According to Dorst (2008), the emphasis in research on the process of design is overwhelming, and there is a need for investigating other issues in design, including the 'content' – the artefacts themselves. Within interaction design, Mazé and Redström (2005) argue that we need new methods and frameworks for studying the designed object – and especially 'computational objects'. In computational objects, computational technology may be regarded as a material (Hallnäs, et al. 2002). In contrast to traditional artefacts, the form of computational objects unfolds in time and through use. Therefore, the form may be seen as more than two- or three-dimensional, as it changes with time and in use (Mazé & Redström 2005). A kinetic interface may be seen as such an object, where temporal as well as spatial form, properties and features need to be investigated. My aim is therefore not to study design practice or methodology, although I produce design experiments through my own practice. In contrast, I do research by design primarily for studying the artefacts themselves, rather than for studying the processes of

[25] It may be confusing that in design practice, 'research' is often seen as a part of the process of designing an artefact or system (e.g. Saffer 2007). To be sure, the term is here used to denote an academic, scholarly inquiry within the field of design.

[26] Frayling (1993/4) and Archer (1995) introduced the notions of research *about*, *for* and *through* design. Research *about* design entails an outsider view on design practice, research *for* (the purpose of) design aims at contributing to design practitioners' activities, while research *through* design is carried out through the practitioner's design activity. Research *by* design (Sevaldson 2010) corresponds more or less to research *through* design. According to Sevaldson, design practice needs to be complemented with a dimension of reflection to qualify as research.

[27] According to Cross (1984), the first conference on design methods in 1962 in London marked the launch of the design methods movement and design methodology as a field of inquiry. The Conference on Design Methods led to the founding of the Design Research Society (DRS) in 1966. DRS initiated the launch of the journal *Design Studies* in 1979. See Bayazit (2004) for an account of 40 years of design research since the 1960s.

[28] Schön (1983) claimed that universities as institutions were devoted to a particular epistemology that was inattentive to practical competence and professional artistry. He argued that practitioners exhibit a kind of 'knowing-in-practice' that they cannot easily verbalize. Therefore, he searched for an 'epistemology of practice' based on 'reflection-in-action' and 'reflection-on-action'.

making them, or their actual use. This allows the use of my own designer skills and practice in order to investigate an emerging phenomenon.[29]

In the digital humanities, researchers have taken up the relationship between design production and analysis. For example, Bolter (2003a) argues that there is a gap between media theory and the cultural practices surrounding new media forms. Bolter (2003b) further argues that studies of new media need "a fusion of the critical stance of cultural theory with the constructive attitude of the visual designer" (2003b: 30), which may be achieved by making something that leads viewers or readers to "reevaluate their formal and cultural assumptions" (2003b: 30). Similarly, Liestøl (2003) argues that traditional humanities analyses that take place 'after-the-event' of production are being challenged by the continued emergence of new innovative media forms; the humanities may gain from moving from *analysis* (interpretation) of existing text to also include *synthesis* (the construction and production of new texts) in order to reveal future potentials. He has earlier described such a methodology as a 'synthetic-analytic approach' (1999). This approach has for example been taken for investigating hypermedia from a rhetorical perspective, by using practical experiments combined with theoretical analysis in order to explore and investigate contradictions between core features of hypermedia texts (Liestøl 1999). More recently, Liestøl (2009) has proposed 'Digital Genre Design' as a constructive humanistic approach to bridge the gap between theory and development, in which experimentation with digital genre prototyping is carried out in order to conduct active genre design. According to Liestøl, experiments into the construction of artefacts can be informed by theory, and also lead to 'innovative' theory by generating concepts and principles that may inform further development. The relationship between analysis and synthesis is therefore a dialogical one, in which the different activities inform each other. For example, analytical concepts developed through analysis may be employed and challenged through making, and thereby lead to new or refined concepts.

Experimental design may also serve as a critical counterweight to mainstream development and research on interface design. For example, Drucker (2009) argues for the need of making speculative and experimental design projects that seek alternative possibilities to the "normalizing pressures of digital protocols" (2009: 7). According to her, research on computer technology, including interfaces, tends to forget the critique of reason and grand narratives from deconstruction and poststructuralism. There is therefore a need to "envision and realise alternative possibilities" (2009:

[29] Such an explorative and interpretive approach is traditionally not common in design research. For example, according to Cross (2001), it has recurrently been a desire to 'scientise' design and design methods in order to secure the outcome of design. This is not a goal for this thesis.

7). A similar argument is posed by Redström (2007), who argues that experimental design research does not have to be about 'problem solving'; an equally valuable aim is to create diversity, to find new problems through design explorations, and to create alternative visions of 'what could be'. According to him, an important contribution of design research is to envision the 'possible', in contrast to the 'factual'. Consequently, creating diversity may be seen as a goal in itself. To envision alternative possibilities and create diversity has therefore been a goal in my study, enabled through experimental design production.

From a social semiotic perspective, van Leeuwen (1999) argues that there are three things social semioticians do: 1) describe semiotic resources, 2) explain how they are used, and 3) explore how they can be expanded. However, it seems that research in social semiotics has concerned itself mostly with analysing existing texts, and not so much with expanding semiotic resources, especially through textual construction and design. In his book *Speech, Music, Sound*, van Leeuwen (1999) points to the possibility and importance of expanding semiotic resources through design:

> In times of rapid change and new communicative challenges, semiotics and design, theory and practice, can work hand in hand. … learning to describe 'what could be' is the single most important job now facing semiotics.
>
> (van Leeuwen 1999: 11)

It is this challenge that this thesis meets. Kinetic interface design is such an area that is characterised by communicative challenges and rapid change, and from a social semiotic perspective, there is a need to investigate and expand semiotic resources, and find out 'what could be'. For example, Zielinski (2006) argues that artistic explorations with interfaces may give new insights that go beyond the tension between calculation and imagination, certainty and unpredictability in discussions of culture and technology. According to him, the interface is one of the more important areas where these two sides engage.

Experimental design is well suited for this; specific issues and questions can be investigated by generating new kinetic interfaces, or visions of such interfaces. Such an approach differs from approaches in which the aim is solely to make 'more usable' artefact for utilitarian purposes, as often seems to be the implicit goal in HCI.[30] In contrast, my aim is to investigate semiotic potentials by both analysing and constructing texts, and find features or principles that can be applied in other design situations. The designer's skills,

[30] For example, Zimmerman et al. (2007) argue that the aim of design research in HCI is to make 'the right thing', as opposed to commercially successful things.

practice and production thereby become means to build knowledge about kinetic interfaces, which again may inform design practice.

An additional advantage of making artefacts is their communicative potential; they may serve as a demonstration of the topic under discussion. By making kinetic interfaces I not only investigate the potential of movement in the interface – I also demonstrate and communicate the potential of movement through sketches and demonstrations of kinetic interfaces.[31]

Through a 'research by design' approach, this thesis combines text construction with textual analysis. In the following section I will focus on the analysis of texts, before turning to the construction of texts through design experimentation.

TEXTUAL ANALYSIS

> The basic tenet of hermeneutics is that understanding is gradual, a circle alternating between the parts and the whole and thus closing in on a better view of the world, but with the realization that there can never be a final, closed interpretation.
>
> (Aarseth 2003: 434)

In order to uncover the potential of kinetic interfaces, what features they may have, and how they may work, I have combined textual analysis with text construction (Eikenes 2009, 2010), and also analysed existing interfaces (Eikenes & Morrison 2010). In this section, I will focus on the analytical approach of textual analysis, while the next section will focus on textual construction through design.

According to Machin (2007), visual designers tend to use descriptive adjectives and aesthetics terms that do not address the meaning of their compositions such as magazine pages; there is a need for creating "inventories of the way that precise design decisions can contribute to the overall meaning of a page" (2007: viii). The same argument goes for kinetic interfaces.

From a social semiotic perspective, a kinetic interface may be seen as a multimodal artefact or 'text'. The main method for analysing these interfaces is that of *textual analysis*. Textual analysis is a mode of research that has been widely applied in the humanities. It was first developed by Barthes (e.g. 1970), who emphasised the role of the readers' interpretations of texts, rather than the intentions of the author. Here, 'text' does not refer to linguistic texts

[31] I do not claim that there is a clear argument 'embedded' in the designed artefact itself, as its reading is dependent on interpretation in context. According to Niedderer (2004) and Biggs (2002), this dependency on interpretation is the reason why an artefact cannot advance knowledge or an argument in itself, and why it needs an explicating counterpart in practice-led research.

only, but to all artefacts and media through which meaning is produced, such as images, clothes, magazines, movies and interfaces.[32] This type of analysis is *hermeneutical*, based on the researcher's interpretations of a text. Such an analysis is therefore significantly different from 'interface evaluations' frequently carried out in HCI in which the aim is to evaluate with users how good an interface works in use.[33] The aim of textual analysis is to study the potential meanings of a text by providing a reading of it, deconstruct it, and thereby present a view on how it is possible to interpret it. This notion of textual analysis rests to a large degree on the situated semiotic analysis of Roland Barthes (1970), who importantly identified the crucial role of the reader in interpreting and constructing the meaning of texts.

In order to distinguish the 'textual level' of kinetic interfaces from other aspects, Liestøl's (2003, 2009) notion of *meaningware* is useful. Meaningware is distinguished from software and hardware (see Figure 8), and is described as "the domain of digital discourse where the individual messages and texts reside" (Liestøl 2009: 24). Kinetic interfaces have previously not been much analysed at a textual level, or as 'meaningware'. However, there are some important exceptions, mostly in the digital humanities and media and communication studies, some of which draw on social semiotics.

Though they do not explicitly use the term 'textual analysis', Bolter and Gromala (2003) and Manovich (2001) analyse interfaces as part of visual culture, discussing the histories and traditions of representation that are at play.

In order to develop a vocabulary for describing and analysing multimodal works, Fagerjord (forthcoming 2010) focuses on the combination of different modes in a close analysis of a *Flash* documentary by National Geographic. In this documentary, Fagerjord finds among other things that 'moving frames' (still images that are put into movement) add more levels of meaning to the images, and direct the reader's eye in reading. Earlier, Fagerjord (2003) has employed textual analysis in analysing websites and media convergence from a rhetoric perspective, also informed by social semiotics.

From an art perspective, Munster (2003) investigates meaning and expression in *Flash* aesthetics. She argues that *Flash* aesthetics is a hybrid

[32] Vihma (2007) argues that the metaphor of text or language is misleading in the semiotic study of artefacts. Her argument is based on the following rhetorical question: "How can a concrete, material thing suddenly be transformed into a word-like and sentence-like system?" (2007: 223). However, analysing an interface as a 'text' does not imply looking at it as a 'word-like' or 'sentence-like' system. In order to understand how an interface is composed and how it communicates, it can be studied as a semiotic artefact by drawing on concepts from social semiotic, in a similar but not the same way as verbal texts.

[33] Online surveys have been conducted in the RECORD project, in which some of the motion sketches analysed in Eikenes (2010) were discussed by professional designers. This informed my analysis by offering interpretations from several people. However, the online discussions tended to focus on concrete and particular aspects of the sketches (such as timing and spatial layout), and were not very helpful in describing more abstract principles for the use of motional form in interfaces.

product of meaning between cultures, such as low-tech, high-tech, digital and analogue. Her analysis is rather general, with some examples, but without any close textual analysis.

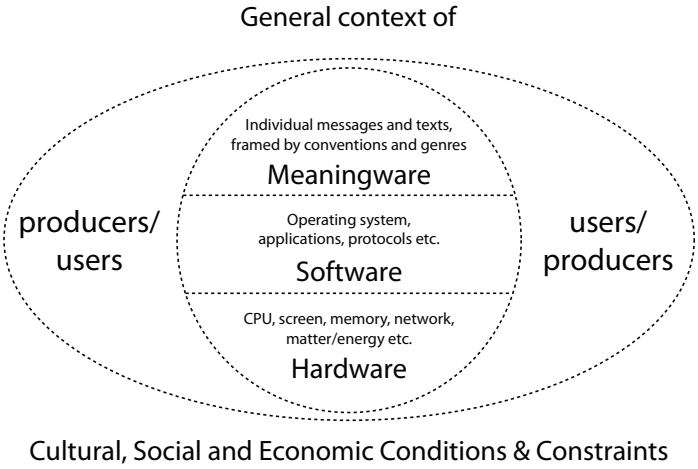


Figure 8. Illustration redrawn from Liestøl (2009) showing three levels of digital media: meaningware, software and hardware. Meaningware is at the topmost level in the hierarchy, above software and hardware. Each lower level constraints the level above.

Aylish Wood (2007) is also concerned with 'moving image media' and interfaces in her textual analyses of computer games. In order to comprehend the spatio-temporal nature of a viewer's encounter with interfaces, she refers to the interface as architecture. Further, she argues that the interface is created by competing elements that work to organize a viewer's attention. These elements may employ features of movement and animation.

Kress and van Leeuwen (2001, 2006/1996), regarded as the researchers who have brought social semiotics from the domain of linguistics into multimodal communication, have barely analysed any interfaces at all, and not much animation or moving images either. However, other researchers have drawn on social semiotics in analysing interfaces.[34] For example, O'Halloran, et al. (2010) report on the design and development of an application and its interface for analysing multimodal texts. Here, they point to the challenges of integrating multiple theoretical views and concepts into one interface, and how interface design thereby becomes a 'theoretical exercise'. Ball (2004) analyses a 'scholarly new media text' by Adrian Miles, including its interface. She finds that the design of the interface supports the

[34] See also the section on social semiotics in Chapter 2.

argument of the text, as "the reader gets to create the text, performing its argument in a true non-linear fashion" (2004: 417).

How is one to carry out a textual analysis of kinetic interfaces? Taking a social semiotic approach, van Leeuwen (1999) suggest a procedure of classifying semiotic resources, following the systemic-functional approach of Halliday (e.g. Halliday & Matthiessen 2004/1985). Here, one starts by gathering a selection of texts, then makes an inventory of available semiotic 'choices' in these texts, and then classify these choices in a 'system network'. I have not employed such a systematic approach, as I have not tried to make a comprehensive grammar of kinetic interfaces or motional form.[35] Rather, I have chosen to focus on specific concepts and features that I have considered to be important or characteristic in the interfaces I have analysed. Being a trained industrial and interaction designer has allowed me to 'see as a designer', that is, actively use my design experience and visual competence in observing and analysing visual material.

Liestøl (2003) propose other methods for textual analysis. He argues that analytical concepts, which are the tools for analysis and interpretation, may be obtained in three ways; first, by borrowing from neighbouring disciplines, second, by borrowing from fields or general approaches such as semiotics, or third, to search for conceptual sources in designers' discourses. In my analyses, I have used all three approaches; I have borrowed concepts and terms from a range of disciplines and fields such as animation studies, motion graphics, industrial design, HCI, and media and communication studies. Further, I draw on core concepts from social semiotics and activity theory in order to situate the study. Finally, I draw on terms from design practice, for example in interaction design and motion graphics. Kinetic interface design may not have been theorised much, but existing terms and knowledge from designers' practices are available through manuals and 'how-to-do-it' books (e.g. Woolman 2004). Such resources are highly valuable for developing a descriptive vocabulary and as inspiration for constructing analytical concepts.

Before and during the PhD project I have gathered links to websites in which movement is used extensively.[36] In addition, I have kept myself updated on the introduction of new screen-based artefacts such as gaming devices and mobile phones, in which kinetic features are employed. Based on this 'collection' of interfaces I have chosen to analyse and make reference to interfaces that somehow make use of movement in unexpected, new or for me fascinating ways. After introducing new concepts I have also looked for interfaces that demonstrate or challenge my concepts.

[35] An exception is Chapter 7, in which I build on van Leeuwen's classification of 'exchange structure'.
[36] I have gathered links using the online bookmarking service at www.delicious.com. For example, I have annotated close to 200 links with the tag 'navimation'. These links are available at http://www.delicious.com/jonolave/navimation. Some of these refer to websites that no longer exist.

Throughout the thesis I have inserted screenshots and pictures of interfaces in order to illustrate and support my argument. Hopefully, this makes it easier for the reader to understand the phenomena that are described and to follow the theoretical analyses. Unfortunately, it has not been possible to include video or fully functioning interfaces in the thesis, as it has to be handed in as a physical document. However, I have composed a video named 'Kinetic Interface Design' that documents a range of interfaces in use and also relates these to some of the concepts I have introduced.[37]

In this section I have primarily concerned myself with textual analysis. However, there is also a need to construct new texts in order to investigate future potentials. In the next section, I will focus on the construction of texts through design experimentation.

DESIGN EXPERIMENTATION

> There are circumstances where the best or only way to shed light on a proposition, a principle, a material, a process or a function is to attempt to construct something, or to enact something, calculated to explore, embody or test it.
>
> (Archer 1995: 11)

This thesis combines text construction with text analysis. I have argued that this is necessary since movement in the interfaces is an emerging phenomenon. Such textual construction can be carried out through experimental design production, in order to explore the 'material' qualities, functions and principles of kinetic interfaces, as pointed out by Archer above. An alternative research approach could be to conduct user-based studies of kinetic interfaces, i.e. by asking users what they like, or test how they perform using kinetic interfaces. However, this would make little sense as long as we do not know what a kinetic interface can potentially be and what it can do.

Being a professional designer, I am able to draw on my designer skills and a range of design methods and techniques. Overall, I call the design production *design experiments,* to indicate that the investigations are experimental and explorative, as opposed to finding solutions to well-defined problems. The process of making is important; the experimental design process is iterative and involves what Schön (1983) calls 'back talk', in which the designer (and researcher, one might add) receives feedback in the

[37] I do not consider this video to be an academic publication in itself, but rather a documentation of kinetic interfaces, one that also demonstrates and explains some aspects of my research in a visually engaging and comprehensible way. The video is available online at http://www.vimeo.com/14852706.

situation while working with the design materials.[38] Schön assumes that practitioners know more then they can articulate, what he describes as "a kind of knowing-in-practice, most of which is tacit" (1983: viii). He argues that such knowledge can be accessed and articulated through what he calls 'reflection-in-action' and 'reflection-on-action'. Here, the designer reflects on his actions while carrying out a specific activity (reflection-in-action), or reflects on his actions afterwards (reflection-on-action). Consequently, these two concepts describe how it might be possible to articulate knowledge from practice.

Even though my study has not focused specifically on knowledge related to practice, such as design techniques and design methods, I have used my own practice as a means to reflect on the properties and possibilities of movement. Here, movement may be regarded as a design material. This process has involved reflection-in-action as well as reflection-on-action, however mostly the latter. This is not a matter of only reflecting on the design process, but also on the overall synthetic-analytic research process (Liestøl 1999). Some of these reflections will be provided in the next section ('Reflections on the research process'). First, however, it is necessary to discuss the status of the design experiments.

The interfaces and sketches produced through design experimentation are not intended to be immediately available for implementation and use. To a certain extent then, the experiments are conducted outside a specific 'real world' context of use. However, they still work as cultural artefacts, drawing on semiotic resources from contemporary culture and other interfaces, and may be used as a starting point or reference for further interface design. First and foremost, they are intended as artefacts that test and demonstrate potentials, and thereby enable analyses. Further, they have been central in the activities of the RECORD project, in facilitating the collaboration between AHO, SINTEF[39] and the business partners. Further, the artefacts have been presented, analysed and critiqued in seminars, at conferences, in teaching, and in publications that have gone through formal peer review.

I have employed a range of design techniques in order to explore the potential of motional form. The design experiments fall into two categories: 'motion sketching' and what I here will call 'motion evidencing'.

Motion sketching includes techniques for rapidly producing rough sketches of motional form. These are sketches that are not made to look like 'real interfaces'; they are simplified and rough in order to quickly make a range of motional forms. I have previously described four techniques of

[38] According to Schön, designing is a 'reflective conversation with a design situation' (1992).
[39] SINTEF (The Foundation for Scientific and Industrial Research) has been a research partners in RECORD, alongside AHO. Their research has focused on 'patterns of use' (understanding users and their media-usage) and 'user-centred evaluation' (involving users in the design and evaluation of online community services). See for example Brandtzæg (2010) and Følstad (2008).

motion sketching, along with presentation and analysis of a range of motion sketches (Eikenes 2010). The techniques are:

- *sketching through video*, which involves the recording of a 'performance' in which interface elements (e.g. represented by paper pieces) are moved in front of the camera. Alternatively, the camera is moved while the elements remain still
- *sketching through stop motion*, which makes depicted interface elements appear to move by starting and stopping the camera, and moving the elements (Figure 9)
- *sketching through computer animation*, which may be achieved by animating interface elements by using animation software
- *sketching through code*, which may be achieved by writing code in specific software environments.[40]

Figure 9. Still image from a motion sketching video made through stop motion, which illustrates how one could browse between webpages on a touch-based tablet (Eikenes 2010).

In design, sketching is regarded as essential to the creative process (Gedenryd 1998). According to Buxton (2007), the aim of a sketch is to explore ideas, question and provoke, in contrast to a prototype, which is developed in order to test, refine, and give answers. For exploring and

[40] Unfortunately, I have not been able to sketch much through code, or make fully functioning kinetic interface prototypes, as a result of lack of time, training and resources. This has obviously affected what kinds of design experiments I have been able to produce. Sketching movement through code therefore offers a potential for further investigations. In addition, new software tools such as Adobe *Catalyst* may also offer new opportunities for sketching and prototyping kinetic interfaces.

sketching motional form, video turned out to be highly useful in my project, as it provides the possibility to easily explore, document and present motional forms. Video is a flexible tool that previously has been used successfully in design as well as research on interfaces (Mackay, et al. 2000).

In my studies I have employed sketching not only as a design method, but as a part of the research method. The sketches have been developed primarily for exploring the potentials of motional form; by constructing texts for analysis, it has for example been possible to extract some general principles for how motional form may be used in web browsing (Eikenes 2010). Such principles are powerful as they can be used for generating new sketches and motional forms beyond the few sketches I have developed. However, to a lesser degree, the motion sketches also work as concrete proposals for how movement could be used, and as such play the same role as sketches do in 'regular' design projects.

Different design techniques and software tools enable and disable possibilities for motional form. For example, sketching through video and stop motion makes it possible to easily and quickly sketch three-dimensional movement, making use of spatial depth and physical three-dimensional objects. However, these techniques also provide constraints; in my experience it was difficult to manage many small elements, and the motional forms often turn out to be rough and abrupt. One is also limited by the available physical space and gravity. On the other hand, constraints such as these may also be inspiring, as they demand the designer-researcher to envision new possibilities enabled by the technique at hand. These techniques may also to a certain degree help the designer-researcher to 'break free' from the limitations of software tools such as *Flash*.

The techniques of motion sketching may allow ideas to be tested out quickly, but are not necessarily suitable for demonstrating how the final interface may look and behave. Therefore, I have also employed what I call *motion evidencing*.

Motion evidencing is achieved through design experiments in which the result looks like a 'real' interface, even though it is not fully developed or technically implemented to work (Figure 10). The term 'evidencing' has been developed in service design, apparently by the design firm live|work (Moggridge 2007). Here, evidencing is understood as "using props that form evidence in the mind of the onlooker" (2007: 423-424). In motion evidencing, videos are made to appear like demonstrations of real kinetic interfaces. These video experiments are presented and analysed in Eikenes (2009). The advantage of motion evidencing is that the results seem more realistic and believable, including a high level of detail. On the other hand, this 'illusion' may result in the envisioned interface being judged as if it was a fully developed interface ready for use, or lead attention towards details

that are not essential for the investigation of motional form (such as the employment of colours and images). Further, techniques of motion evidencing may be time consuming, and require a high level of software skills.

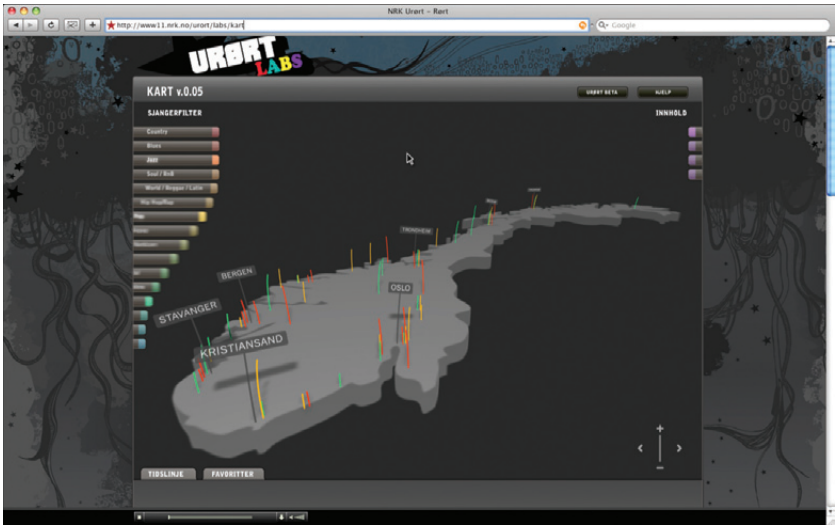


Figure 10. Still image from a 'motion evidencing' video made with Adobe After Effects, which illustrates an interface for exploring music from NRK Urørt (Eikenes 2009). Here, the video is made to look as close as possible to a finished interface, in order to be perceived as 'evidence' for how it could work.

Motion sketching and motion evidencing are not mutually exclusive but rather form a continuum for exploring the possibilities of kinetic interfaces. For example, sketching through code or computer animation may result in motion sketches that appear to be real interfaces. The different techniques may also be combined, depending on the aim of the experiment.

Employing design experimentation as a part of the research methods is not necessarily unproblematic, especially if there are multiple partners involved in the research project. In the following section I will provide some reflections on the research process, in retrospect.

REFLECTIONS ON THE RESEARCH PROCESS

Combining textual construction with textual analysis may result in a complex research process, especially when it involves multiple actors. I will now reflect on some of the challenges and characteristics of the research process and how it developed.

There is a certain amount of risk involved in an explorative approach that combines textual construction with textual analysis. First, there is a challenge of working within a large research project with multiple business partners and research institutions, resulting in multiple actors, discourses, ideas, goals and expectations. Navigating within and between multiple discourses may present challenges concerning language and values, as different people and institutions have developed their own specialist terms and valued ideas. At some points in the process this has resulted in misunderstandings and minor conflicts. However, it seems that the motion sketches and motion evidencing videos have functioned well as mediating artefacts; they have provided a shared starting point for discussions, as examples that demonstrate abstract concepts, and as *epistemic objects* (Morrison, et al. forthcoming 2010) - 'tools' that serve in the advancement of knowledge by focusing on issues that go beyond people's current knowledge and understanding.

Secondly, there is a risk in that design experimentation is a highly unpredictable activity, one that may show not to generate any new or interesting potentials. This is also a matter of time, skills and resources available to the researcher. The time frame for design experimentation is limited within a PhD project, and the results depend heavily on the researcher's designer skills, including software skills and sketching techniques. For example, my experience in using Adobe *After Effects* has been crucial for investigating the potential of movement. Every tool presents constrains as well as possibilities; however, *After Effects* is one of the most powerful and flexible software applications for creating movement on screens today. Further, my background in industrial design has provided me with a sensibility for materiality, texture and three-dimensional space and objects. My background as a cinema projectionist may have provided me with insights into the communicative power of moving images as well as the intrinsic relationship between technology and media, which is highly evident in the cinema theatre.

I have only limited experience from commercial design projects. More experience would probably have provided me with different assumptions, interests, working methods and skills. However, I do not believe my lack of commercial design experience has impacted the research process negatively in any major way. On the contrary, I have been able to focus on knowledge building through design, keeping a critical distance to commercial design practice, while accessing and analysing a multitude of commercially designed interfaces. There is a need for such a distance in order to explore in depth the features of interfaces, independent of a need for immediate commercial success. This is also why there is a need for design research that is not primarily focused on commercial achievements, but more concerned

with theoretical questions, which after all may have profound implications for commercial design practice.

There is a challenge in developing design experiments in such a way that the results are interesting for the business partners as well as for the researchers. A project that is commercially successful may not necessarily yield any useful theoretical finings; correspondingly, a successful research project may not necessarily yield any results that are immediately useful for a commercial business partner. This points to a potential conflict in practice-based research, between knowledge production and commercial innovation. Within the field of HCI, Fallman (2003) makes a distinction between *design-oriented research* and *research-oriented design*; while research-oriented design has production of new artefacts as its main motivation, design-oriented research has the production of new knowledge as its main contribution. This is a binary distinction that not necessarily reflects the complexity of a research project like RECORD, in which the aim has been to produce new knowledge as well as increase the business partners' possibilities for commercial success. However, the aim of my PhD project has primarily been to produce new knowledge, and as such falls closer to design-oriented research than research-oriented design. In working with the business partners my focus has been on finding out about the possibilities and features of kinetic interfaces rather than producing new interfaces that could immediately become commercial successful products.

I have been lucky working with companies and people that have been open minded towards such an exploratory study. This has allowed me to identify features and 'functions' of kinetic interfaces, and build concepts for analysing these (Eikenes 2009, 2010). In addition, the partners have explicitly stated that the results of the experiments have provided them with inspiration, new understanding and knowledge regarding the potentials of kinetic interfaces. For example, when presenting some of my design experiments for Opera Software, a leading person within the company stated that he saw the need for considering movement early on in their processes of developing new interfaces.

There has also been some tension between the different research approaches taken within RECORD. Diverging philosophical assumptions and research questions may lead to conflicting needs within a research project. For example, my design experimentation has not primarily been directed towards creating interfaces that are more easy to use – even though this may happen as a 'side effect'. Rather, I have tried to investigate what an interface and its properties can be, and the communicative potential of movement. Such an approach is not common in mainstream research in HCI or interaction design, and may therefore conflict with other approaches. However, during the project I believe we have come to respect the different

approaches in RECORD as valid and complementary rather than conflicting and incommensurable.

It was a great challenge to produce the first article (Eikenes & Morrison 2010), trying to get an overview of relevant literature and to construct my research questions and arguments – especially since I had a professional as opposed to academic higher education. Therefore, this became a part of my formal training for becoming a researcher and learning the conventions of academic writing and presentation.

We were three people from AHO in the RECORD project - a project leader and a designer-researcher in addition to myself.[41] They supported my research throughout the project, and took to some degree part in the planning and execution of the design experiments. The project leader took care of administration and AHO's overall role within RECORD, while the designer-researcher supported me theoretically as well as practically. For example, while exploring the potential of football services and interfaces for Telenor we worked together in order to make a set of scenarios that incorporated social navimation interfaces. Here, a designer with special expertise in Adobe *Flash* assisted us in designing the interfaces as well as producing the final presentation in *Flash*.[42] The support of these people has been crucial for the research process.

Some might argue that it is problematic for a researcher to analyse interfaces that he has created himself, as the designer-researcher brings pre-knowledge from designing that will affect the reading. However, when seeking to understand semiotic potentials that are not yet realised, it would be counterproductive to separate making from analysing. Analytical concepts are developed through making as much as they are developed through analysis, and the experimental making is further embodying, testing and inspired by theoretical concepts. This is not an entirely new way of working; it was done by experimental film-makers like Sergei Eisenstein in Soviet Russia in the 1920s (van Leeuwen 1999). Eisenstein set out to investigate the communicative potential of film, and his writings as well as his films have had a major impact on film studies as well as filmmaking. Consequently, there is a dialogical and interdependent relationship between making and analysing. Importantly, the features and concepts are built through design experimentation and analysis together; employing textual construction or textual analysis alone would therefore not lead to the same results.

The semiotic reading and interpretation of interfaces will always be 'subjective' and up for discussion, based on the reader's historical background as well as social and cultural contexts. I have done my best to present a critical and reflexive reading, one that can and should be challenged

[41] Jonathan Romm and Jørn Knutsen
[42] Morten Solem

by others. In the digital humanities, such a research approach is not controversial. In addition, throughout my PhD project I have presented my research to business partners, my supervisor, friends, colleagues, designers and students in interaction design. In addition, all the publications have gone through anonymous peer review; I have presented at two international academic conferences (Eikenes 2009; Morrison & Eikenes 2008), and two independent researchers have read and commented upon the draft of the full thesis, offering helpful suggestions for improvement. Consequently, this is not the work of one individual, but a product of many people and activities.

It has been inspiring to see that my work has already been taken up in design, research and teaching. For example, I have been asked to conduct workshops with interaction design students on 'motion sketching', which has helped me to see the potentials and limitations of the techniques presented above.[43] Further, a master student in Medialogy at Aalborg University Copenhagen has written a semester paper based largely on the concept of *navimation* (H. Jørgensen 2009). Jørgensen investigates how navimation and its features can be used in interface design in order to create a 'world of play' and achieve a higher level of 'flow'. Here, he also draws on the work of Mihaly Csikszentmihalyi and concepts from game design. For me, his work is interesting in itself, but it also indicates that my research is comprehensible and relevant for design, research and teaching.

C O N C L U S I O N S

This chapter has addressed how the emerging phenomenon of kinetic interfaces may be investigated. Drawing on the notion of 'research by design', I have argued that features and potentials of kinetic interfaces may be investigated through the combination of textual construction and textual analysis. Here, the interface is seen as a multimodal text. This is a way of constructing concepts and theory in the interplay between design and analysis, between theory and practice.

Textual construction may be achieved through design experimentation. A number of design techniques have been employed in order to explore the potential of motional forms in kinetic interfaces. These fall into the categories of *motion sketching*, which are techniques that may be employed for rapidly producing rough sketches of motional forms, and *motion evidencing*, in which the result looks like a 'real' interface.

[43] Some of the videos from these student workshops are available at http://www.navimationresearch.net/2009/sketching-with-time/

Textual analysis is the main analytical approach, which involves the researcher's interpretations of a text or artefact. Such hermeneutical analysis does not claim to provide a fixed or closed interpretation, but rather a gradual understanding.

Together, textual analysis and textual construction are capable of exploring the potential of kinetic interfaces, of building analytical concepts as well as artefacts that demonstrate their potentials.

Part II: Developments

This part contains four chapters in which the contribution of the study is developed. In Chapter 4, I argue that kinetic interfaces can be considered to work as both *signs* and *tools*. This opens up the notion of *instrumental mediation* (interface as tool/instrument) and *semiotic mediation* (interface as sign/medium), which are developed further in Chapter 5 and 6, respectively. Chapter 5 explores how movement in the interface may play a role when an interface is used as an instrument in activity by drawing on activity theory, and connecting the concept of *interface actions* to *motional form*. Chapter 6 focuses on how the interface works as a *semiotic artefact*, drawing on social semiotics. Here, I suggest that the concepts of *connotation*, *experiential metaphor*, and *intertextuality* are useful for analysing how meaning is made in kinetic interfaces. Finally, Chapter 7 addresses the much-debated notion of *interactivity*. I argue that interaction can be studied as a dialogue, in terms of exchanges between kinetic interfaces and their users, drawing on social semiotics and discourse analysis.

Chapter 4. Double mediation

Kinetic interfaces are complex semiotic artefacts that allow us to carry out certain actions. In this chapter I discuss how a kinetic interface can be regarded as both tool/instrument and sign/media, and I call this *double mediation*. A visual diagram is presented to indicate the relation between instrumental mediation (interface as tool/instrument) and semiotic mediation (interface as sign/medium) in kinetic interfaces. This opens up two directions that are developed further in Chapter 5 and 6.

INTERFACE AS SIGN AND TOOL

The mediating role of the interface is more complex than that of a medium for linear communication between two agents – a user and a system. The interface may be described as a tool for serving human needs, but it must also be described as a cultural artefact that functions as a medium for communication, directly as well as indirectly. This is especially important when considering kinetic and navimational interfaces in which navigational action and movement are intertwined. Consequently, there is a need to integrate cultural and instrumental views in research on interface design.

If we agree that the interface may be conceived of as both tool and sign, what is the relationship between these 'functions' of the interface? Is it possible to integrate such different views in an overarching concept or model? Before going into these questions it is necessary to go back to some of the theory relevant to interface design.

To polarize and generalize, one might say that the digital humanities have sought to understand the interface as a medium, a semiotic artefact that can be read and criticised, while Human-Computer Interaction often has evaluated the interface as a tool, focusing on work and usability (see discussion of the fields in Chapter 2: Interface Design). In other words, the interface is considered as a semiotic artefact *or* a tool, depending on the field from which it is analysed. As Bødker argues:

> Neither an isolated the-user-and-her-tool perspective, nor a pure media or communication perspective seems sufficient for understanding human-computer interaction.
>
> (Bødker 1991: 19)

Is the computer a medium or a tool? Alan Kay claims that it is not interesting to ask or resolve this questions. Rather, he argues that the computer is a *metamedium*:

> The protean nature of the computer is such that it can act like a machine or like a language to be shaped and exploited. It is a medium that can dynamically simulate the details of any other medium, including media that cannot exist physically. It is not a tool, although it can act like many tools. It is the first metamedium, and as such it has degrees of freedom for representation and expression never before encountered and as yet barely investigated.
>
> (Kay 1984: 47)

In my mind, Kay answers the question that he does not want to ask: he sees the computer as a medium, one that can only simulate tools.

Søren Pold (2008) argues that the computer "mediates the instrumental or functional and functionalizes the representional" (2008: 33). Pold draws on Frieder Nake, who has described the computer as an *instrumental medium*, one that we use instrumentally as a tool while communicating with it as a medium.[44] According to Pold, the button represented on a screen incarnates the paradox of the instrumental and the representational. Obviously, the button triggers a function in the computer. However, the represented button is only a simulation of how we know buttons from old machinery and electronics: several layers of representation are at work. The button represents mechanical functionality and thereby gives the impression of being a simple cause-and-effect mechanism, while the underlying and more complex consequences are disguised. Consider for example the possible implications of pushing a 'publish' or 'share' button on Facebook; the simple act of pushing the button has complex cultural and social consequences, and may in its outmost consequence change people's lives enormously, for good or for worse.

Bødker and Andersen (2005) describe the interplay between semiotic and instrumental activities as *complex mediation*. They focus on computer-mediated work, and use the concept of mediation to combine the approaches

[44] Unfortunately, Nake's research is primarily written in German, and has therefore not been accessible for me.

of activity theory and Peircian semiotics. They identify the mediator of activity theory (instrument) with the semiotic representation (the representamen in Peircian semiotics). In their proposed model, 'interpretation' is placed at the opposite side of the human actor. This I find strange, since the human actor is usually the one who interprets. Further, Bødker and Andersen's use of semiotics seems to be more concerned with semiotic activity such as human-to-human communication, rather than semiotic properties of artefacts. They see social semiotics as a promising field, but discard it as suitable for other professions than linguistics, because it is "difficult to learn" (2005: 357). Therefore, they do not draw on social semiotics, and are not able to use its insights. I argue that social semiotics is necessary in order to understand complex mediation, to account for the social and cultural context in which this mediation takes place. Social semiotics may be hard to learn, but it is not necessary to include all aspects of the theory in order to study complex mediation. One way of getting to this complex mediation may be to look more closely at the distinction between tool and sign, as introduced previously in the section on activity theory (starting on page 34).

THE DISTINCTION BETWEEN TOOL AND SIGN

> [P]ure tools and signs, clean instrumental and semiotic behavior, are only theoretical endpoints of a scale.
>
> (Bødker & Andersen 2005: 361)

As described earlier, Vygotsky made a distinction between tool and sign. However, this distinction between tool and sign, or instrumental and semiotic mediation, may not be as clear as it seems.

For example, to a certain degree a tool will always also function as a sign. Wartofsky (1979) argues that the production of artefacts for use is also the production of representations:

> artifacts not only have a use, but also are understood as representing the mode of activity in which they are used, or the mode of their own production.
>
> (Wartofsky 1979: xiii)

A tool is representational in that it shows signs of its production and use. In addition, a tool is also an artefact that is designed and used in a cultural and historical context, and necessarily communicates something through its materiality and form. Barthes (1994/1964: 182) points out that "all objects

which belong to a society have a meaning", even objects that we believe are 'pure instruments'. A button on a screen is not only a tool for activation; it is a representation of a physical button (PoId 2008), and thereby carries connotations of machinery, duality, stability and control. Further, following Barthes, the button is a sign of its function, telling the user that it can be pushed.

Similarly, a sign may also function as an instrument or tool in the sense that communication through signs may be used as a means for achieving a material outcome.[45] This is especially the case in human-to-human communication when someone instructs someone else to act. However, signs may also be embedded in an artefact so as to prompt the user to do something, as pointed out by Wells:

> Some signs are used to "cause" another subject to perform an action, as in the case of verbal commands and traffic signals. It is in these cases that the sign most closely approximates a material tool in mediating action —although the action is typically performed through the agency of a subject other than the one who issues the sign.
>
> (Wells 2002: 49)

To take another example: most mobile phones are designed to use sound, vibration and imagery so as to attract the attention of its owner when there is an incoming call. Multimodal communication is used as a 'tool' for alerting and prompting the user to respond. A different example is the vertical slider on a webpage, which can be seen as a kinetic element that moves in response to user action. This slider is a navigational tool for navigating vertically on the page, but it is also an indication of where on the webpage the user is, and possibly also shows how long the webpage is. In addition, it signifies through its multimodal design, including colours and graphical form.

Even if the distinction between tool and sign is floating rather than discrete, it is helpful for analytical purposes, and to broaden the perspective on what an interface is. Based on the above discussion I argue that the interface functions both as a semiotic artefact and a tool or instrument for manipulating some aspect of reality. Therefore, I will incorporate these two modalities or functions in a coherent model, as nested in each other, always intertwined.

[45] A further complicating aspect for the distinction between tool and sign is the fact that the material outcome of using the computer as an instrument most often is a semiotic artefact: e.g. a document, e-mail, image, text or piece of music.

INTRODUCING A DOUBLE MEDIATION MODEL

I propose the following abstract model to visualise the relationship between the instrumental and semiotic function of the interface (Figure 11):

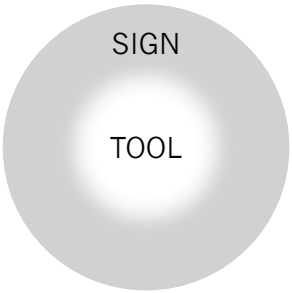


Figure 11. An abstract model of interface as sign *and* tool. "Sign" here refers to semiotic mediation: the semiotic function of the interface. "Tool" refers to instrumental mediation: the instrumental function of the interface. Importantly, the interface will always be situated in a cultural and historical context.

The notion of *sign* is used to denote the social semiotic mediation that takes place at the interface, that is, how meaning is embodied in the interface in a social and cultural context. The notion of *tool* is used to denote the instrumental mediation that takes place at the interface, that is, how the interface is used as a means for achieving material change in activity.

In this model, the tool is "wrapped" in the sign. This is to indicate that in order to access a tool or an interface there is first a process of interpretation to understand its potential use and meaning. This process of interpretation continues throughout use, as a person interprets the results of his or her actions. For example, when confronted with a new interface, we try to figure out how it works by observing and relating it to other interfaces we have used in the past, interpreting the semiotic resources embedded in the interface. This process may include experimentation, for example by browsing and trying out the available functionality in order to find out how the interface works. Consequently, there is a process of learning in order to understand and master the interface.

Further, the model may indicate that using a tool generates meaning in itself. Through mediated activity the interface provides perceivable feedback through various modes in response to human actions and operations. In addition, achieving a specific goal by using a tool or instrument is meaningful in itself, and may provide a sense of success, control and power

over the medium. In this sense the interface functions in a similar way as a physical tool.

CONCLUSION

This chapter has discussed whether the interface may be considered a tool or sign, considering the distinction that is often implied in activity theory. The relations between the sign-mediating and tool-mediating role of the interface is complex, and I suggest that kinetic interfaces function as *both* sign and tool at the same time. I call this *double mediation*: the kinetic interface plays a role in *instrumental mediation* (indicating the role of the kinetic interface as tool/instrument in activity) and *semiotic mediation* (indicating the role of the interface as sign / semiotic artefact). Finally, a visual diagram is presented to indicate the relation between the semiotic and instrumental role of the interface.

The notion of double mediation points to the need for integrating social semiotics and activity theory in order to understand the complex role of kinetic interfaces. Kinetic interfaces thereby provide an opportunity for linking two theoretical traditions that are not often brought together, by focusing on the interface as having a double mediating role. Further, I argue that this double mediation is possible to study through design and analysis of kinetic interfaces.

The notion of double mediation challenges the 'either-or' view that often is found in research on interfaces. The interface is not only a functional tool or instrument, or a semiotic artefact or medium; as a complex and mediating artefact it must be considered to be both. However, there is still a need for analysis to focus on instrumental mediation and semiotic mediation independently. This will be done in the two following chapters.

Chapter 5. Instrumental mediation

Through kinetic interfaces we carry out activities of work and play. In the previous chapter I introduced the notions of instrumental and semiotic mediation. This chapter explores kinetic interfaces from the view of *instrumental mediation*. I will investigate how movement in the interface may play a role if we consider the interface as a tool or instrument in human activity. Before looking at how kinetic interfaces can be used in instrumental mediation, it is necessary to introduce what I call *interface action*.

INTERFACE ACTIONS

For most users, the interface *is* the computer (Kay 1984). The interface therefore assumes an important role in mediating the various activities we engage in while using computers, mobile devices and gaming platforms. Computer-mediated activities span from production to consumption, from information seeking to interpersonal communication. Computing has moved from the office and the lab into our pockets, our living rooms and urban spaces. Simultaneously, the rise of social and participatory media has shifted our attention from individual productivity to social activities of play and entertainment.

In what ways may kinetic interfaces play a role in mediating activities? Here, I will call the mediating role of the interface in activity *instrumental mediation*. In instrumental mediation, the interface is seen as a tool or instrument employed in activity for the purpose of an outcome or 'material change'.

Earlier in my work on kinetic interfaces I introduced the concept of *interface actions* to denote an action that a user performs through an interface (Eikenes 2010). This notion of action is drawn from Leont'ev (1978), as introduced in Chapter 2. In this view, actions are carried out through a series of operations to realise objective results in the world, in this case the computer. Actions are therefore goal-oriented.

Importantly, interfaces enable some actions and activities at the expense of others. No interface will ever be able to enable a user to do 'everything'. Therefore, designing for interface actions is highly critical and important as it sets the premises for use. Even simple features such as buttons or links encourage or discourage activities. To a certain degree then, designers get to decide how people carry out their work, find information or communicate through digital technology.

A visually static interface may of course allow activities to be carried out in an open-ended and dynamic manner. However, if all possibilities for action are reduced to static and discrete options (e.g. through a limited set of buttons), rather than dynamic and open-ended options (e.g. through *temporal navigation*), the interface may impose a rigour that could impact negatively on the possibilities of the user. Similarly, a kinetic interface does not automatically allow open-ended activities. Often the case has been the opposite; through 'spash screens' on the web and other animated sequences the user has been forced into becoming a passive spectator provided with a simple 'skip' button. In contrast, consider the kinetic interfaces of Computer-Aided Design (CAD) software in which the user is given a high degree of freedom to rotate, zoom, scale, connect, drag, push, pull etc.

The focus on activity in activity theory may imply a shift from *tasks* to *actions* (Kaptelinin 2002; Norman 2005). Rather than considering the user as having a clearly defined set of routine tasks to carry out, the user may be considered an actor with multiple motives and goals, involved in multiple activities at the same time. The relationship between the different levels of activity and action is dynamic, and these are continuously undergoing transformations. The actor may for example have several conflicting motives at the same time, or may be distracted by external events.

Further, a focus on activity may imply a shift from *usability* and *simplicity* to *learnability*. The concept of usability has been an important and underlying principle in HCI, with a focus on the ease with which people can employ a particular (computer) tool in order to achieve a particular task. Good interfaces are seen as "interfaces that are easy to use and easy to understand, that meet the needs of the intended users, and that support users in the tasks they wish to undertake" (Stone, et al. 2005: 3). However, as argued by Redström (2001) and Kuutti (2009), a perspective on usability and utility alone is too narrow to understand the relationship between humans and technology from a design point of view. It undermines the complexity of human activity, our needs for pleasurable experiences, and the will to master complex situations.

If we consider the interface to be an *instrument*, it is not so obvious that it should be simple and easy to use. As Norman (2005) has pointed out, the 'interfaces' of musical instruments are highly successful despite the fact that

they are complex and difficult to manipulate. The same goes for the 'interface' of the car - much time goes into learning to drive. It turns out that people adapt to tools in order to perform complex actions and operations. This then becomes an issue of assisting people in *learning* to use the interface. In a similar way, Norman (2008) argues that simplicity is not the goal of interface design if we wish to keep the power and flexibility of our computers:

> The real issue is about design: designing things that have the power required for the job while maintaining understandablility, the feeling of control, and the pleasure of accomplishment.
>
> (Norman 2008: 46)

Arguably, in order to do so, some interfaces will be more complex and harder to learn than others; sometimes we need to learn to 'play' the interface in order to enact a forceful performance. This is however not a reason for making interfaces harder to use than they have to be in a specific context; usability is still important. In terms of activity theory, it is a matter of learning how to operate the interface in order to carry out actions and activities in an efficient manner. Here, kinetic interfaces may have an advantage in communicating what is going on through the use of animation (Chang & Ungar 1993). However, the use of movement and animation in the interface may also be annoying and confusing, as pointed out by Nielsen (2000). At the worst, animation may distract and distress users, thereby working against the activities that the user is trying to carry out.

In the next section I will discuss how motional form may support instrumental mediation in kinetic interfaces by being connected to interface actions.

INSTRUMENTAL MEDIATION IN KINETIC INTERFACES

In order to analyse how movement can play a role in mediating activities in kinetic interfaces, interface actions can be connected to motional form. In Publication 3 (Eikenes 2010), I investigated how interface actions in web browsing could be supported or facilitated by the use of motional form. I suggested ten ways in which movement could support actions in web browsing. For example, motional form can be used in order to place, retrieve, transform, sort, order and rearrange various elements in a web browser interface. How might this approach of joining interface action with motional

form be applied to the concepts of *navimation* (Eikenes & Morrison 2010) and *social navimation* (Eikenes 2009)? Since this approach was developed in Publication 3, it has not previously been applied to the concepts in the two first publications.

Navimation

If we think of digital environments as multi-dimensional spaces of information, we may also think of people as 'navigators' in this 'information space' (Benyon 2001). Consequently, navigation becomes an activity of moving through information space. This is a matter of 'virtual navigation', as opposed to navigation in a physical environment (Vainio 2010). Activities of navigation may range from exploratory or seeking ones, to opportunistic or even involuntary ones (Spence 2007). Navigational activities may further incorporate a range of interface actions, such as selecting links to open a new webpage, push a button to change the displayed information, move around in a three-dimensional environment, zoom in or out, scroll up or down, or rotate a three-dimensional object in order to see its backside. When such interface actions of navigation are connected to motional form, they may be described as *navimation* (Eikenes & Morrison 2010). Navimation is thus the intertwining of movement and navigational action.

The best integration of interface actions of navigation and motional form is arguably in *temporal navigation* (Eikenes & Morrison 2010). Here, navigation is durable and continuous, in contrast to how hyperlinks typically produce an abrupt experience or 'HTML jump' when moving between page-based websites (Skjulstad 2004). In temporal navigation, the actions of navigation and the corresponding movement on the screen are integrated in real-time. Consider the example provided in Figure 12 below.

In this interface, a picture of a man is placed on the screen. Through different 'scenes' the user is allowed to drag the man or pull at his clothes. In the opening scene, for example, the user unzips the man's jacket by positioning the mouse pointer on the zipper and dragging the zipper down. In the next scene, the user drags the man to the right or the left, as if controlling the actions of a real person. The representation is highly realistic; it looks much like a scene from a movie, except here, the user is able to control the movement of the actor. We may see this actor as a part of the interface, and the acts of moving him as actions of navigation. Here, the user is not himself visually moving in information space, but is rather moving around elements that are contained in the information space. There is a one-to-one correspondence as the user continuously operates the interface and controls the man, which provides a sense of mastery over the interface and the man, like playing an instrument. To some degree, the user gets to control not only

the man, but also the brand and its advertising. The kinetic interface thereby facilitates interface actions of navigation through the use of motional form in instrumental mediation.

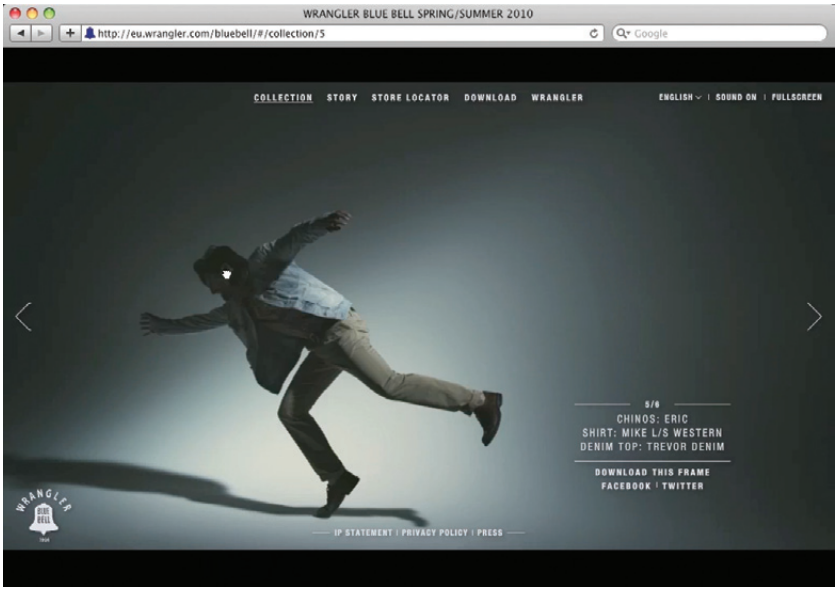


Figure 12. A web campaign for Wrangler, in which the user is allowed to continuously control the representation of a man. http://www.wrangler-europe.com/bluebell/ss10/#/collection

However, if the interface does not manage to follow the user and his actions by responding continuously and as expected, there may be a 'breakdown' in the activity (Bødker 1991). Experiences of 'frozen screens' or 'stuttering' interfaces are something that most of us are familiar with, and it often seems to cause irritation, tension or anxiety. Therefore, responsitivity is an important issue to consider for supporting activities of navigation.

Social navimation

Navimation may occur in all kinds of screen-based interfaces, including software applications and websites, on PCs as well as on mobile devices and gaming platforms. I have previously developed the term *social navimation* to describe navimation employed to assist activities in social media (Eikenes 2009). Activities in social media typically involve conversations between people, the production and sharing of information and media content in the community, and the consumption of 'user-generated content' (Mayfield 2006). Several of the examples of social navimation from my publication include specific interface actions that are connected to motional form:

- actions of navigating user-generated content across timescales (in the Timeline application) are enabled through the employment of *temporal navigation*
- actions of filtering and navigating mixed media content (in the VideoMix interface) are achieved through the employment of *virtual kinetics* and *indexical compositing*
- actions of exploring relations between people and mediating artefacts such as events, fan groups, images and videos (in the Magnet interface), are achieved through *virtual kinetics*
- actions of navigating user-generated content in different spatial representations (in the Urørt map interface) are achieved through motional form that creates a sense of *spatial manipulation.*

These features suggest that interface actions can be connected to motional form also in social navimation, in order to facilitate instrumental mediation. Today, it seems that the interfaces of social media applications are adopting more kinetic features, especially on mobile devices. One example is the application *Flipboard* for the *iPad*, which allows users to browse content from Twitter and Facebook in a kinetic environment with visual references to physical magazines.[46] I believe, however, that there still is an underutilised potential for employing motional form in social media interfaces.

Co-located social navimation

Here, I would like to suggest that the notion of social navimation might be extended to include co-location. In the examples of social navimation (Eikenes 2009), the social activities take place across time and space; the participants are not located in front of the same interface. However, I now suggest extending the notion of social navimation to include the phenomenon of several people using one or several kinetic interfaces at the same time and place. In *co-located social navimation*, interaction between people also takes place face to face, not only through the interface and services that are commonly seen as 'social media'. The kinetic interface thereby takes on the role as a mediating artefact in the social situation. I will now provide two examples of co-located social navimation.

The first example is from a project I carried out in 2006 with the company ABB (see Figure 13).[47] The aim of the project was to envision an interface for an interactive collaboration table for use in a control room environment,

[46] *Flipboard* will be discussed more in detail in Chapter 7.
[47] At this time I was a master's student in interaction design. The project was done as part of a summer position at ABB Research and Development at Billingstad, Oslo. (http://www.abb.com/).

to allow professionals to bring their applications and documents to a shared space in an emergency situation. The table should support activities of retrieving and finding information, manipulation of data, and the presentation of documents to colleagues in order to use these as mediating artefacts in discussions.

The result of the project was a video demonstrating how such an interface might work, through the technique I now refer to as 'motion evidencing'. At the collaboration table the user would find their documents placed in 'menus' (delimited sections) along the side of the table, appearing by placing an ID card or personal object on the table. Each user has a menu in which his or her documents are located. These documents can then be dragged onto the table and manipulated in various ways by using a 'pen tool'.

Actions of scaling, moving and rotating the documents are achieved through movement. These actions are performed by individual people, but are necessary in order to make the documents work as mediating artefacts in the social context. Movement in the interface is therefore employed to facilitate social interaction. The interface also enables a person to send a document to another person: by pushing the document slightly using the pen, it continues to move across the table, while at the same time rotating, aligning itself in front of the other person. Consequently, movement and rotation are used in order to transfer a mediating artefact from one person to another.

The second example I provide is the SCRABBLE application for the Apple iPad (Figure 14). This is an adapted version of the traditional and well-known SCRABBLE board game in which participants place individual tiles with letters on the board in order to create words and thereby gain points. In 'Party Play' mode, several iPhones or iPads may be connected to the same game. While the game board itself is located on the iPad, the individual tile racks may be located on the connected iPhones.

In 'Party Play' mode, the interface action of placing a tile on the game board is achieved by a gesture of 'flicking' each individual tile on the iPhone. The tiles then move in the direction towards the iPad, escaping the iPhone screen, and appearing on the iPad, next to the game board. Then, the user drags each tile to the right spot on the board. The action is achieved through movement: the tiles move on the iPhone, appear on the iPad, and are moved onto the board. By moving the tiles between different devices, a sense of *spatial manipulation* is achieved; the tiles make a virtual 'jump' from one screenspace to another. Consequently, a 'virtual connection' is made between the screens, thereby manipulating the sensation of independent and discrete screenspaces. Further, the user moves tiles on the iPad continuously through *temporal navigation*, giving a sense of directly manipulating the tiles as if they were physical entities.

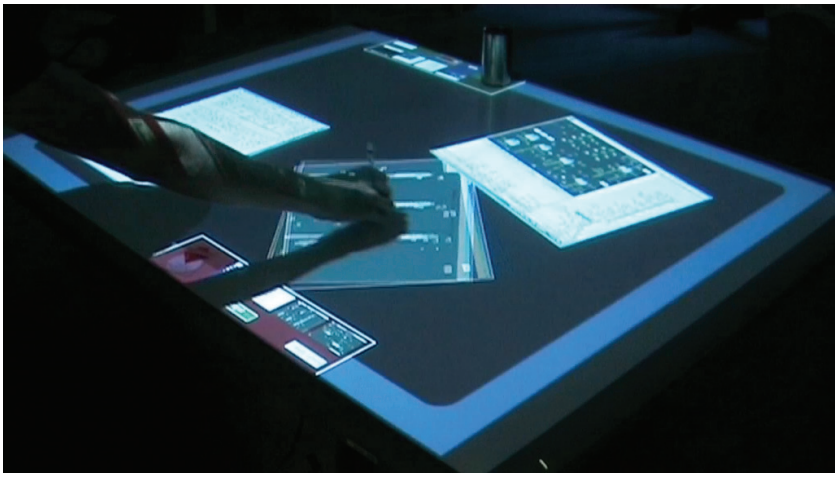


Figure 13. Demonstration video of an 'interactive collaboration table' for ABB. Still image taken from the video (available online): http://www.navimationresearch.net/2010/abb/

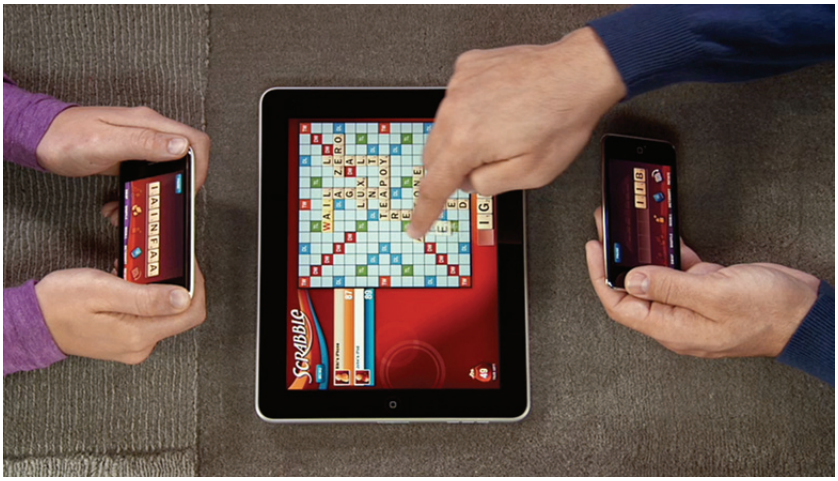


Figure 14. The SCRABBLE application for the Apple iPad and iPhone. Here, several iPhones or iPads may be connected in order to play. Still from video at www.vimeo.com/10658005

The action of placing tiles on the board is part of the social activity of game play, in which the iPad becomes an essential mediating artefact. Through movement, tiles are transferred from the 'personal' screenspaces onto the socially shared screenspace. This shows how movement in the interface may be employed in order to facilitate co-located social activities in instrumental mediation, and points out a potential for further investigation.

CONCLUSION

This chapter has explored how kinetic interfaces may be studied in terms of *instrumental mediation*, that is, how movement in the interface may play a role if we consider the interface to be an instrument in human activity. This is one side of the double mediation that takes place at the interface. Through the interface, we *do* things, like producing documents and sharing images and videos with friends.

In order to study instrumental mediation, I have elaborated on the concept of *interface action*, primarily by drawing on Leont'ev and activity theory. An interface action refers to the conscious process in which a person makes use of an interface as an instrument for achieving some material or digital outcome. Interface actions are oriented towards specific goals, and may take part in several activities at the same time. Further, interface actions consist of automatic operations that are carried out unconsciously by the user. The relation between operations, actions and activity is dynamic, unstable and continuously developing in real-world contexts. Hence, interface actions must not be seen as stable, fixed or context-independent. However, for analytical purposes, it is useful to identify and connect interface actions to *motional form* in order to investigate how movement may facilitate an activity in which an interface action takes place. Consequently, kinetic features may also increase the usability of interfaces by enabling and supporting interface actions.

Finally, I have provided some examples of how movement may be seen as connected to interface actions in activities of navigation and social activities. Here, the approach developed in Publication 3 was applied to concepts from the two first publications. I have previously described this phenomenon of movement intertwined with navigation as *navimation*, and extended this to social activities in *social navimation*. In this chapter, I have suggested extending the concept of navimation one step further, to *co-located social navimation*, a term I have devised. This refers to the phenomenon of several people using one or several kinetic interfaces at the same time and at the same place, as part of their social interaction. Here, the kinetic interface becomes a mediating artefact in the social activity, and movement in the interface takes a role in facilitating this activity.

Motional form is not a matter of 'styling'; it can play an important role in facilitating activities, be it individual activities, in social media interfaces, or in physical environments where one or several kinetic interfaces take part in social activities. While researchers focusing on usability and efficiency often have tended to regard animation as something to avoid, I suggest a more 'constructive' attitude towards animation and motional form.

While social semiotics is concerned with interpretation and 'reading' of texts and artefacts, this chapter has suggested that such a view needs to be complemented with one that focuses on action and activity. Kinetic interfaces are not only semiotic artefacts for contemplation to be 'read' – they also work as instruments in carrying out activities. However, this does not diminish the need for investigating kinetic interfaces as (social) semiotic artefacts. I now turn to this in the next chapter.

Chapter 6. Semiotic mediation

I have argued that a kinetic interface can be conceptualised as both instrument/tool and sign/medium. The previous chapter approached kinetic interfaces from the view of instrumental mediation, looking at the interface as an instrument in activity. This chapter presents a complementary and equally important view, focusing on *semiotic mediation* - how we may understand kinetic interfaces as *semiotic artefacts*.

In social semiotics, *semiotic resources* are observable actions and artefacts/entities that can be used to communicate. These resources do not embody any fixed meaning, but rather have a semiotic potential for making meaning, that may develop and change. How do semiotic resources in kinetic interfaces gain their potential meaning? How is it that motional form in a kinetic interface may be meaningful to us? Here, I will draw broadly on social semiotics, and suggest that the concepts of *connotation*, *experiential metaphor*, and *intertextuality* are particularly useful for analysing how meaning is made in kinetic interfaces. These three concepts are not usually brought together in social semiotics, but represent different understandings of the kinetic interface that may be informed by a social semiotic view.

CONNOTATIONS

In social semiotics, as described by van Leeuwen (2005), the understanding of connotation is mainly drawn from Roland Barthes, who argued that images as well as texts have layers of meaning:

> Images, too, have two layers of meaning – the layer of denotation, that is the layer of 'what, or who is represented here?' and the layer of connotation, that is the layer of 'what ideas and values are expressed *through* what is represented, and through the way in which it is represented?'
>
> (van Leeuwen 2005: 37)

Connotation refers to the abstract ideas and values that are expressed through what is represented, as opposed to *denotation*, which refers to the concrete objects, graphical elements, and motional forms that are represented on the screen (Eikenes 2010). Importantly, these meanings are accepted and shared within communities, so that semiotic resources may induce culturally shared associations. Such communities may range in size from a few people to a whole civilisation. However, connotations are also context-specific; interfaces and their semiotic resources are read and interpreted differently according to their contexts. For example, the colour *red* may in certain context bring connotations of love, sensuality, pleasure, and passion. Used in a different context, it might rather allude to aggressiveness and hate. Therefore, connotations depend heavily on the context in which the semiotic resources are employed.

van Leeuwen (2005) argues that the principle of connotation becomes a mechanism for semiotic invention through creating novel 'composites of connotations'. This is what happens when people combine different pieces of clothing and accessories, in order to communicate allegiance to ideas and values. Arguably, this is also what interface designers do more or less deliberately, by 'importing', combining and re-mixing semiotic resources that bring various connotations to the interface. The meanings of a composition then depends heavily on how the semiotic resources are combined multimodally with each other; a kinetic interface typically employs a range of motional forms, colours, shapes, sound and typography in addition to diverse media types (images, videos), which already are composites of semiotic resources. Motional form in an interface may in itself prompt connotations by alluding to something dynamic, elastic or responsive. To complicate the matter even further, meaning emerges through use and the dialogic interaction between the user and the interface (see Chapter 7).

How may different types of movement allude to different connotations? Consider for example the website of Home Invest AS (Figure 15), a private investment company in Norway. The website (www.homeinvest.no) is designed by the communications consultant firm Apt, and presents a selection of Home Invest's properties, press material and art collection, among other things.

At the level of denotation, the users are presented with a perspectival view of a board similar to a Monopoly game board. Different objects are placed on the board, including caricatured representations of objects, buildings owned by the company, and a character representing the manager of the company, Petter A. Stordalen, strolling around the board with his dog.

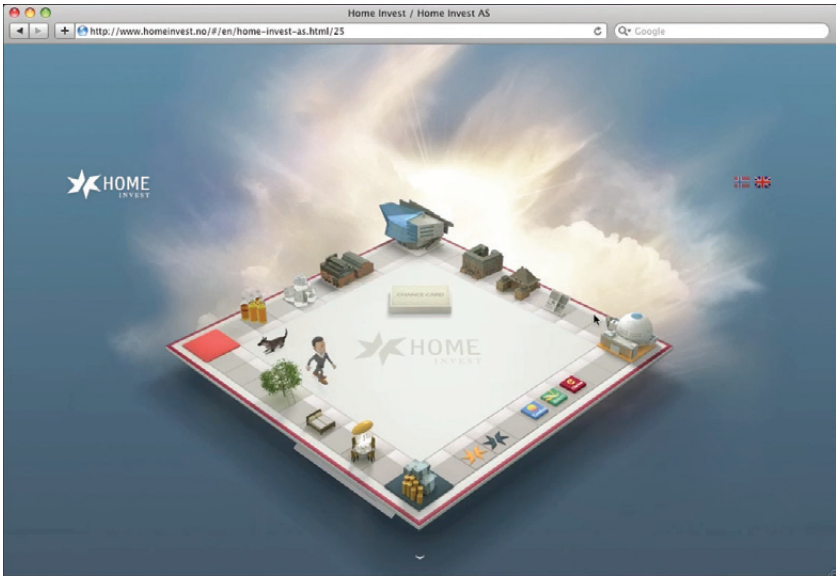


Figure 15. A screenshot from the website of the Norwegian company Home Invest AS. www.homeinvest.no

A range of kinetic properties are employed: when opening and navigating between sections of the website, the board folds and transforms through white, rectangular shapes. Further, the objects on the board appear and disappear through motional transformations, and move in various ways as the user hovers the mouse over the objects. These motional forms support the construction of a coherent environment based on the Monopoly board, and add a sense of three-dimensionality. However, this is not just a simple interface metaphor that perfectly maps the interface onto a real-world situation. In contrast, the Monopoly-metaphor is being manipulated and is inconsistent; the board transforms through movement in ways that a Monopoly game board would not, into walls in an art gallery, or white and flat canvases with menus, text and images. (The notion of metaphor will be discussed further in the next section.)

For many people, the reference to the Monopoly game will invoke connotations of gameplay and competition as well as associations to money and power. The kinetic features such as the folding of the board may be associated with folding paper, which may allude to something flexible, playful or even magic. The motional transformations are quick and precise, giving a sense of efficiency and control, but also embody qualities of development and transformation. This is not by accident; the ‘composites of connotations’ in the website are deliberately created through its kinetic design and multimodal composition.

Investment companies do not usually have such playful and kinetic websites, and the website of Home Invest thereby stands out from its competitors' websites with its distinct and persuasive kinetic interface. Business and finance is here turned into something playful, fun, flexible, informal an enjoyable. The values and connotations that have been composed in the website are being projected onto the company, which in turn makes us assign those values to the company itself.

The concept of connotation is important as it addresses semiotic mediation and the level of 'meaningware' (Liestøl 2009). However, it may be difficult to identify and describe connotations since they are not fixed or 'objectively' present in the interface. Therefore, subjective interpretations are important. However, in the design and analysis of kinetic interfaces, it might be highly useful to describe and make explicit the connotations in order to understand better how the interface works and communicates in semiotic mediation. Now I turn to another concept that is useful for understanding semiotic mediation, that of 'experiential metaphor'.

EXPERIENTIAL METAPHORS

The function of a metaphor is to understand and experience one kind of thing in terms of another (Lakoff & Johnson 1980), that is, to transfer something from one place to another, on the basis of a perceived similarity between the two places. A metaphor has traditionally been seen as a figure of speech and rhetorical device in language; we may use it to understand a word or concept in terms of another. However, in their influential book *Metaphors We Live By* (1980), Lakoff and Johnson convinced us that metaphors are pervasive in thought and action in everyday life, not just in language; our whole conceptual system is metaphorical in nature. Metaphor is therefore one of the most basic mechanisms we have for understanding experience.

The notion of *experiential metaphor* has been employed in social semiotics by van Leeuwen (2005), drawing mostly on Lakoff and Johnson, and Halliday. The notion of 'experiential' is used to highlight that we understand metaphors on the basis of concrete experience. Such experience may be physical or cultural. For example, physical experiences of looking, moving or acting in the world can be used in order to understand ways of looking, moving and acting in a screen-based interface. Some bodily experiences are shared by everyone, such as the experience of up and down, heavy and light, front and back. Other physical experiences and their meanings are typically shared within a community; there are for example ways of walking and acting that are different from one community to another (Norris 2004).

In a kinetic screen-based interface, experiential metaphors may be used in order to understand what is happening on the screen based on shared physical experiences. If a graphical element is falling from the top to the bottom of the screen, it makes sense because it is similar to how objects behave in the physical world. Further, it suggests that the element possesses weight ('heaviness') and is placed in an environment with elemental forces such as gravity – a phenomenon I have previously described as *virtual kinetics* (Eikenes 2009).

The notion of metaphor has been widely used in theory and practice of interface design. Here, it has been used to refer to how an interface can make sense to a user by employing elements and actions that the user is already familiar with. According to Erickson (1990) for example, interface metaphors work as 'models' that a user has of a system. The 'desktop metaphor' is the most known interface metaphor, and emerged on a massive scale in the early 1980s (Kaptelinin & Czerwinski 2007). The idea of the desktop metaphor was to provide users with familiar elements from their physical office desktop, such as documents, files, folders, and a trashcan.[48]

In contrast to interface metaphors, such as the desktop metaphor, experiential metaphors are not to be understood as comprehensive systems of actions and elements that all make a perfect 'match' between something in the physical and the virtual world. A danger of designing comprehensive interface metaphors is that they do not acknowledge the intrinsic limitations of the metaphor; some features match and some do not (Crawford 2003). An experiential metaphor, on the other hand, is directed towards specific actions and elements, and may therefore be applied in highly abstract interface environment without trying to resemble any real-world physical location or an existing 'working space' in any major way. In this way, a kinetic interface can be made meaningful by employing multiple experiential metaphors, without necessarily complying with an overarching interface metaphor.

van Leeuwen (2005) argues that experiential metaphors are vital in creating new ideas and new practices. Metaphors may contribute to invention when they go beyond earlier metaphors, or are used in new ways. However, they may also limit our understanding of something:

[48] The desktop metaphor has been criticised by various authors. For example, Kaptelinin & Czerwinski (2007) argue that "the metaphor does not provide adequate support for the access to information objects along with the display of the content of those objects, multitasking, dealing with multiple information hierarchies, communication and collaboration, and coordinated use of multiple technologies" (2007: 6). Selfe and Selfe (1994) point out that the desktop metaphor maps the virtual world of the computer "in terms of corporate culture and the values of professionalism. This reality is constituted by and for white middle- and upper-class users to replicate a world that they know and feel comfortable within" (1994: 486).

> Because all metaphors are based on similarity, and as all similarities are partial, all metaphors tend to highlight different aspects of their domain of application, and obscure others.
>
> (van Leeuwen 2005: 32)

Each metaphor offers a way to understand something, but also obscures other aspects. This is important to be aware of in research as well as design.[49]

As an example of experiential metaphor understood as semiotic mediation, consider the portfolio of Thibaud Van Vreckem (www.thibaud.be, Figure 16). The website presents a set of 'card collections', similar to physical collections of colour sample cards. Each card contains text, images or videos, and each collection of cards represents a specific category. These collections can be dragged and moved around the screen by using the mouse, and opened to reveal the individual cards in a similar way as the physical card collections.

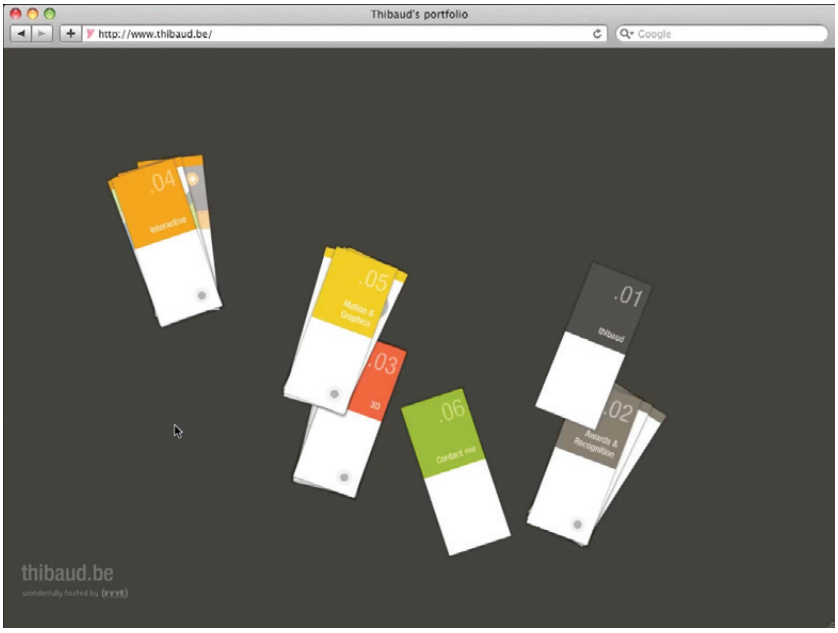


Figure 16. The portfolio of Thibaud Van Vreckem, a computer graphics artist from Belgium. Screengrab from www.thibaud.be

By clicking a collection and moving the mouse, the collection may be thrown around in the screenspace, and it bounces back when it hits one of the

[49] For example, the notion of the *interface* is itself a metaphor, as pointed out in Chapter 2. The interface may be conceptualised further in terms of other phenomena such as tool, surface, instrument, medium, playground, or mirror. Since different metaphors offer different insights, I have sought to approach the interface using different metaphors - interface as instrument, semiotic artefact, and dialogue partner.

edges of the screen. In terms of experiential metaphor, this is an example of virtual kinetics that we know from real physical experience; we may grab and throw things around in the physical world, and they bounce back when they hit something. Many of us may also have experienced similar behaviour in kinetic screen-based interfaces before. However, the collections of cards do not bounce when they hit each other; they overlap and continue to move as if located on different layers independent of each other. In one sense, this breaks the interface metaphor as it does not correspond to what would happen with physical card collections. However, it makes sense as an experiential metaphor: it is common that flat objects overlap in the physical world, and such overlapping is also well known from various GUIs, especially window-based interfaces.

When hovering the mouse over a card, the coloured area of the card expands slightly in one direction. The movement of this expansion is similar to that of a spring being released - the edge of the card moves quickly back and forth before settling in a certain position, indicating that something has been unlocked or released. Physical colour cards do not expand in this way, but we are familiar with this kind of movement from other experiences. One might say that the experience of this particular kinetic behaviour has been transferred from one context (a spring being released) and applied in a different context (the colour card interface).

While interface metaphors are supposed to provide the user with a coherent model of a system, experiential metaphors from diverse contexts may be mixed together in kinetic interfaces. The interface metaphor still has its place, but it is important to recognize the more complex role of metaphors, and realise that kinetic interfaces do not have to match perfectly any external reality or context. Metaphors are resources that can be manipulated and put together in new ways, and thereby engage and help the user in gaining understanding of what is happening in the 'virtual world'. Rather than employing a rigid interface metaphor at the expense of features, a combination of specific experiential metaphors may better manage to exploit the powers of computers and digital information, which not always map perfectly to one overarching interface metaphor.

While connotations and experiential metaphors are based on cultural values and personal experiences, meaning is also produced in correlations between interfaces and texts.

INTERTEXTUALITY

> One of the most useful principles of social semiotics … is the principle of *intertextuality*. We are all constantly reading and

> listening to, writing and speaking, *this text* in the context of and against the background of *other* texts and other discourses.
>
> (Lemke 1995: 10)

As discussed earlier, artefacts and interfaces may be studied as 'texts', according to how they communicate through semiotic means.

According to Chandler (2007), the notion of *intertextuality* was introduced in semiotics by Julia Kristeva, to denote how a text works on two axes: it connects the author with the reader (the horizontal axis), but also connects to other texts (vertical axis). One implication of the notion of intertextuality, as Lemke says, is that our interpretation of a specific text always takes place against the background of other texts and discourses. Consequently, the meaning of a text does not fully reside in the text itself; it emerges in the interplay between the author/designer, users, and other texts. In addition, as Lemke writes, each community has its own set of important and valued texts, which affect how other texts are valued within that community.

Kress (2000) points out that the concept of intertextuality leads to the need for a social semiotic theory of language. Further, he proposes what he calls a 'radical' notion of intertextuality that treats "*all texts as always constituted of transformed elements of other, prior texts*" (2000: 139, italics in original). In the field of design history, a similar argument is made by Michl (2002), who points out that the word 'design' has a tendency to hide the fact that a designer's work always depends on earlier 'functional and formal solutions'. He proposes the concept *redesign* to highlight how design always contains "a collective and evolutionary dimension" (2002: 9). Such a view may be threatening for designers who see their work as a product of their individual ingeniousness. However, Michl does not dismiss the creative role of the individual designer:

> One can certainly not be a creator without being a re-creator and co-creator. But neither is it possible to be a re-creator and a co-creator without being a creator.
>
> (Michl 2002: 19)

Consequently, we draw on earlier texts and artefacts not only in the interpretation of texts and artefacts, but also in their design production.

The principle of intertextuality also applies to kinetic interfaces; our interpretations of an interface are influenced by other interfaces, advertisement, conversations, movies and artefacts that are circulating in our communities. Consider for example how the Apple *iPhone* has changed the mobile phone market since its appearance in 2007; now, in 2010, it seems

that every new phone model – as well as other interfaces and digital artefacts – imitate the interface of the *iPhone*, and are compared to it. This applies to designers as much as journalists and users. In moving the notion of intertextuality to the context of kinetic interfaces, we may say, following Kristeva, that every interface is from the outset under the jurisdiction of discourses and other artefacts/interfaces that impose a universe on it.

The notion of intertextuality to some extent is similar to that of *remediation* proposed by Bolter and Grusin (1999). For Bolter and Grusin, the concept of *remediation* denotes the reuse of a property from one medium to another. Further, they define medium as 'that which remediates' – which further highlights the intertextual nature of *all* media forms. However, as pointed out by Kay (1984), the computer and its interface is in a special position as it can easily simulate other media. This means that interface designers may draw on semiotic resources from a range of media types, including television, physical products, magazines, books, cinema, and other interfaces. The interface does not exist in a vacuum; we understand it in relation to other texts. Kinetic interfaces will typically draw on semiotic resources from movies, television and motion graphics (Eikenes & Morrison 2010). Social semiotic resources travel between media and interfaces in complex networks.

A media text that has often been referred to in discussions and reviews of kinetic interfaces with novel forms of physical interactions, is the gesture-based interface presented in the movie *Minority Report* from 2001. Directed by Steven Spielberg, the movie was a blockbuster at its time and became a common point of reference for interface design, one that everyone had seen.

In order to predict and prevent murders from taking place in the future, the protagonist, played by Tom Cruise, uses a gesture-based interface to puzzle together clue fragments such as videos and images (see Figure 17), envisioned by three psychics called 'precogs'. As Tom Cruise uses the kinetic interface, the interface and its interactions are given certain meanings. Not only is the interface portrayed as a realistic and plausible interface that is relatively easy to use and learn, it also gets associated with efficiency and control, blurring the border between human action and digital technology.

The interface was envisioned by science and technology advisor John Underkoffler, who previously had worked at the MIT Media Lab exploring and developing tangible interfaces (see for example Ishii, et al. 2002). According to Kirby (2010), Underkoffler developed a complete gestural language for the interface in order to achieve internal consistency and realism. Kirby further refers to the interface in the movie as a 'diegetic prototype' - a cinematic scenario that depicts a future technology to a large audience and thereby demonstrates its need, viability and benevolence.

Figure 17. Still from the movie *Minority Report* from 2002, in which a gesture-based interface is used by the protagonist, played by Tom Cruise.

How does interfaces depicted in movies relate to 'real' interfaces? One possible way of tracing intertextual relations is to observe how researchers, journalists and ordinary people explain one text or interface in terms of another. Many products and interfaces have been described as bearing a similarity to the interface in Minority Report, including Nintendo *Wii*, Apple *iPhone*, Microsoft *Surface*, and *Kinect* (e.g. Bleecker 2009).

Figure 18. John Underkoffler demonstrates the ‘g-speak spatial operating environment’ at a TED conference in 2010.

However, the most similar interface, called 'G-Speak', has been developed by John Underkoffler and his firm Oblong Industries (Figure 18). Wearing special gloves, the user may control the interface by moving their hands and fingers in particular ways. Elements on the screen may for example be selected, moved and rearranged, or navigation can be achieved by controlling the virtual camera, all according to the gestures performed by the user.

For Underkoffler, the work on Minority Report was crucial in the development process of G-Speak (Kirby 2010). After the success of the movie, working prototypes have been developed and showcased, for example at a TED (Technology, Entertainment, Design) conference in 2010.[50]

The link between G-Speak and the interface in Minority Report is direct and explicit. Such explicit references are easier to track than intertextual relations that are not explicitly articulated. However, less explicit intertextual relations are as important, if not more than the articulated ones, in governing our readings of texts.

As we are confronted with new interfaces and texts we read them against interfaces we have seen and tried before, including the ones from the movies. This may help us understand how an interface works, and we can continuously compare and contrast them to each other. In addition, values and meanings given to interfaces may carry over to other interfaces. The G-Speak interface is not yet commonly available, but I am sure many users will think of *Minority Report* as they encounter G-Speak or a similar interface for the first time.

RELATIONS BETWEEN CONCEPTS

The three concepts from social semiotics are not definite categories, but have been chosen based on their relevance to kinetic interfaces. The interplay between these concepts is complex. For example, experiential metaphors may also carry certain connotations. If something moves upwards, we may understand it based on our shared bodily experiences in the physical world, in which heavy things fall to the ground, and light objects or powerful structures may 'defy' gravity. The movement may connote a sense of lightness, freedom or power, depending on the context. The context is therefore where the level of connotation takes over; connotations are constructed and sustained in communities, while experiential metaphors to a larger degree depend on individual bodily experiences. Bodily experiences are largely shared within communities; we walk and move in certain manners that are accepted within a community. Further, connotations may have their origins in experiential metaphors; what we first understand based on bodily experience may be extended and manipulated in particular historical and social contexts.

The relation between intertextuality and connotation is also intricate. When we read or interpret a kinetic interface against the background of other texts, we also 'import' the connotations of the other artefact to our reading.

[50] http://www.ted.com/talks/john_underkoffler_drive_3d_data_with_a_gesture.html. See also Oblong Industries at http://oblong.com/.

Interfaces become 'composites of connotations' (van Leeuwen 2005) by the help of intertextuality. For example, if an interface makes use of intertextual references to a particular scene in a movie that we are familiar with, the interpretation of the interface is affected by the connotations of that particular movie. We may say that intertextuality is a strong resource for design exactly because of the possibility to import the connotations of other texts.

The relations between experiential metaphor and intertextuality are not so obvious. However, it might be argued that if we may understand an interface based on experiential metaphors, then this understanding will also be transferred to other texts that are in an intertextual relationship with the interface. Further, if connotations have their origins in experiential metaphors, these connotations may be brought together in new texts through intertextuality.

A social semiotic approach to interface design is an important complement to other views that focus merely on tasks or ease-of-use. For example, it has been argued in HCI that the interface should 'go away' (Norman 1990). Similarly, by drawing on activity theory, Bannon and Bödker (1991) argue that design should focus on tasks rather than the details of interfaces. Their reason is fair enough - to support people in their activities. However, from a social semiotic point of view, it is also possible to see the interface as a complex semiotic artefact. This is not to argue that we should not consider tasks and ease-of-use when designing interfaces, but that we must acknowledge the role of the interface as a rich cultural artefact. For this purpose, a social semiotic view is suited for understanding contemporary kinetic interfaces. The purpose of interface design is not simply to make the interface and its features go away, but to create a communicating artefact by drawing on a wide range of semiotic resources. Further, social semiotics helps us to see that meaning is not 'coded' into the artefact, as often seems to be assumed in product semiotics, but is dependent on the historical, cultural and social context in which it is located.

CONCLUSION

In this chapter I have focused on *semiotic mediation*, that is, the semiotic processes in which interfaces are made meaningful in a historical, social and cultural context. Here, kinetic interfaces are regarded as multimodal semiotic artefacts or texts that can be studied through multimodal textual analysis, drawing primarily on social semiotics.

I have suggested that the concepts of *connotation*, *experiential metaphor*, and *intertextuality* are particularly useful for analysing how meaning is made

in kinetic interfaces. *Connotation* refers to abstract ideas and values that are expressed through what is represented in the kinetic interface, as opposed to denotation, which refers to the concrete objects, graphical elements, and motional forms that are presented on the screen. The ideas and values of connotation are constructed and shared within communities. *Experiential metaphor* refers to the understanding of motional form based on previous physical and cultural experience. Some experiences are shared by 'everyone' (such as experiences of up and down, back and front) while others are shared within a community or in a particular context. Experiential metaphors are more immediate than what is commonly described as 'interface metaphors', in which the aim often has been to construct comprehensive interface environments that correspond fully to an external context. *Intertextuality* refers to how texts and kinetic interfaces relate to other texts and artefacts; we are always using and interpreting kinetic interfaces against the background of other interfaces and cultural artefacts. These relations are symbolic and often subtle, explicit or implicit.

As we have seen, the three concepts link to each other in complex ways, and in processes of meaning making they blend together. For analytical purposes however, they seem to offer different and useful perspectives to the understanding of kinetic interfaces' semiotic mediation.

Common to the three concepts is their relevance for interface design. Designers may be seen as creators and manipulators of semiotic resources, and these resources may bring certain connotations, experiential metaphors, or refer to other texts. Consequently, semiotic innovation may be achieved through the creation, manipulation and new combinations of such semiotic resources. An implication for design then, is the need for knowing the community in which the kinetic interface is to be used, people's experiences, the community's valued texts, and their connotations.

Importantly, kinetic interfaces are not static artefacts with a predefined meaning. Meaning emerges in context and through use, in the interplay between what people do with the kinetic interface and how it responds. Therefore, the next chapter will investigate the 'interactions' or exchanges taking place between the user and the interface.

Chapter 7. Towards dialogic interfaces and interaction

As mentioned before, the interface may be seen as tool, media, or dialogue partner (Holmqvist 1993). The three previous chapters have addressed double mediation, which entails instrumental mediation (tool) and semiotic mediation (sign / media). There is a need to complement double mediation with an approach that accounts for how meaning is made through use, in the interplay between the user and the interface. Here, the interface may be regarded as a dialogue partner. This also relates to the underlying assumption in sociocultural theory on the dialogical and interdependent relationship of the mind and the world.

In this chapter I will argue that interaction between users and kinetic interfaces can be studied as a dialogue, by drawing mostly on social semiotics and van Leeuwen. I will address different kinds of exchanges that may take place between a user and a kinetic interface. In order to do so, however, it is first necessary to take up the much-debated concepts of *interactivity* and *interaction*.

INTERACTIVITY

The interplay between the user and the computer is essential in kinetic interface design. In interaction design, the concept of *interaction* is central, but problematic. The concept is rarely defined, and has different meanings in different contexts (McMillan 2002).[51] Here, I will only briefly outline some of the challenges with the concept.

From a media perspective, McMillan (2002) identifies three different categories into which different definitions and perspectives on interaction fall: *user-to-user interaction* (e.g. communication via e-mail), *user-to-document interaction* (e.g. the possibility for users to create content), and *user-to-system interaction* (interaction between people and computers or

[51] For example, in their book *Thoughtful interaction design*, Löwgren and Stolterman (2004) do not provide definitions of 'interactivity' or 'interaction'.

other media system). In social media, for example, all three types of interaction are at play (Eikenes 2009): people produce and share content such as videos and images (user-to-document interaction), communicate directly with each other (user-to-user-interaction), but always also through and with an interface (user-to-system interaction). In this chapter, however, I focus mostly on user-to-system interaction, or, what I would rather describe as user-to-interface interaction, since the interface is what the user is confronted with when interacting with a computer system.

Interactivity between users and computers has been approached in a range of different ways.[52] For example, Chris Crawford defines it in terms of a conversation, "a cyclic process in which two actors alternately listen, think, and speak." (Crawford 2003: 3). Here, both the user and the computer are seen as actors in a conversation. However, Espen Aarseth (2003) rejects such a definition. According to Aarseth, this implies that there is a "functional or cognitive equality between human and machine" (2003: 425), which is not possible, and the definition thereby excludes all current human-machine communication systems.

However, interactivity does not have to imply an 'intelligent' computer. Consider this definition provided by Poggenpohl, et al.;

> Interaction is a process of mutual or reciprocal influence among the variables or parts of a system. Interactions are a succession of actions, each responding to prior actions and each being responded to by succeeding action. … The essential concept of interaction is reciprocal action, influence, or effect.
>
> (Poggenpohl, et al. 2004: 603)

This definition does not assume that the computer system is more 'intelligent' than a mechanical machine. Rather, the system responds to actions performed by the user. Importantly, these actions and events depend on previous actions and events. Further, it might be added that interactivity includes the possibility for a person to intervene in the representations itself (Lister, et al. 2009), in contrast to the more simple interventions that are possible in other media (such as starting a movie from a DVD, switching to a different channel on TV, or turning the page of a book etc.). Consequently, I now argue that interactivity can be understood as *a process of exchange between a person and an interface that involves a perceived intervention in the interface, in which each exchange responds to previous exchanges, and enables new exchanges to take place*. By 'exchange' I mean a unit of dialogue between the parts, employing different sensorial modes, for example

[52] For an overview, see for example McMillan (2002) or Kiousis (2002).

sound, visuals or physical contact.[53] By 'perceived intervention' I mean that the user must perceive a change in the interface in order to support the succession of actions and events. This relates to the concept of interface action (see Chapter 5), in which actions carried out by a user result in some sort of outcome or material change. If no change can be perceived by the user, the activity of exchange breaks down, and, to the user, there is no interaction. Interactivity is therefore ultimately 'in the eye of the beholder' – the human actor (McMillan 2000). If a person is not able to notice that an interface responds to his actions, it can hardly be described as a process of interactivity. This understanding of interaction implies that some mechanical machines can be regarded as enabling interactivity, but, in contrast to Aarseth (2003), I do not see this as a problem. From the viewpoint of a regular user, it does not matter much if an artefact is digital or mechanical as long as it enables meaningful interactions to take place.

This view on interaction focuses on process and communication rather than technology and physical control. I propose it as a starting point for the purpose of describing and analysing how kinetic interfaces enable processes of interaction. Seeing interaction as a process of exchange makes it possible to study this process as a dialogic one.

INTERACTION AS DIALOGUE

The meanings of interfaces emerge through use. Therefore, there is a need for understanding the different ways in which interactions between a human actor and a kinetic interface may unfold. However, the understanding of interactivity presented above does not automatically provide any analytical approach to study such interaction. In the following I will draw on social semiotics and discourse analysis in order to investigate the possibility of analysing the interaction between a person and a kinetic interface as a dialogue, without assigning the computer any 'human intelligence'.

In the history of digital technology, many efforts have been put into creating artificial intelligence and 'conversational' or 'natural language' interfaces (Stock, et al. 2006). Here, the aim has been to develop interfaces that behave and respond much like humans do, more or less intelligently. However, Castelfranchi (2006) argues that conversation and dialogue is not the right model for interaction; a view on interaction as dialogue implies seeing the participants as striving towards a common goal based on common understanding. According to Castelfranchi, interactive technology is not capable of such intelligent behaviour. However, there are several similarities

[53] For a discussion on the need for considering different sensorial modes in interaction with digital media, see Back (2003).

between human-to-human interaction and human-to-computer interaction, as pointed out by Poggenpohl:

> What is obvious is that turn-taking is a phenomenon of interaction, as is feedback and interpretation. Whether it occurs person-to-person or person-to-computer, the situations are similar, the difference being the level of variability in the human context in contrast to the limited and programmed interaction in the person-to-computer context.
>
> (Poggenpohl 2006: 296)

As with interaction between people, interaction with an interface is also a dialogic process in which information is exchanged, interpreted and responded to. Therefore, it might be useful to consider this interaction as a dialogue. Such an inquiry does not have to equate interaction with interfaces to that between humans, or to assign computers any intelligence or human-like appearance.[54]

Dialogic interaction

Adopting a sociocultural view, interaction may be seen as a combination of action and interpretation, of instrumental and semiotic mediation. This is a dialogical process between mind and world, in which activities are enabled by meditational means (Wertsch 1991). The user's interface actions are driven by goals and motives that guide the dialogue (Vygotsky 1978). When a user interacts with a kinetic interface, he or she is not only in a dialogue with the interface, but also with oneself, the designer, and the cultural context in which the interface is used.

Wells (2002) argues that dialogue is different from tool-mediated action, as the action of dialogue is related to meaning and semiotic conventions rather than material change. While Wells focuses on human-to-human interaction, I will primarily concentrate on the interactions taking place between the user and the interface. For studying interaction with kinetic interfaces, the work of van Leeuwen (2005) has come to be more applicable than related approaches to multimodal action and interaction (e.g. Norris 2004; Norris & Jones 2005; O'Halloran 2004). In analysing multimodal

[54] To see interaction as dialogue may seem to be in conflict with instrumental mediation, and notions such as *direct manipulation* (Shneiderman 1983). The distinguishing features of direct manipulation are 1) continuous representation of the object of interest, 2) physical actions or labelled buttons instead of complex syntax, and 3) rapid, incremental, reversible operations whose impact on the object of interest is immediately visible. However, according to Brennan (1990), "direct manipulation interfaces succeed *because* they share important features with real conversation" (1990: 393). For example, according to Brennan, in human conversation as well as in direct manipulation, feedback should be timely and relevant.

dialogue, van Leeuwen sees "exchange structure" as a semiotic resource for creating cohesion in multimodal texts. Here, dialogue may involve multiple people and modes (including movement). For example, people involved in the same musical activity are involved in a musical dialogue with each other, in which different structures of exchange may take place. I will adopt this approach to describe interaction as exchange between a user and an interface, drawing on concepts from social semiotics (van Leeuwen 2005) and discourse analysis (Sinclair & Coulthard 1975).

The interaction that takes place between a user and a kinetic interface may be understood as a number of succeeding "exchanges" between the two. This dialogic interaction may be illustrated as a diagram (Figure 19), based on the model of double mediation introduced in Chapter 4:

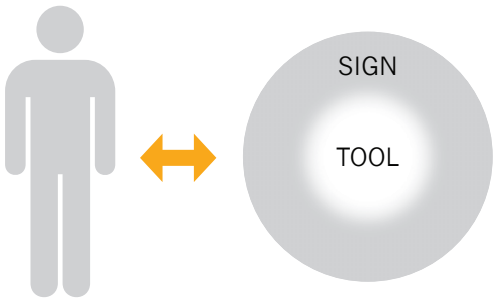


Figure 19. An abstract model indicating the dialogic interaction between a user/actor and a kinetic interface.

In discourse analysis, an exchange is a unit of dialogue or discourse, above the clause (Sinclair & Coulthard 1975). An exchange can consist of one or more "communicative acts" or "moves", which are carried out by the actors involved. In the exchange structure, there is minimally two communicative acts, usually an *initial move* followed by a *response* (or *countermove*), and possibly a *follow-up* (van Leeuwen 2005). Through these communicative acts, the actors can offer or demand information to/from each other.

At the interface, both the user and the computer may demand and offer information, but the user is usually the one initiating a sequence of exchange. Such offerings and demands may take a number of forms: when a user operates the interface, e.g. by using the keyboard or his fingers on a screen, he performs an initial move demanding the computer to responds accordingly. If nothing happens, the exchange is disrupted, and the user will probably be disappointed or confused. Similarly, the interface may demand the user to make choices by providing "dialogue boxes" or forms to fill in.

One might argue that many websites are annoying dialogue partners in that they keep demanding the same information from the user over and over again, resulting in repetitive 'conversations'. This is especially a problem on devices with poor text-input capabilities, such as mobile phones (Rukzio, et al. 2008).

According to van Leeuwen, the initiator of an exchange holds the balance of power in the exchange. For example, if a 'dialogue box' pops up on the screen of a user, one might argue that the box establishes a relation of power between the user and the computer, in which the computer takes control of the situation, acting more powerful than the user. In some situations this might be desirable, in others it might be highly intimidating.

The interface also demands attention through its use of semiotic modes. Animation, for example, is a highly effective mode for drawing attention to the interface, and may for that reason become a source of irritation for people, as with the (mis)use of animated banners on webpages (Nielsen 2000). Several modes may also work together for demanding or offering information, which van Leeuwen refers to as 'multimodal communicative acts' (2005).

Exchange types

How may the turn-taking exchanges between the user and the interface be realised? According to van Leeuwen (2005), exchanges may be sequential or simultaneous, linguistic or non-linguistic, in harmony or in conflict with each other. As an example, van Leeuwen refers to how the simultaneous exchanges of several voices and instruments in music harmonize (consonance) or clash (dissonance).[55] The dialogic exchange between a user and the interface may be visualised schematically as it unfolds in time:

Figure 20. A diagram showing the dialogic exchange between a user and an interface. Time is represented along the horizontal axis. (My illustration).

The initial move performed by the user followed by the response from the interface corresponds to the notion of interface action (Eikenes 2010), in

[55] Not only participants, but also semiotic modes may be treated as being in a dialogue with each other. For interfaces, it is possible to use this approach to analyse the interplay of semiotic modes as well as the dialogic relationship between user(s) and interface(s). Here, however, I will only focus on how one single user interacts with an interface.

which the user is trying to achieve something by using the interface as a tool (Leont'ev 1978). Consider for example the action of selecting a hypertext link and thereby be transported to a different website, illustrated as a diagram in Figure 21:

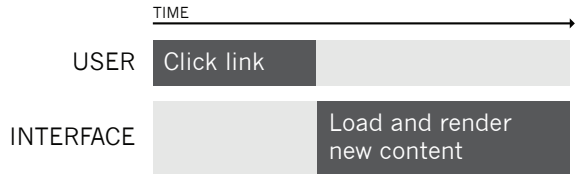


Figure 21. A diagram showing the action of selecting a hypertext link. (My illustration).

This is a *sequential exchange* between the user and the interface; the user performs the initial move by selecting / clicking the link, and as a response the new page is being loaded. This is a discrete, temporally sequential form of navigation. In contrast, consider the action of scrolling a webpage vertically or horizontally by moving a slider, in Figure 22:

Figure 22. A diagram showing the action of scrolling a webpage. The kinetic interface responds continuously as the user drags the slider. (My illustration).

Here, navigation is continuous, realised as a *simultaneous exchange* between the user and the interface. This corresponds to the concept of *temporal navigation* (Eikenes & Morrison 2010).[56] In this simultaneous exchange, the moves of the user and the interface blend together in co-action. Here, instrumental and semiotic mediation are more intertwined than in sequential exchanges, as action and interpretation are so tightly coupled in time.

[56] Operating a slider is probably the simplest example of temporal navigation, as navigation here only takes place along one dimension with an otherwise static 'page'. However, temporal navigation may also be applied to two-dimensional navigation (moving vertically and horizontally along a canvas) and three-dimensional navigation (adding depth).

DIALOGIC INTERACTION AND KINETIC INTERFACES

What kinds of dialogic interactions does a kinetic interface enable? How does different types of dialogue affect the interaction between a user and a kinetic interface? Here, I will draw on van Leeuwen in order to describe different types of dialogical relationship between the user and the interface. After describing four dialogue types I will relate them to kinetic interfaces, and provide an example. Finally, I will discuss how dialogical interaction may relate to social navimation and co-located social navimation.

Types of simultaneous dialogue

van Leeuwen (2005: 255-259) describes four kinds of simultaneous dialogue taking place between voices and instruments in a musical setting. According to van Leeuwen, this has implications for the power relation between the participants in terms of equality and inequality. The four types of dialogue are:

- *Interlock*. Participants are allowed to do their own thing independently, so that it is impossible to ascribe a dominant role to any part. The result may be chaotic but also pleasurable.
- *Social unison*. The participants in the dialogue express the same sense of belonging. In music, the participants sing or play the same notes, which thereby express a sense of being united.
- *Social plurality*. The participants play different parts that are equal in musical value. The exchanges may for example run in parallel (each participant 'saying the same thing') or be contrasting (each participant 'saying opposite things').
- *Social dominance*. One participant becomes dominant. In music, the melody is often dominant, while other voices or instruments become subservient to it. This may lead to 'class struggles' between dominant and subservient participants.

These are dialogues between instruments and voices, but do these dialogue types also apply to the exchanges taking place between a user and a kinetic interface? The interface is obviously not a socially intelligent participant, but may still be involved in a simultaneous interactional exchange. As I will show, these dialogue types may be applied both in sequential and simultaneous exchanges. I will now relate the four dialogue types to kinetic interfaces, and adjust the terms by adding the word 'kinetic'.

Kinetic interlock. If the interface behaves independently through movement, or the user does not understand how to control the interface, it might be described as a kinetic interlock. Alternately, the same may happen if the interface does not 'understand' what the user is trying to 'say' or do, for example through a specific gesture. This would most often be undesirable in utilitarian interfaces, but could be used as a strategy for more experimental interfaces, such as those found in artistic installations.

Kinetic unison. Here, the kinetic interface does 'the same' as the user. For example, as the user moves the mouse or his fingers on a screen, an object in the interface moves accordingly. This is similar to the notion of *direct manipulation* (Shneiderman 1983), in which responses to actions are immediate. According to Thomas and Calder (1995), animation may be used to "enhance the illusion of direct manipulation by strengthening the impression that users are manipulating "real" objects" (1995: 11) – and thereby creating a sense of unison between the user and the interface. Alternatively, unison may be achieved if the user does the same as the interface. This is sometimes the case in computer games, in which the user must perform specific tasks of 'following the interface' according to rules in the game.

Kinetic plurality. Can the user and the interface play different but equal parts in an exchange? If so, the interface must provide a contribution that is of equal value to that of the user. It is problematic to compare the value of what an interface does against what a human does, risking getting into a debate on artificial intelligence. However, an interface can be designed to do something unexpected that the user did not ask for. In that case, it may be conceptualised as an exchange of plurality. Such behaviour could be desirable in situations when the user is open for being surprised, while undesirable in other situations.

Kinetic dominance. The user *or* the interface may become dominant in the interaction at the kinetic interface. If the user is dominant, it might be argued that the interface becomes more like an instrument, a partner that is subservient to the actions of the user. This seems to be the case in most utilitarian interfaces, in which the interface obediently serves the user. Alternately, the interface may become dominant in the dialogic exchange. For example, some applications and websites make use of splash screens or introduction sequences that users are not able to skip. In other cases, the interface may demand the user to do certain kinetic actions in certain ways to achieve a specific goal. This might not be a bad thing, but it may also leave the user passive at the command of the interface.

In the next section I will apply these dialogue types to one of the motion sketches I have made.

A web browser interface

How may the different types of dialogue affect the interaction between a user and a kinetic interface? Here, I will investigate how the four dialogue types apply to one of the design experiments carried out with Opera software (Eikenes 2010), Experiment 1.3*: Zoom out* (Figure 23):

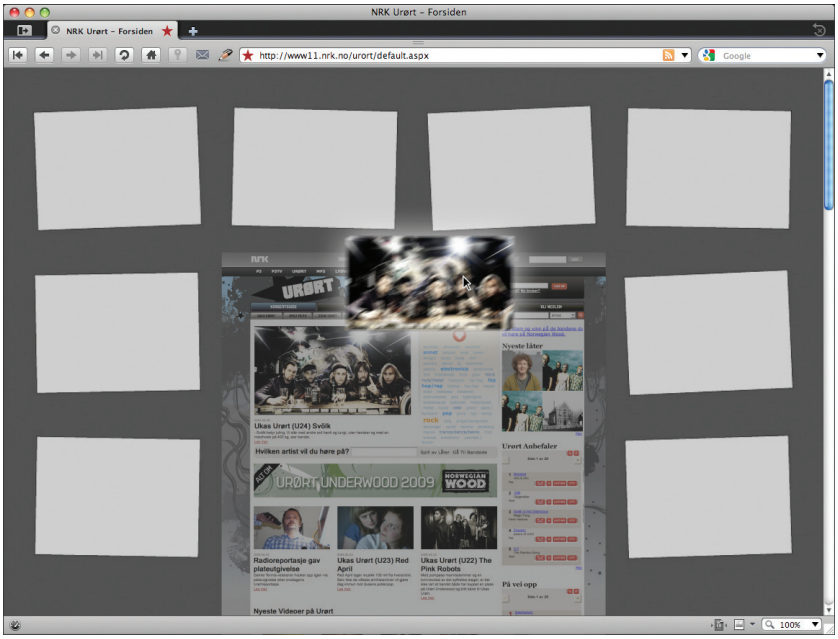


Figure 23. Design experiment 1.3 from Eikenes (2010). Still from video, available online at http://www.vimeo.com/11718882.

The experiment investigates how motional form may assist in adding a media item from a website (in this case an image) to a collection (here represented by grey boxes). The user clicks the image, resulting in the webpage retracting by being scaled down. Simultaneously, a copy is made of the image. The copy is scaled down and moves to visually connect to the mouse pointer. The user then moves the mouse (and thereby the image) to a collection in order to save it there. By clicking the small web page, the page scales up to normal size.

This interface action of assigning an image to a collection may be visualised schematically as a multimodal dialogue between a user and an interface (Figure 24):

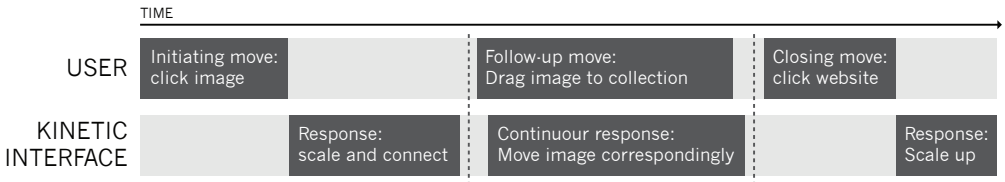


Figure 24. A diagram showing the multimodal exchanges between a user and a kinetic interface. (My illustration).

First, the user makes an *initiating move* by clicking the image. The interface *responds* afterwards by scaling the webpage down and connecting the image to the mouse pointer. So far, the dialogue has been sequential, and in terms of *kinetic dominance*, the interface is subservient to the user. However, as the user follows up by continuously moving the mouse, the interface continuously responds by moving the image. This continuous 'navigation' of the image is an instance of temporal navigation. Here, the dialogue is *simultaneous*, and the interface works in *kinetic unison* with the user. The user is still in charge, but the interface moves the image according to how the user moves the mouse. Finally, after dropping the image in the collection, the user clicks on the website. The interface responds by scaling the website back/up to normal size. Again, the dialogue is sequential, and the user is dominant. However, it is worth noting that the interface's first response (scaling down the webpage and connecting the image) and the last response (scaling up the webpage) are communicative acts that the user is not controlling in detail. Therefore, it might be argued that there is a certain *kinetic plurality* to the interaction, in which the interface plays a part that supplements the acts of the user. I suspect that such supplementing plurality may be used to enrich the interaction at the interface, as long as the acts do not lead to *kinetic interlock*. Interlock may be the result of acts that do not make sense in a given context.

The four dialogue types establish different power relations between the user and the kinetic interface. In this example, kinetic dominance and kinetic unison are present, and to some degree also kinetic plurality. Further, the types of simultaneous exchange drawn from van Leeuwen seem to apply to simultaneous as well as sequential exchanges.

The example above indicates that different dialogue types may take place at the kinetic interface during a short period of time. This demonstrates the need for analysing interaction at a micro level. In each section of the dialogic interaction described above, the interface uses motional form as part of its 'communicative acts'. Consequently, kinetic features may be employed in order to create different power relations between a user and an interface.

Applying terms from social semiotics and discourse analysis to kinetic interfaces shows that there is a potential for studying interactions between a user and a kinetic interface as a dialogue of exchanges. Through such an investigation we may uncover how meanings and relations of power unfold over time. Do these principles of dialogic interaction also apply to social navimation?

Dialogic interaction in social navimation

Social navimation is realised if a user engages with social media through navimation (Eikenes 2009). In social media, such as social networking sites (boyd & Ellison 2007), people engage in multimodal dialogues with each other across time and space (Morrison, Westvang, et al. 2010). For example, if a user posts a video to YouTube, someone may comment on it two years later from somewhere far away. Still, the overall principles of dialogic interaction seem to apply: exchanges may be sequential (as with direct messaging, email, and discussion boards) or simultaneous (as in some online games and video/voice chat), linguistic or non-linguistic (video, images, music), in harmony or in conflict.

The users of social media typically access the social media environments through screen-based interfaces, and thereby engage in user-interface exchanges. Therefore, when engaging with social media, people are involved in a "double dialogue": they are both interacting with each other and with interfaces at the same time. Following McMillan (2002), there is both user-to-user interaction and user-to-interface interaction. The two kinds of interaction are both mediated by the interface, as illustrated in Figure 25 below, building on the diagram from Chapter 4:

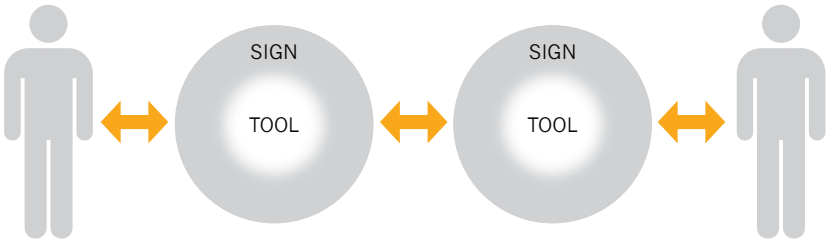


Figure 25. In *social navimation*, people are involved in a "double dialogue" - with the interface, and with each other, across time and space. (My illustration).

Consider for example the application *Flipboard* for the Apple *iPad* (Figure 26). This application allows people to connect to Facebook and Twitter, so that media content is brought into a consistent kinetic interface. Instead of

only showing Twitter messages,[57] the software fetches the articles, videos and images to which the 'tweets' refer, and presents them in a magazine-like layout. The user may browse from one page to another by moving a finger horizontally on the screen, resulting in half of the page 'flipping' towards the virtual camera, imitating the turning of pages of a paper magazine. Consequently, the interface aggregates media content from multiple social media services, and presents the content in a coherent manner through a kinetic interface. As such, it may be describe as a 'meta-interface'. The implicit reference to a paper magazine adds a layer of professionalism, quality and maybe even glamour to the interface.

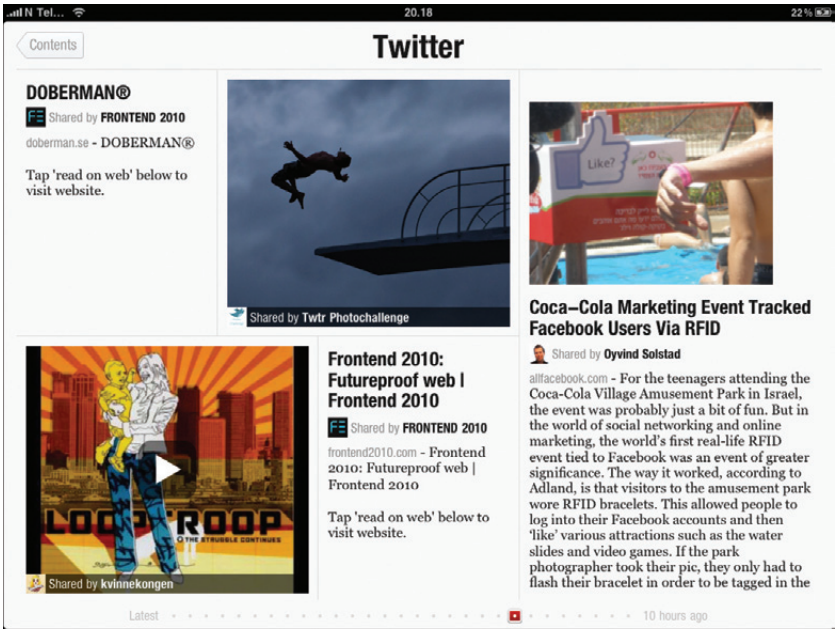


Figure 26. Screengrab from the application *Flipboard* for the Apple *iPad*, which allows people to bring information from various sources and social media services into one coherent kinetic interface.

In addition to consuming social media content, the user may 'like', 'retweet' or 'reply' to messages, in this case from Twitter, and thereby take part in social interaction. Here, the user-to-user exchanges are sequential, as the interaction between people is not taking place simultaneously. On the other hand, the exchanges between the user and the kinetic interface can be either simultaneous or sequential, depending on the actions of the user; flipping the page may be achieved as temporal navigation by slowly moving

[57] A Twitter message, often called a 'tweet', is maximum 140 characters long. For more information, see www.twitter.com.

a finger across the screen, resulting in a simultaneous exchange. However, if the user chooses to quickly 'swipe' a finger across the screen, the page does not follow the movement of the user simultaneously, put rather plays back a 'default' flip animation.

In terms of dialogue type, the user-to-interface interaction is complex. The user is the one who initiates and controls the exchange (kinetic dominance). However, as soon as the interface responds by flipping the page, the page moves in kinetic unison with the user. For a new user of *Flipboard*, the motional flip may not be expected but rather come as a surprise, and thereby provide kinetic plurality to the interaction. Such a surprise may be confusing for some users, but I found it amusing and delighting the first time I explored the interface.

Many social media interfaces such as Facebook and Twitter have traditionally been accessed through 'conventional' web pages, without much kinetic features. *Flipboard*, in contrast, shows great promise for social navimation, or in other words, for kinetic social media interfaces. As indicated above, this opens up a range of possibilities for user-to-user interaction as well as user-to-interface interaction.

Dialogic interaction and co-located social navimation

In co-located social navimation, several people are engaged in using one or several kinetic interfaces in a shared environment. People are still involved in an exchange with interfaces, but also directly with each other. The result is multiple processes of exchange, for example between two people, between a person and an interface, and from one person to another via the kinetic interface. These processes may take place simultaneously: people constantly make exchanges with each other through words and gestures (Norris 2004), at the same time as they engage in exchanges with the interface (see Figure 27).

A full analysis of the dialogic interactions taking place between several users and interfaces is outside the scope of this thesis. However, I have included this section and the diagram here so as to point to an area that is likely to need further research. As the number of participants and interfaces increases, so does the level of complexity. Such complexity is both a challenge and a possibility for kinetic interface design.

Throughout this chapter I have regarded the kinetic interface as a dialogue partner in interaction. This has been presented as a complementing perspective to the concept of double mediation. In the following section I will discuss how these perspectives may relate to each other.

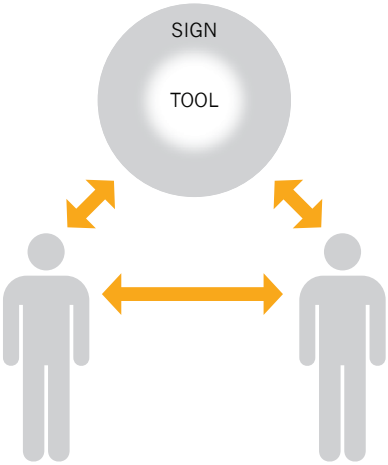


Figure 27. In *co-located social navimation*, people are simultaneously in dialogue with the interface and each other.

DOUBLE MEDIATION AND TRANSPARENCY

The perspective of dialogic interaction is closely related to the concept of double mediation (which includes semiotic and instrumental mediation, as explained in Chapter 4, 5 and 6). These perspectives present two distinct but related ways of looking at how we engage with interfaces, which also relates to the "transparency" of the interface.

While double mediation focuses on the role of the interface in mediating activities and meaning, dialogic interaction focuses on the actual exchanges between a user and an interface. However, the dialogical is also at play in double mediation; there is a constant dialogue between action and semiosis, between doing and interpreting. This corresponds to the notion of the interface as tool and sign; there is a dialogic and oscillating relationship between the interface-as-sign and interface-as-tool. According to Bødker and Andersen (2005), this is a matter of complex mediation, in which "clean instrumental and semiotic behaviour are only theoretical endpoints of a scale" (2005: 361). I must agree on this. However, there might be cases in which the pendulum of mediation swings closer to the instrumental, "transparent" or "seamless interface" (A. Wood 2007), while it other times swings closer to the semiotically complex and expressive end of the scale. Several authors, including Donald Norman, have discussed the issue of interface transparency:

> The real problem with the interface is that it is an interface. Interfaces get in the way. … An interface is an obstacle: it stands between a person and the system being used. … If I were to have my way, we would not see computer interfaces. In fact, we would not see computers: both the interface and the computer would be invisible, subservient to the task the person was attempting to accomplish.
>
> (Norman 1990: 210-217)

For Norman, the interface is *only* an instrument. A similar argument is made by Bannon and Bødker (1991), who want to look beyond the interface to the tasks in which it is used as a tool. Negroponte (1995) also wants the interface to disappear, but for a different reason. For Negroponte, the interface should behave like a human, and ideally a 'well-trained English butler'; the user might be conscious of the looks of the interface at first, but then the 'content of communication' starts to dominate, and the interface itself disappears. These views do not see the value of an interface in itself as a cultural, expressive, aesthetic and meaningful artefact. The quest for interface transparency has been problematised, for example by Kirschenbaum:

> the ideal of transparency is now being called into question and replaced with a broader awareness of how the visual (and aural, or tactile and olfactory) elements on page or screen function as integral aspects of the information experience, rather than as afterthoughts to some "pre-existing bundle of functionality".
>
> (Kirschenbaum 2004)

Kirschenbaum further points out that the debate on interface transparency mirrors the debate in literary studies over the nature of a book's 'contact surface', and the role of its physical and material features in the production of meaning of a text (e.g. Hayles 2002). In literary studies as well as interface studies, the interface cannot be decoupled from functionality or aesthetics, he argues. This also relates to the dichotomy between form and function, which has been common in discourses on architecture and design (Michl 2009), including webdesign (D. Wood 2007).

When discussing interface transparency, Bolter and Gromala (2003) argue that we should see the interface as a mirror rather than a window. Sometimes, the user should look at the interface, not through it:

> If we only look *through* the interface, we cannot appreciate the ways in which it shapes our experience. □ Every digital design functions as both a window and a mirror.
>
> (Bolter & Gromala 2003: 27)

According to Bolter and Gromala, the strategy of transparency (which goal is information delivery) and reflectivity (which goal is compelling experience) form a continuum. They are both always present, perhaps with more elements of one or the other. According to Bolter and Gromala, interfaces should oscillate between transparency and reflectivity. They argue that the success of the Apple *Macintosh* interface stems from the fact that it does not fully accept its own transparency, while Microsoft *Windows* □shows the folly of accepting the simple definition of interface design as transparency □ Windows is too consistent. The user crashes into the clear window that the system tries to be, and the result is confusion and mystification.□(2003: 69-70). This conclusion seems somewhat exaggerated and hasty, but there might be something to it. It would be interesting to do a more detailed analysis of interfaces from Apple and Microsoft from a sociocultural and social semiotic view, in order to investigate their strategies of transparency and reflectivity.

The notions of double mediation and dialogic interaction account for the kinetic interface as oscillating between being transparent and reflective, by looking at the interface as both sign and tool involved in a dialogic process of action and signification. The oscillation between transparency and reflectivity may be illustrated in the abstract model of double mediation (Figure 28), which was introduced in Chapter 4:

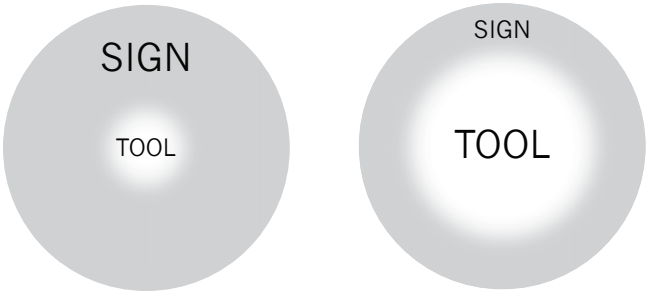


Figure 28. The model of double mediation accounting for degrees of transparency and reflectivity. To the left, the interface becomes highly □reflective□as the semiotic layer is more prominent than the tool-function of the interface. To the right, the tool-function is dominating so that the interface becomes more (but not entirely) □transparent□

In interfaces where the expressive and aesthetic aspects are at the core, the interface becomes reflective, and its semiotic function is essential. In other interfaces where instrumental aspects and routine operations are essential, the interface may become more transparent. However, in all kinetic interfaces, through dialogic interaction, the interface will oscillate between being reflective and transparent in use, between working mostly as sign or tool. For design practice, teaching and research, this provides a means of seeing, constructing and analysing kinetic interfaces that are meaningful and engaging and at the same time allow activities to be carried out.

CONCLUSION

This chapter has focused on how meaning in a kinetic interface is made through processes of use, in the interplay between one or several users and interfaces. I have taken up the much-debated concepts of *interactivity* and *interaction*, and proposed that the interaction between kinetic interfaces and their users can be analysed as a dialogue of exchange, by drawing on social semiotics and discourse analysis. Such a view provides insights that complement the notions of instrumental and semiotic mediation.

The concepts of interaction and interactivity are frequently used in interaction design. However, there are no agreed-upon definitions of the terms, and they are commonly used without an analytical framework. The concepts have also been regarded as problematic. For example, Aarseth claims that the word *interactive* "connotes various vague ideas of computer screens, user freedom, and personalized media, while denoting nothing" (Aarseth 1997). A central objection is that interaction is seen as a phenomenon that can only take place between socially intelligent or 'thinking' actors. This implies an intelligent computer, which so far does not exist. However, the concepts of interaction and interactivity do not have to imply that all partners are intelligent.

I have proposed that interaction with a kinetic interface may be seen as a process of exchange between a person and the interface, one that involves intervention in the interface. Importantly, these exchanges respond to and are enabled by previous exchanges. In order to analyse interactivity in kinetic interfaces, I draw on the notions of dialogue and 'exchange structure' from social semiotics and discourse analysis. In the exchange structure, there is minimally two moves or 'communicative acts', which may be carried out by the user or the computer. Here, distinctions are made between *sequential exchanges* and *simultaneous exchanges*. I have suggested that kinetic interfaces may allow for simultaneous exchanges to a larger degree than what visually static interfaces do. Further, four types of simultaneous interaction

are identified: *kinetic interlock*, *kinetic unison*, *kinetic plurality* and *kinetic dominance*. These highlight different possible relations of power and exchange between a user and a kinetic interface.

I have argued that in social navimation, people are involved in a process of 'double dialogue', interacting with the interface and with each other at the same time. In co-located social information the exchange structure becomes even more complex, as people communicate face to face and with interfaces simultaneously. This opens up questions that go beyond this thesis, and points to an opportunity for research into the complexity of meanings and relations that may unfold in such a situation.

Finally, I have discussed the relationship between double mediation and dialogic interaction. This has been linked to the debate on interface transparency. The sociocultural approach and the notions of double mediation and dialogic interaction offer a way off seeing the kinetic interface as oscillating between being reflective and transparent through dialogic interaction.

Social semiotics needs to move beyond images and texts that do not change when used, and deal with interfaces and their features of interactivity. Such interfaces are playing an increasingly important role in people's lives, in mediating work, leisure and social interaction. Kinetic interface design seems to be a suited site for investigating interaction. As shown here, social semiotics and discourse analysis offer the conceptual framework that is needed for studying the exchanges taking place in the use of kinetic interfaces, and how these produce meaning. Such an understanding may also guide the design of new kinetic interfaces and the interactions they enable.

The analytical approach of dialogic interaction provides an alternative to existing views on interaction and interactivity. This approach could therefore be important to the field of interaction design, which already in its name is intrinsically linked to the notion of 'interaction'.

Part III: Conclusions

This part contains only one chapter, in which I present the findings of the study, based on the previous chapters. Here, I also discuss some issues that go across the chapters, and point out the implications for sociocultural theory and the field of interaction design in particular.

Chapter 8. Conclusions

FINDING THE KINETIC INTERFACE

Movement is essential in human activity and communication. Our actions are performed through movement, and we communicate through moving our bodies in space. Movement and action are intrinsically linked; there cannot be action if there is no movement, nor movement without action.

With the introduction of cinema and television, visual movement became a central feature of mediated communication. Today, we are increasingly surrounded by screens that not only make use of moving images, but also react to our individual actions by presenting us with sophisticated motional forms. This is not an entirely new phenomenon; such features were already an integrated part of Ivan Sutherland's *Sketchpad* in the early 1960s. However, it is not until recent years that movement in the interface has become a widespread and recurring phenomenon. 'New' interfaces are continuously being introduced, in which novel kinetic features and expressions play a key role. Movement is an integrated part of the interfaces of commercially successful products such as the Apple *iPad*, a diversity of gaming platforms such as Nintendo *3DS* and Microsoft *Kinect*, and a range of successful websites. In short, they are *kinetic interfaces*. Being kinetic, they are characterised by movement, and make use of visual movement as a mode of communication. These interfaces are culturally complex artefacts imbued with meaning as much as they serve as technological tools for carrying out computational processes.

Some of us spend several hours each day working with and against interfaces. These interfaces shape our ways of acting and understanding, and are therefore highly important to study. Kinetic features may for example communicate values and emotions, visualise dynamic processes, engage users, guide us through complex digital environments, and not least persuade us into buying new products. However, movement in the interface may also be badly designed, and thereby disturb and confuse users.

For design theory, teaching and practice, it is important to know what kinetic interfaces are, how they are constructed, and how they work. Such knowledge is important not only for designing new interfaces, but also for describing and critiquing existing ones. I have referred to movement in the interface as *motional form*, to bring attention to the fact that such movement has to be shaped and designed by someone, much like physical materials are shaped into artefacts.

REFLECTION ON FRAMEWORK

The starting point for this thesis was to investigate the emerging phenomenon of kinetic interfaces from a designer-researcher's point of view. Primarily, the study set out to investigate how we may understand the employment of movement in screen-based interfaces, and secondary, how such an emerging phenomenon might be investigated by combining textual construction with textual analysis.

In order to account for the role of the interface as a complex communicative artefact situated in a cultural and historical context, I have adopted a sociocultural view on design and interfaces, informed by social semiotics. Further, the study has drawn on concepts from activity theory, which shares many of the basic assumptions of social semiotics. Here, the meaning and use of artefacts are seen as situated in particular historical and social contexts. While activity theory focuses on development and the activities in which tools and signs are used, social semiotics allows us to see how the interface as a 'text' is meaningful, and how this meaning is continuously being reproduced and altered through processes of semiotic production and interpretation. Textual analysis has been the main analytical approach, looking at the interface as a cultural artefact and a multimodal text.

In order to study a phenomenon that very much is emerging and continuously developing, a practice-based approach has been taken. Taking up a *research by design* approach, design experimentation and design production constitutes an important aspect of the overall research approach. Consequently, the construction of texts has been coupled with textual analysis. This has allowed me to investigate potential features of kinetic interfaces that not yet had been realised in existing interfaces, to focus on these features in a concentrated manner, and to build concepts through the interplay of design and analysis.

Sociocultural views are not usually applied to kinetic interfaces; they are mostly employed in developmental psychology and studies of learning, education and literacy (e.g. Erstad, et al. 2007; Wells 1994). However, such a view may also be applied to the study of interfaces. Through analysis I have

demonstrated the relevance of regarding kinetic interfaces as both sign and tool, seen from the perspective of human activity and development. Activity theory has been applied to interface design before (e.g. Kaptelinin & Nardi 2006; Nardi 1996), but not to kinetic ones. I have also extended and elaborated on the concepts of tool, sign and action in order to account for the complex mediational role of kinetic interfaces. By drawing on Leont'ev (1978), I have argued that kinetic features in the interface may be directly connected to actions that a user performs through an interface, and thereby support activities of work and play.

Social semiotics is not often applied to kinetic screen-based interfaces. However, it provides a powerful approach for multimodal textual analysis. Social semiotics accounts for the active role of people in producing meaning through semiotic resources. These resources are not fixed 'codes' that people have to learn in order to communicate, but provide potentials for meaning, which are open for interpretation and manipulation, and highly dependent on cultural, social and historical contexts. The meaning of motional form is not simply encoded into an interface; it exists in relation to other texts, emerges and is transformed through use within communities. From a social semiotic perspective, design can be regarded as semiotic production, and as such always motivated and driven by certain interests and values. The power of interface design to produce and reproduce meaning cannot be underestimated. However, interface design cannot simply be seen as a 'one-shot' message to an 'end user'. Both designers and users are part of multiple communities in which meaning is continuously being negotiated. This becomes further complicated as users themselves become producers of 'content' through social media applications, and are able to design and customize their own kinetic interfaces.

Social semiotics has strong roots in systemic functional linguistics. Even though it has been extended to visual communication, there is a need to extend the notion of multimodality to include other sensorial modalities than those currently studied in social semiotics. As suggested by Maribeth Back (2003), the notion of reading may be extended beyond the book and into the world around us, leading to *multisensory reading*. This kind of reading includes all the sensory modalities available through sight, hearing, touch, and even to some degree smell and taste. Such an extended version of multimodality could provide an important contribution to the design and analysis of products, services, games, installations and architecture.

Social semiotics also has limitations. It may be hard to learn, as pointed out by Bødker and Andersen (2005). For example, O'Halloran et al. (2010) point out that there are a multiplicity of frameworks and theories within social semiotics, and key concepts such as 'mode' and 'medium' are understood differently from one researcher to another. This may make it hard

for someone coming from the outside to grasp the theories and concepts of social semiotics. Further, social semiotics does not offer much help in telling designers how to design interfaces, or what a 'good' interface is. Therefore, social semiotics needs to be complemented with other approaches, especially in design practice and teaching.

In the next section, I will present the main findings and concepts of the thesis.

FINDINGS

By combining textual construction with textual analysis, and thereby making use of my own skills as a professional designer, I have been able to investigate the potentials and features of kinetic interfaces. Consequently, I have not only constructed texts, but also concepts through design and analysis. These concepts are the main findings of the thesis. Building concepts has been necessary in order to understand the employment of movement in the interface. This would be impossible or at least very hard to do through design or analysis independently. The concepts have been applied in analysis as well as experimental design of kinetic interfaces, and may inform further analyses. Further, they may be taken up in design education and design practices as terms for critiquing existing interfaces as well as constructing new kinetic interfaces.

Through the publications and the meta-reflection, I have introduced and expanded on a range of concepts. In the publications, and through *design experiments*, I have investigated movement in the interface under the headings of *navimation, social navimation* and *motional form.* In the meta-reflection (Part I and Part II), I have investigated the phenomenon I have called *kinetic interfaces* from three angles within the sociocultural framework. First, from the perspective of what I have called *instrumental mediation*, I have suggested that movement may be used in order to enable or support certain actions and activities to be carried out in and through the interface. Second, through what I have called *semiotic mediation*, motional form provides a rich semiotic potential for designing expressive, communicative and aesthetic interfaces. Third, from the perspective of *dialogic interaction*, it is possible to see how kinetic features enable specific and new types of exchanges to take place between users and interfaces. I will now describe these concepts in more detail.

Design experiments

Taking a 'research by design' approach, I have referred to the activities and results of textual construction for *design experiments*, in order to highlights the explorative and concentrated study of movement in the interface. A range of design techniques have been employed under the labels of what I have called *motion sketching* (Eikenes 2010) and *motion evidencing*. Motion sketching includes techniques that have allowed me to quickly explore a range of motional forms, while motion evidencing has allowed me to construct visions of kinetic interfaces that appear to be demonstrations of real interfaces.

Navimation

In order to account for the intertwining of movement with navigational actions, I have coined the term *navimation* (Eikenes & Morrison 2010). Further, I have constructed five terms that are helpful for describing features of navimation: motional transformation, temporal navigation, spatial manipulation (Eikenes & Morrison 2010), virtual kinetics and indexical compositing (Eikenes 2009).

Motional transformation accounts for how visual elements may change gradually over time, for example in colour, transparency, size, or shape. The concept of *temporal navigation* helps us see that navigation may become continuous by the use of movement, as opposed to the discontinuous forms of navigation found in traditional hypertext documents. *Spatial manipulation* accounts for how a sensation of space can be created and manipulated by the use of visual movement in the interface. *Indexical compositing* has been devised in order to account for how a kinetic interface composition may allude to a specific external context, place or event. Finally, *virtual kinetics* accounts for the sensation of visual elements on the screen exhibiting magnetism or possessing mass in an environment providing elemental forces like gravity.

Further, the term *social navimation* has been introduced in order to understand how features of navimation may enable, make visible or assist activities in social media applications (Eikenes 2009). Here, a number of examples were made and analysed. Finally, in this meta-reflection, I have extended this concept to *co-located social navimation*, in order to better understand how movement and navimation may play a role when the interface becomes a mediating artefact in co-located social interaction between people.

As these terms are directly connected to movement, they do not immediately apply to static interfaces. They thereby demonstrate both the potential and need for analysing movement in the interface.

Motional form and kinetic interfaces

I have coined the term *motional form* in order to bring attention to the fact that movement in the interface has to be shaped and designed by someone (Eikenes 2010). Here, motional form is understood as designed changes in visual appearance over time. It includes the 'arrangement of parts' over time and 'what is directly given to the senses' (Tatarkiewicz 1980), where movement is created through animation techniques or computer software.

In order to describe interfaces in which motional form plays an important role, I have elaborated on the concept of *kinetic interface* that was introduced by Skjulstad (2004). This has been necessary in order to account for the proliferation of interfaces in which movement is a central characteristic. This includes websites, but also other types of screen-based interfaces such as gaming platforms and mobile devices in which screen-based movement is a key characteristic. A potential for further research is to investigate specifically how these are integrated with the physical movements and gestures of users.

Double mediation

I have argued that kinetic interfaces work both as tool or instrument in instrumental mediation, and as sign or semiotic artefact in semiotic mediation. I have called this *double mediation.* In Chapter 4, I proposed an abstract model of the kinetic interface to indicate how it works as sign and tool in double mediation. Here, the interface as a tool or instrument is 'wrapped' in a semiotic layer, indicating that it functions both as sign and tool at the same time.

The notion of double mediation points to the need for design research to integrate social semiotics and activity theory in order to understand the complex role of kinetic interfaces. In return, kinetic interfaces offer a case for bridging two research traditions that are not often combined, but complement each other in their views on mediation.

Instrumental mediation

From the perspective I have called *instrumental mediation*, I have suggested that movement may be used in order to enable or support certain actions and activities to be carried out in and through the interface. By drawing on activity theory and Leont'ev (1978), I have coined the term *interface action* to refer to a conscious process in which a person makes use of an interface as an instrument for achieving some material (digital/computational) change or outcome. I have demonstrated how interface actions can be connected to motional form in order to investigate how movement may facilitate the activity in which the interface action takes place. The concept of *navimation* denotes exactly such a coupling of navigational action with animation.

Further, in *social navimation*, movement is employed in navigating social media applications. I have also introduced the notion of *co-located social navimation*, which refers to the phenomenon of several people using kinetic interfaces at the same time and at the same place. Here, the kinetic interface becomes a mediating artefact in social activity.

Semiotic mediation

From the perspective I have called *semiotic mediation*, I have suggested that movement in the interface provides rich semiotic potentials for designing expressive, communicative and aesthetic interfaces. Here, the interface is investigated as a multimodal text, drawing mainly on social semiotics. From this perspective, interface designers may be seen as creators and manipulators of semiotic resources, which may be seen as elements or actions that do not have a fixed meaning, but rather a meaning potential. Further, it is suggested that the concepts of *connotation*, *experiential metaphor*, and *intertextuality* are particularly useful for analysing how meaning is made in kinetic interfaces. Connotation refers to abstract ideas and values that are expressed through what is represented in the interface, experiential metaphor refers to the understanding of motional form based on previous physical or cultural experience, and intertextuality refers to how kinetic interfaces relate to other texts and artefacts. A social semiotic view on interfaces challenges the argument that interfaces should go away or vanish, which has been argued by several authors, including ones with sociocultural views (Bannon & Bødker 1991).

Dialogic interaction

From the perspective of *dialogic interaction*, I have suggested that kinetic features enable specific and new types of exchanges to take place between users and interfaces. Here, the focus is on how meaning in a kinetic interface is made in the interplay between one or several users and kinetic interfaces. I propose that the interaction between kinetic interfaces and their users can be analysed as a dialogue, that is, as a process of exchange. Drawing on social semiotics and discourse analysis, distinctions are made between *sequential exchanges* and *simultaneous exchanges*. Here, I have suggested that kinetic interfaces may allow for simultaneous exchanges to a larger degree than static interfaces can. Further, extending the work of van Leeuwen, four types of simultaneous interaction are identified: *kinetic interlock*, *kinetic dominance*, *kinetic plurality*, and *kinetic unison*. These are necessary in order to highlight the different possible relations of power between a user and a kinetic interface. This soon becomes complicated as several interfaces and people are involved, for example in co-located social navimation, and points to the need for further research. Further, the notion of dialogic interaction

may provide a way of approaching the concepts of ‘interaction’ and ‘interactivity’, which are critical to interaction design.

The notions of semiotic mediation, instrumental mediation and dialogic interaction are complementary rather then exclusive, and they are all needed in order to understand movement in the interface. It is hard to think of a kinetic interface that would not function both as a semiotic artefact and as an instrumental one; even interfaces designed to be ‘meaningless’ or without clear purpose will be assigned meaning and purpose by its interpreters. Further, if dialogic interaction is not present, we are actually not dealing with a kinetic interface, but rather a flow of moving images that we are not able to intervene in. I have used and developed these overarching terms so as to account for kinetic interfaces. However, I believe they could be applied to static interfaces as well.

CLOSING REMARKS

Why is it important to investigate and deal with kinetic interfaces? There are several reasons for this. First, kinetic interfaces are pervasive; we carry with us devices with small screens in which motional forms play a crucial role, and we are increasingly surrounded by larger screens that also react to our actions through movement. There is no reason to believe that screens will go away in the near future, or that they will become more static. On the contrary, I believe kinetic screens will proliferate. The second reason is that kinetic features change the way digital artefacts work, and the way we interact with them. Kinetic features are highly persuasive, demanding and engaging. As movement is central to human life and activity, we are affected and touched by things that move, especially when we are allowed to take part in the movement ourselves. Further, kinetic features provide powerful means for communication. When employed in appropriate ways, motional forms can convey values, ideas and complex information, support and facilitate actions and activities to be carried out. Admittedly, designers can also misuse the power of movement in the interface; kinetic features can distract, confuse, or persuade us into consuming yet more products we do not necessarily need. This is also the reason why design research needs to engage with kinetic interfaces: to find a balance between constructing and analysing, between praising and critiquing kinetic interfaces.

This study has demonstrated that features of kinetic interface can be studied through design experimentation. It is possible to build concepts for analysing kinetic interfaces through text construction, coupled with textual analysis. An exclusively analytical approach would not be able to investigate

such an emerging phenomenon in a similar way. I have been able to investigate features that were not yet realised, to take part in constructing and building the phenomenon myself, and to investigate it in a concentrated manner.

For research in HCI and interaction design, the sociocultural view coupled with social semiotics provides a robust framework for understanding the complex mediating role of kinetic interfaces as cultural artefacts, situated in particular social, cultural and historical contexts. For design teaching and practice, the concepts developed here provide resources for describing, critiquing and constructing kinetic interfaces.

Kinetic interfaces should also be of interest for sociocultural theory and in studies of learning and education. Digital devices and their interfaces are increasingly playing an important role in children's lives, and thereby activities of learning, education and development. The use of computers and digital devices is in itself a developmental process of learning, for children and seniors alike. While interfaces have previously been studied by employing an activity theoretical perspective, these have seen the interface merely as an instrument in activity, not as an expressive, semiotic, and culturally rich artefact with value in itself. Activity theory needs to see the interface as both sign and tool, and draw on semiotic approaches in order to account for the interface as a complex and expressive artefact.

Social semiotics talks generally about design as semiotic production, but has not engaged itself much with professional designers and their practice. Here, there seems that both parties can gain from collaboration. Social semiotics needs to move beyond text-image relations and concern itself with complex, interactive and kinetic environments in which diverse media types and modes are combined and intertwined.

Arguably, the next shift in kinetic interface design will be when the screens of our laptops and mobile devices are capable of screening 'three-dimensional' stereoscopic images in motion, without the need for 3D glasses. This is already underway with the upcoming Nintendo *3DS* handheld gaming platform, which provides a stronger sense of depth in the screenspace. This gives a whole new dimension to the notion of spatial manipulation, and provides a range of new possibilities and challenges. This is what makes kinetic interface design exciting: it is still an emerging phenomenon that will continue to challenge us as designers and researchers.

References

Aarseth, E. J. (1997). *Cybertext: perspectives on ergodic literature*. Baltimore, MD: The Johns Hopkins University Press.

Aarseth, E. J. (2003). We all want to change the world: The ideology of innovation in digital media. In G. Liestøl, A. Morrison & T. Rasmussen (Eds.), *Digital media revisited: Theoretical and conceptual innovation in digital domains* (pp. 415-439). Cambridge, MA: The MIT Press.

Abowd, G. D., & Beale, R. (1991). Users, systems and interfaces: a unifying framework for interaction. In D. Diaper & N. Hammond (Eds.), *People and computers VI: proceedings of the HCI '91 conference* (pp. 73-87). Cambridge, NY: Cambridge University Press.

Andersen, P. B., Holmqvist, B., & Jensen, J. F. (Eds.). (1993). *The computer as medium*. Cambridge: Cambridge University Press.

Archer, B. (1995). The nature of research. *Co-design*, 6-13.

Back, M. (2003). The reading senses: designing text for multisensory systems. In G. Liestøl, A. Morrison & T. Rasmussen (Eds.), *Digital media revisited: theoretical and conceptual innovation in digital domains* (pp. 157-182). Cambridge, MA: The MIT Press.

Baecker, R. (1969a). *Interactive computer-mediated animation.* Massachusetts Institute of Technology, Cambridge, MA.

Baecker, R. (1969b). Picture-driven animation. In *Proceedings of the spring joint computer conference* (pp. 273-288). Boston, MA: ACM.

Baecker, R., & Small, I. (1990). Animation at the interface. In B. Laurel (Ed.), *The art of human-computer interface design* (pp. 251-267). Reading: Addison-Wesley.

Baecker, R., Small, I., & Mander, R. (1991). Bringing icons to life. In *Proceedings of the SIGCHI conference on human factors in computing systems: Reaching through technology* (pp. 1-6). New Orleans, LA: ACM.

Bagnara, S., & Crampton Smith, G. (Eds.). (2006). *Theories and practice in interaction design*. Mahwah, NJ: Lawrence Erlbaum.

Ball, C. E. (2004). Show, not tell: the value of new media scholarship. *Computers and composition, 21*(4), 403-425.

Bannon, L. J., & Bødker, S. (1991). Beyond the Interface: encountering artifacts in use. In J. M. Carroll (Ed.), *Designing interaction: psychology at the human-computer interface* (pp. 227-253). Cambridge: Cambridge University Press.

Barthes, R. (1970). *S/Z*. Paris: Seuil.

Barthes, R. (1994/1964). Semantics of the object (R. Howard, Trans.). In R. Barthes (Ed.), *The semiotic challenge* (pp. 179-190). Berkeley, CA: University of California Press.

Bayazit, N. (2004). Investigating design: a review of forty years of design research. *Design Issues, 20*(1), 16-29.

Benyon, D. (2001). The new HCI? Navigation of information space. *Knowledge-Based Systems, 14*(8), 425-430.

Biggs, M. (2002). The role of the artefact in art and design research. *International journal of design sciences and technology, 10*(2), 19-24.

Bleecker, J. (2009). *Design fiction: a short essay on design, science, fact and fiction*. Unpublished manuscript, from http://cloud.nearfuturelaboratory.com/writing/DesignFiction_WebEdition.pdf.

Blunden, A. (2010). *An interdisciplinary theory of activity*. Leiden: Brill.

Blythe, M. A., Overbeeke, K., Monk, A. F., & Wright, P. C. (2003). *Funology: from usability to enjoyment*. Dordrecht: Kluwer Academic.

Bødker, S. (1991). *Through the interface: a human activity approach to user interface design*. Hillsdale, NJ: Lawrence Erlbaum.

Bødker, S., & Andersen, P. B. (2005). Complex Mediation. *Human-Computer Interaction, 20*(4), 353-402.

Bolter, J. (2003a). Critical theory and the challenge of new media. In M. E. Hocks & M. R. Kendrick (Eds.), *Eloquent images: word and image in the age of new media* (pp. 19-36). Cambridge, MA: The MIT Press.

Bolter, J. (2003b). Theory and practice in new media studies. In G. Liestøl, A. Morrison & T. Rasmussen (Eds.), *Digital media revisited: theoretical and conceptual innovation in digital domains* (pp. 15-33). Cambridge, MA: The MIT Press.

Bolter, J., & Gromala, D. (2003). *Windows and mirrors: interaction design, digital art, and the myth of transparency*. Cambridge, MA: The MIT Press.

Bolter, J., & Grusin, R. A. (1999). *Remediation: understanding new media*. Cambridge, MA: The MIT Press.

boyd, d., & Ellison, N. (2007). Social network sites: definition, history, and scholarship. *Journal of Computer-Mediated Communication, 13*(1), article 11.

Brandtzæg, P. (2010). Towards a unified Media-User Typology (MUT): a meta-analysis and review of the research literature on media-user typologies. [doi: DOI: 10.1016/j.chb.2010.02.008]. *Computers in Human Behavior, 26*(5), 940-956.

Brennan, S. (1990). Conversation as direct manipulation: an iconoclastic view. In B. Laurel (Ed.), *The art of human-computer interface design* (pp. 393-404). Reading, MA: Addison-Wesley.

Buxton, W. (2007). *Sketching user experience: getting the design right and the right design*. San Francisco, CA: Elsevier.

Card, S. K., Moran, T. P., & Newell, A. (1983). *The psychology of human-computer interaction*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Carroll, J. M. (Ed.). (2003). *HCI models, theories, and frameworks: toward a multidisciplinary science*. San Francisco, CA: Morgan Kaufmann.

Castelfranchi, C. (2006). From conversation to interaction via behavioral communication. For a semiotic design of objects, environments, and behaviours. In S. Bagnara & G. Crampton Smith (Eds.), *Theories and practice in interaction design* (pp. 157-179). Mahwah, NJ: Lawrence Erlbaum.

Chandler, D. (2007). *Semiotics: the basics* (Second edn.). London: Routledge.

Chang, B., & Ungar, D. (1993). Animation: from cartoons to the user interface. In *Proceedings of the 6th annual ACM symposium on user interface software and technology* (pp. 45-55). Atlanta, GA: ACM.

Cramer, F., & Fuller, M. (2008). Interface. In M. Fuller (Ed.), *Software studies: a lexicon* (pp. 149-153). Cambridge, MA: The MIT Press.

Crawford, C. (2003). *The art of interactive design: a euphonious and illuminating guide to building successful software*. San Francisco: No Starch Press.

Crilly, N., Maier, A., & Clarkson, P. (2008). Representing artefacts as media: modelling the relationship between designer intent and consumer experience. *International Journal of Design, 2*(3), 15-27.

Cross, N. (2001). Designerly ways of knowing: design discipline versus design science. *Design Issues, 17*(3), 49-55.

Cross, N. (Ed.). (1984). *Developments in design methodology*. Chichester: John Wiley & Sons.

Darley, A. (2000). *Visual digital culture: surface play and spectacle in new media genres*. London: Routledge.

de Souza, C. S. (2005). Semiotic engineering: bringing designers and users together at interaction time. *Interacting with Computers, 17*(3), 317-341.

Dorst, K. (2008). Design research: a revolution-waiting-to-happen. *Design Studies, 29*(1), 4-11.

Drucker, J. (2009). *SpecLab: digital aesthetics and projects in speculative computing*. Chicago: University of Chicago Press.

Ehn, P. (1998). Manifesto for a digital Bauhaus. *Digital Creativity, 9*(4), 207-217.

Eikenes, J. O. (2009). *Social navimation: engaging interfaces in social media*. Paper presented at Engaging Artifacts, the 3rd Nordic design research conference (NORDES). Retrieved from http://ocs.sfu.ca/nordes/index.php/nordes/2009/paper/view/246/133

Eikenes, J. O. (2010). Connecting motional form to interface actions in web browsing: investigating through motion sketching. *FORMakademisk, 3*(1), 80-100.

Eikenes, J. O., & Morrison, A. (2010). Navimation: exploring time, space & motion in the design of screen based interfaces. *International Journal of Design, 4*(1), 1-16.

Erickson, T. (1990). Working with interface metaphors. In B. Laurel (Ed.), *The art of human-computer interface design* (pp. 65-73). Reading, MA: Addison-Wesley.

Erstad, O., Gilje, Ø., & de Lange, T. (2007). Re-mixing multimodal resources: multiliteracies and digital production in Norwegian media education. *Learning, Media and Technology, 32*(2), 183-198.

Fagerjord, A. (2003). *Rhetorical convergence: earlier media influence on web media form*. University of Oslo, Oslo.

Fagerjord, A. (forthcoming 2010). Multimodal polyphony: analysis of a Flash documentary. In A. Morrison (Ed.), *Inside multimodal composition*. Cresskill, NJ: Hampton Press.

Fallman, D. (2003). Design-oriented human-computer interaction. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 225-232). Fort Lauderdale, FL: ACM.

Følstad, A. (2008). Towards a living lab for the development of online community services. *The Electronic Journal for Virtual Organizations and Networks, 10*, 47-58.

Frayling, C. (1993/4). Research in art and design. *Royal College of Art Research Papers, 1*(1), 1-5.

Gay, G., & Hembrooke, H. (2004). *Activity-centered design: an ecological approach to designing smart tools and usable systems*. Cambridge, MA: The MIT Press.

Gedenryd, H. (1998). *How designers work: making sense of authentic cognitive activities*. Unpublished doctoral thesis, Lund University.

Gere, C. (2006). Genealogy of the computer screen. *Visual Communication, 5*(2), 141-152.

Gonzalez, C. (1996). Does animation in user interfaces improve decision making? In *Proceedings of the SIGCHI conference on human factors in computing systems: common ground* (pp. 27-34). Vancouver, British Columbia, Canada: ACM.

Halliday, M. A. K., & Matthiessen, C. M. (2004/1985). *An introduction to functional grammar* (3rd edn.). London: Arnold.

Hallnäs, L., Melin, L., & Redström, J. (2002). Textile displays: using textiles to investigate computational technology as design material. In *Proceedings of the second Nordic conference on human-computer interaction* (pp. 157-166). Aarhus, Denmark: ACM.

Hallnäs, L., & Redström, J. (2006). *Interaction design: foundations, experiments*. Borås: The Interactive Institute, The Swedish School of Textiles, and University College of Borås.

Hayles, N. K. (2002). *Writing machines*. Cambridge, MA: The MIT Press.

Hodge, R., & Kress, G. (1988). *Social semiotics*. Cambridge: Polity Press.

Holmqvist, B. (1993). Face to interface. In P. B. Andersen, B. Holmqvist & J. F. Jensen (Eds.), *The computer as medium* (pp. 222-235). Cambridge: Cambridge University Press.

Hummels, C., & Overbeeke, K. (2010). Special issue editorial: aesthetics of interaction. *International Journal of Design, 4*(2), 1-2.

Hummels, C., Overbeeke, K. C., & Klooster, S. (2007). Move to get moved: a search for methods, tools and knowledge to design for expressive and rich movement-based interaction. *Personal Ubiquitous Computing, 11*(8), 677-690.

Hussain, S., & Keitsch, M. (2010). Cultural semiotics, quality, and user perceptions in product development. In S. Vihma (Ed.), *Design semiotics in use* (pp. 144-158). Helsinki: Aalto University, School of Art and Design.

Ishii, H., Ben-Joseph, E., Underkoffler, J., Yeung, L., Chak, D., Kanji, Z., et al. (2002). Augmented urban planning workbench: overlaying drawings, physical models and digital simulation. In *Proceedings of the 1st international symposium on mixed and augmented reality* (pp. 1-9): IEEE Computer Society.

Jeamsinkul, C., & Poggenpohl, S. (2002). Methodology for uncovering motion affordance in interactive media. *Visible Language 36*(3), 254-280.

Johnson, S. (1997). *Interface culture: how new technology transforms the way we create and communicate*. San Francisco, CA: Harper Edge.

Jonas, W. (2007). Design research and its meaning to the methodological development of the discipline. In R. Michel (Ed.), *Design research now: essays and selected projects* (pp. 187-206). Basel: Birkhäuser.

Jørgensen, A. H., & Udsen, L. E. (2005). From calculation to culture: a brief history of the computer as interface. In K. Bruhn Jensen (Ed.), *Interface://culture: The World Wide Web as a political resource and aesthetic form* (pp. 39-64). Frederiksberg: Samfundslitteratur Press.

Jørgensen, H. (2009). *Interfaces as games: a proposed model for developing animated interfaces.* Aalborg University Copenhagen, Copenhagen. Retrieved from http://www.heinojorgensen.dk/resources/InterfacesAsGamesFinal.pdf.

Kaptelinin, V. (2002). Making use of social thinking: the challenge of bridging activity systems. In Y. Dittrich, C. Floyd & R. Klischewski (Eds.), *Social thinking—software practice* (pp. 45-68). Cambridge, MA: The MIT Press.

Kaptelinin, V., & Czerwinski, M. P. (Eds.). (2007). *Beyond the desktop metaphor: designing integrated digital work environments*. Cambridge, MA: The MIT Press.

Kaptelinin, V., & Nardi, B. A. (2006). *Acting with technology: activity theory and interaction design*. Cambridge, MA: The MIT Press.

Kay, A. (1984). Computer software. *Scientific American, 251*(3), 41-47.

Keitsch, M. (2010). A postmodernist approach to product semantics. In S. Vihma (Ed.), *Design semiotics in use* (pp. 24-39). Helsinki: Aalto University, School of Art and Design.

Kiousis, S. (2002). Interactivity: a concept explication. *New Media Society, 4*(3), 355-383.

Kirby, D. (2010). The future is now: diegetic prototypes and the role of popular films in generating real-world technological development. *Social Studies of Science, 40*(1), 41-70.

Kirschenbaum, M. G. (2004). "So the colors cover the wires": interface, aesthetics, and usability. In S. Schreibman, R. G. Siemens & J. Unsworth (Eds.), *A companion to digital humanities* (pp. 523-542). Oxford: Blackwell.

Kress, G. (1998). Visual and verbal modes of representation in electronically mediated communication: the potentials of new forms of text. In I. Snyder (Ed.), *Page to screen: taking literacy into the electronic era* (pp. 55-80). London: Routledge.

Kress, G. (2000). Text as the punctuation of semiosis: pulling at some of the threads. In U. Meinhof & J. Smith (Eds.), *Intertextuality and the media: from genre to everyday life* (pp. 132-154). Manchester: Manchester University Press.

Kress, G. (2010). *Multimodality: a social semiotic approach to contemporary communication*. London: Routledge.

Kress, G., & van Leeuwen, T. (2001). *Multimodal discourse: the modes and media of contemporary communication*. London: Arnold.

Kress, G., & van Leeuwen, T. (2006/1996). *Reading images: the grammar of visual design* (2nd edn.). London: Routledge.

Krippendorff, K. (2006). *The semantic turn: a new foundation for design*. Boca Raton, FL: CRC Press, Taylor & Francis group.

Kuutti, K. (2009). HCI and design - uncomfortable bedfellows? In T. Binder, J. Löwgren & L. Malmborg (Eds.), *(Re)searching the digital Bauhaus* (pp. 43-59). London: Springer.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.

Laurel, B. (1991). *Computers as theatre*. Reading, MA: Addison-Wesley.

Laurel, B. (Ed.). (1990). *The art of human-computer interface design*. Reading, MA: Addison-Wesley.

Laurel, B. (Ed.). (2003). *Design research: methods and perspectives*. Cambridge, MA: The MIT Press.

Lemke, J. L. (1995). *Textual politics: discourse and social dynamics*. London: Taylor & Francis.

Leont'ev, A. N. (1977). Activity and consciousness. In V. Kulesov (Ed.), *Philosophy in the USSR: problems of dialectical materialism* (pp. 180-202). Moscow: Progress Publishers.

Leont'ev, A. N. (1978). *Activity, consciousness, and personality*. Englewood Cliffs, N.J.: Prentice-Hall.

Liestøl, G. (1999). *Essays in rhetorics of hypermedia design.* Department of Media & Communication, University of Oslo, Oslo.

Liestøl, G. (2003). "Gameplay": from synthesis to analysis (and vice versa). In G. Liestøl, A. Morrison & T. Rasmussen (Eds.), *Digital media revisited: theoretical and conceptual innovation in digital domains* (pp. 389-413). Cambridge, MA: The MIT Press.

Liestøl, G. (2009). Situated simulations: a prototyped augmented reality genre for learning on the iPhone. *International Journal of Interactive Mobile Technologies (iJIM), 3*, 24-28.

Liestøl, G., Morrison, A., & Rasmussen, T. (Eds.). (2003). *Digital media revisited: theoretical and conceptual innovation in digital domains*. Cambridge, MA: The MIT Press.

Lim, F. V. (2004). Developing an integrative multi-semiotic model. In K. O'Halloran (Ed.), *Multimodal discourse analysis: systemic-functional perspectives*. London: Continuum.

Linell, P. (2009). *Rethinking language, mind, and world dialogically: interactional and contextual theories of human sense-making*. Charlotte, NC: Information Age Publishing.

Lister, M., Dovey, J., Giddings, S., Grant, L., & Kelly, K. (2009). *New media: a critical introduction* (2nd edn.). Oxon: Routledge.

Loke, L., Larssen, A., Robertson, T., & Edwards, J. (2007). Understanding movement for interaction design: frameworks and approaches. *Personal and Ubiquitous Computing, 11*(8), 691-701.

Löwgren, J., & Stolterman, E. (2004). *Thoughtful interaction design: a design perspective on information technology*. Cambridge, MA: The MIT Press.

Machin, D. (2007). *Introduction to Multimodal Analysis*. London: Hodder Arnold.

Mackay, W., Ratzer, A., & Janecek, P. (2000). Video artifacts for design: bridging the gap between abstraction and detail. In *Proceedings of the 3rd conference on designing interactive systems* (pp. 72-82). New York, NY: ACM.

Mäkelä, M., & Routarinne, S. (Eds.). (2006). *The art of research: research practices in art and design*. Helsinki: University of Art and Design Helsinki.

Manovich, L. (2001). *The language of new media*. Cambridge, MA: The MIT Press.

Martinec, R. (1998). Cohesion in action. *Semiotica, 120*(1/2), 161-180.

Mayfield, A. (2006). What is social media? Available from http://www.icrossing.co.uk/fileadmin//uploads/eBooks/What_is_Social_Media_iCrossing_ebook.pdf

Mazé, R. (2007). *Occupying time: design, technology, and the form of interaction*. Stockholm: Axl Books.

Mazé, R., & Redström, J. (2005). Form and the computational object. *Digital Creativity, 16*(1), 7-18.

McDonagh, D., Goggin, N., & Squier, J. (2005). Signs, symbols, and subjectivity: an alternative view of the visual. [doi: DOI: 10.1016/j.compcom.2004.12.009]. *Computers and composition, 22*(1), 79-86.

McMillan, S. (2000). Interactivity is in the eye of the beholder: function, perception, involvement, and attitude toward the Web site. In *Proceedings of the 2000 Conference of the American Academy of Advertising* (pp. 71-78). East Lansing, MI: Michigan State University.

McMillan, S. (2002). Exploring models of interactivity from multiple research traditions: users, documents, and systems. In L. Lievrouw & S. Livingstone (Eds.), *Handbook of new media: social shaping and consequences of ICTs* (pp. 163-182). London: Sage.

Michel, R. (Ed.). (2007). *Design research now: essays and selected projects*. Basel: Birkhäuser.

Michl, J. (2002). On seeing design as redesign: an exploration of a neglected problem in design education. *Scandinavian Journal of Design History, 12*, 7-23.

Michl, J. (2009). E.H. Gombrich's adoption of the formula form follows function: a case of mistaken identity? *Human Affairs, 19*(3), 274-288.

Moggridge, B. (2007). *Designing interactions*. Cambridge, MA: The MIT Press.

Morrison, A. (Ed.). (forthcoming 2010). *Inside multimodal composition*. Cresskill, NJ: Hampton Press.

Morrison, A., & Eikenes, J. O. (2008). *The times are a-changing in the interface*. Paper presented at Multimodality and learning. An international conference.

Morrison, A., Skjulstad, S., & Sevaldson, B. (2007). *Waterfront development with web mediation*. Paper presented at Design Inquiries, the 2nd Nordic design research conference (NORDES). Retrieved from http://www.nordes.org/data/uploads/papers/109.pdf

Morrison, A., Smørdal, O., Lund, A., & Moen, A. (forthcoming 2010). Multiple activity - multiple mediation. Conceptualizing and furthering the use of wikis. In A. Morrison (Ed.), *Inside multimodal composition*. Cresskill, NJ: Hampton Press.

Morrison, A., Stuedahl, D., Mörtberg, C., Wagner, I., Liestøl, G., & Bratteteig, T. (2010). Analytical perspectives. In I. Wagner, T. Bratteteig & D. Stuedahl (Eds.), *Exploring digital design* (pp. 55-103). Vienna: Springer.

Morrison, A., Westvang, E., & Skogsrud, S. (2010). Whisperings in the undergrowth: performativity, collaborative design and online social networking. In I. Wagner, T. Bratteteig & D. Stuedahl (Eds.), *Exploring digital design* (pp. 221-259). Vienna: Springer.

Müller-Prove, M. (2002). *Vision and reality of hypertext and graphical user interfaces.* Unpublished masters thesis, Universität Hamburg.

Munster, A. (2003). Compression and the intensification of visual information in Flash aesthetics. In *Proceedings of the fifth international digital arts and culture conference* (pp. 135-143). Melbourne, Australia: RMIT.

Myers, B. A. (1998). A brief history of human-computer interaction technology. *Interactions, 5*(2), 44-54.
Nadin, M. (1988). Interface design: a semiotic paradigm. *Semiotica, 69*(3/4), 269-302.
Nardi, B. A. (Ed.). (1996). *Context and consciousness: activity theory and human-computer interaction*. Cambridge, MA: The MIT Press.
Negroponte, N. (1995). *Being digital*. London: Hodder & Stoughton.
Niedderer, K. (2004). Why is there the need for explanation? – objects and their realities. *Working Papers in Art and Design, 3*.
Nielsen, J. (2000). *Designing web usability: the practice of simplicity*. Indianapolis, IN: New Riders.
Noble, I., & Bestley, R. (2005). *Visual research: an introduction to research methodologies in graphic design*. Lausanne: AVA.
Norman, D. A. (1990). Why interfaces don't work. In B. Laurel (Ed.), *The art of human-computer interface design* (pp. 209-219). Reading, MA: Addison-Wesley.
Norman, D. A. (2005). Human-centered design considered harmful. *Interactions, 12*(4), 14-19.
Norman, D. A. (2008). Simplicity is not the answer. *Interactions, 15*(5), 45-46.
Norris, S. (2004). *Analyzing multimodal interaction: a methodological framework*. New York, NY: Routledge.
Norris, S., & Jones, R. H. (Eds.). (2005). *Discourse in action: introducing mediated discourse analysis*. New York, NY: Routledge.
O'Halloran, K. (Ed.). (2004). *Multimodal discourse analysis: systemic-functional perspectives*. London: Continuum.
O'Halloran, K., Tan, S., Smith, B., & Podlasov, A. (2010). Challenges in designing digital interfaces for the study of multimodal phenomena. *Information Design Journal, 18*(1), 2-21.
O'Neill, S. (2008). *Interactive media: the semiotics of embodied interaction*. London: Springer.
O'Toole, M. (2004). Opera Ludentes: the Sydney Opera House at work and play. In K. O'Halloran (Ed.), *Multimodal discourse analysis: systemic-functional perspectives* (pp. 11-27). London: Continuum.
Petersen, H., & Nielsen, J. (2002). The eye of the user: the influence of movement on users' visual attention. *Digital Creativity, 13*(2), 109-121.
Poggenpohl, S. (2006). Interaction as an ecology: building a framework. In S. Bagnara & G. Crampton Smith (Eds.), *Theories and practice in interaction design* (pp. 287-299). Mahwah, NJ: Lawrence Erlbaum.
Poggenpohl, S., Chayutsahakij, P., & Jeamsinkul, C. (2004). Language definition and its role in developing a design discourse. *Design Studies, 25*(6), 579-605.
PoId, S. (2008). Button. In M. Fuller (Ed.), *Software studies: a lexicon* (pp. 31-36). Cambridge, MA: The MIT Press.

Prior, P. (2005). Moving multimodality beyond the binaries: a response to Gunther Kress' "Gains and losses". *Computers and composition, 22*(1), 23-30.

Ratti, C., Wang, Y., Ishii, H., Piper, B., & Frenchman, D. (2004). Tangible User Interfaces (TUIs): a novel paradigm for GIS. *Transactions in GIS, 8*(4), 407-421.

Redström, J. (2001). *Designing everyday computational things.* Göteborg University, Göteborg.

Redström, J. (2006). Towards user design? On the shift from object to user as the subject of design. *Design Studies, 27*(2), 123-139.

Redström, J. (2007). En experimenterande designforskning (Experimental design research). In S. Ilstedt Hjelm (Ed.), *Under ytan: en antologi om designforskning (Beneath the surface: an anthology on design research)* (pp. 164-177). Stockholm: Raster Förlag.

Rettig, M., & Wright, A. (2009). From interface to experience. *Interactions, 16*(6), 52-55.

Rheingold, H. (2000). *Tools for thought: the history and future of mind-expanding technology*. Cambridge, MA: The MIT Press.

Rockwell, G., & Mactavish, A. (2004). Multimedia. In S. Schreibman, R. G. Siemens & J. Unsworth (Eds.), *A companion to digital humanities* (pp. 108-120). Oxford: Blackwell.

Rukzio, E., Noda, C., De Luca, A., Hamard, J., & Coskun, F. (2008). Automatic form filling on mobile devices. *Pervasive and Mobile Computing, 4*(2), 161-181.

Rust, C., Mottram, J., & Till, J. (2007). *AHRC research review: practice-led research in art, design and architecture*. Sheffield and Nottingham: Arts & Humanities Research Council.

Saffer, D. (2007). *Designing for interaction: creating smart applications and clever devices*. Berkeley, CA: New Riders.

Schön, D. (1983). *The reflective practitioner: how professionals think in action*. New York, NY: Basic Books.

Schön, D. (1992). Designing as reflective conversation with the materials of a design situation. *Knowledge-Based Systems, 5*(1), 3-14.

Schreibman, S., Siemens, R. G., & Unsworth, J. (Eds.). (2004). *A companion to digital humanities*. Oxford: Blackwell.

Selfe, C., & Selfe, R. (1994). The politics of the interface: power and its exercise in electronic contact zones. *College Composition and Communication, 45*(4), 480-504.

Sevaldson, B. (2010). Discussions & movements in design research: a systems approach to practice research in design. *FORMakademisk, 3*(1), 8-35.

Shneiderman, B. (1983). Direct manipulation: a step beyond programming languages. *IEEE Computer, 16*(8), 57-69.

Sinclair, J., & Coulthard, M. (1975). *Towards an analysis of discourse: the English used by teachers and pupils*. London: Oxford University Press.

Skjulstad, S. (2004). "Flashback": tracing developments from electronic paper to dynamic digital environments in the software Macromedia Flash. In *Proceedings of future ground international conference* (Vol. 2. CD-ROM). Design Research Society/Faculty of Art and Design Monash University, Melbourne, Australia.

Skjulstad, S. (2007). Communication design and motion graphics on the Web. *Journal of Media Practice, 8*(3), 359-378.

Skjulstad, S. (2008). *Mediational sites: a communication design perspective on websites.* Unpublished doctoral dissertation, University of Oslo, Oslo.

Skjulstad, S. (forthcoming 2010). What are these? Designers' websites as communication design. In A. Morrison (Ed.), *Inside multimodal composition*. Cresskill: Hampton Press.

Skjulstad, S., & Morrison, A. (2005). Movement in the interface. *Computers and Composition, 22*(4), 413-433.

Spence, R. (2007). *Information visualization: design for interaction* (2nd edn.). Harlow: Pearson Prentice Hall.

Stock, O., Guerini, M., & Zancanaro, M. (2006). Interface design and persuasive intelligent user interfaces. In S. Bagnara & G. Crampton Smith (Eds.), *Theories and practice in interaction design* (pp. 193-207). Mahwah, NJ: Lawrence Erlbaum.

Stone, D., Jarrett, C., Woodroffe, M., & Minocha, S. (2005). *User interface design and evaluation*. Amsterdam: Elsevier: Morgan Kaufmann.

Sutherland, I. E. (1963). *Sketchpad: a man-machine graphical communication system.* Massachusetts Institute of Technology, Cambridge, MA.

Tatarkiewicz, W. (1980). *A history of six ideas: an essay in aesthetics*. Warzawa: Martinus Nijhoff.

Thomas, B., & Calder, P. (1995). Animating direct manipulation interfaces. In *Proceedings of the 8th annual ACM symposium on user interface and software technology* (pp. 3-12). Pittsburgh, PA: ACM.

Ullmer, B., & Ishii, H. (2000). Emerging frameworks for tangible user interfaces. *IBM Systems Journal, 39*(3-4), 915-931.

Vainio, T. (2010). A review of the navigation HCI research during the 2000's. *International Journal of Interactive Mobile Technologies, 4*(3), 36-42.

van Dam, A. (1997). Post-WIMP user interfaces. *Communications of ACM, 40*(2), 63-67.

van Leeuwen, T. (1999). *Speech, music, sound*. London: MacMillan Press.

van Leeuwen, T. (2005). *Introducing social semiotics*. London: Routledge.

van Leeuwen, T. (2006). Towards a semiotics of typography. *Information Design Journal, 14*(2), 139-155.

van Leeuwen, T. (2008). *Discourse and practice: new tools for critical discourse analysis*. Oxford: Oxford University Press.

Verhoeff, N. (2008). Screens of navigation: from taking a ride to making the ride. *Journal of Entertainment Media, 12*.

Vihma, S. (2007). Design semiotics - institutional experiences and an initiative for a semiotic theory of form. In R. Michel (Ed.), *Design research now: essays and selected projects* (pp. 219-232). Basel: Birkhäuser.

Vihma, S. (Ed.). (2010). *Design semiotics in use*. Helsinki: Aalto University, School of Art and Design.

Vygotsky, L. (1978). *Mind in society: the development of higher psychological processes*. Cambridge: Harvard University Press.

Wartofsky, M. (1979). *Models: representation in scientific understanding*. Dordrecht: Reidel Publishing.

Wells, G. (1994). The complementary contributions of Halliday and Vygotsky to a "language-based theory of learning". *Linguistics and Education, 6*(1), 41-90.

Wells, G. (2002). The role of dialogue in activity theory. *Mind, Culture, and Activity, 9*(1), 43-66.

Wertsch, J. V. (1991). *Voices of the mind: a sociocultural approach to mediated action*. Cambridge, MA: Harvard University Press.

Wood, A. (2007). *Digital encounters*. London: Routledge.

Wood, D. (2007). Form and function in web design: a humanistic perspecive. *Design Principles and Practices: An International Journal, 1*(3), 71-78.

Woolman, M. (2004). *Motion design: moving graphics for television, music video, cinema, and digital interfaces*. Mies: RotoVision.

Zielinski, S. (2006). *Deep time of the media: toward an archaeology of hearing and seeing by technical means*. Cambridge, MA: The MIT Press.

Zimmerman, J., Forlizzi, J., & Evenson, S. (2007). Research through design as a method for interaction design research in HCI. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 493-502). San Jose, CA: ACM.

Part IV: Publications