TECH FASHION

Yanqing Zhang

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Tech Fashion

Fashion Institutionalization in Digital Technology

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To my dear grandmother Cuiqun Han and mother Yingjie Xu.

Abstract

This thesis explores aesthetization in general and fashion in particular in digital technology design and how we can design digital technology to account for the extended influences of fashion. The thesis applies a combination of methods to explore the new design space at the intersection of fashion and technology. First, it contributes to theoretical understandings of aesthetization and fashion institutionalization that influence digital technology design. We show that there is an unstable aesthetization in mobile design and the increased aesthetization is closely related to the fashion industry. Fashion emerged through shared institutional activities, which are usually in the form of action nets in the design of digital devices. “Tech Fashion” is proposed to interpret such dynamic action nets of institutional arrangements that make digital technology fashionable and desirable. Second, through associative design research, we have designed and developed two prototypes that account for institutionalized fashion values, such as the concept “outfit-centric accessory.” We call for a more extensive collaboration between fashion design and interaction design.

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Stockholm, May 2016
Yanqing Zhang

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1 Introduction

> Aesthetics is not a human luxury, but a universal human desire.
>
> -----Virginia Postrel

Human culture has always been oriented toward what is considered to be attractive and beautiful. Philosopher George Santayana once stated, "….the sense of beauty has a more important place in life than aesthetic theory has ever taken in philosophy" (Santayana 2002: 1). Humans do not pursue their aesthetic desire only when basic needs have been satisfied. Beauty is almost everywhere in our life: we stop by a fashion store to appreciate the nicely designed windows; we decorate our smart phones to make them look more beautiful; we hang paintings on the wall or put flowers in a vase for our home; we eat food with beautiful porcelain plates and shining stainless steel forks; we like to go to a café with stylish interior design ….We are living in a world where our aesthetic demands and ideology are projected into the objects around us. Our world is a society of the "spectacle," the "display," the "design," and the "icons" (Sztompka 2012).

Aesthetics concerns the creation, understanding, and appreciation of beauty and art (Dickie 1974). We should not take aesthetics for granted, as if they were merely beautiful surfaces or had not been institutionalized at some precise moment (Benjamin 1968: 10). Taking them for granted will restrict will restrict our understanding of everyday aesthetics. In academia scholars have observed and discussed the pervasive beauty and the demands for aesthetics in modern life. Sociologist Mike Featherstone claims that there is an abundant "aesthetization (aestheticization) of everyday life." Since the late 20th century there has been a growing trend whereby many consumer products, such as homeware or technical gadgets, become part of a "constant search for new styles, new sensations and experiences" (Featherstone 1991:84). Cultural writer Virginia Postrel describes the 21st century as an "age of aesthetics" where people are "demanding and creating an enticing, stimulating, diverse, and beautiful world" (Postrel 2004: 4). The topic of everyday aesthetics is also emerging in contemporary philosophy, which particularly emphasizes an increasingly blurred boundary between high art and mass culture. This blurring is visible in the aesthetization of mundane objects and the experiences of everyday life, such as when we prepare a meal (Duncum 2002; Dowling 2010). These discussions motivate a detailed

and empirical study on the visual aesthetics in everyday objects, such as the ubiquitous mobile phone.

Simultaneously there has been growing research on the relation between aesthetics and technology in the field of Human Computer Interaction (HCI). Its general concern is to understand and influence the ways in which digital technology plays a role in users' "experience, emotion, desire [and] fulfillment" (Wright et al. 2008) and thus extend the classic concern of increasing the uses of computing. Some recent studies (e.g. Quinn and Tran 2010) suggest that the boundary between aesthetics and usability is much less blurred than what was previously expected since attractiveness plays a key role even in the usability ratings. Visual attractiveness is then not only about beauty on the surface, but also influences interaction and usability. Therefore, both the increasing interests of aesthetics in everyday life in social theory and HCI motivate us to explore the aestheticization of ubiquitous digital devices in our everyday life.

In this thesis, we are particularly interested in fashion, which is closely related to everyday aesthetics. Fashion is seen as playing an important role in shaping the ideas of what is aesthetical. It has a long-term orientation toward aesthetics and beautification, which is unpacked and analyzed in fashion studies. There is a strong tradition in aesthetic theories that focuses on the individual's internal state or experience of an appreciated object, such as judgment of beauty, the sensuous emotions, and the imagination. However, in fashion studies, fashion is widely seen as a "social" phenomenon. For example, it represents the ambiguity between individuality and social conformity (Wilson 2003; Simmel 1997); it can also refer to institutionalized arrangements and collective activities that turn clothing into abstract fashion (Crane 2000; Kawamura 2005; Blaszczyk 2009). Moreover, fashion is characterized by novelty and change in both the styles and the ideas of beauty (Kawmaura 2005; Wilson 2003). Compared to aesthetic theories that look for harmony and stability in beauty, fashion studies try to account for the constant variations of beauty and the desire for new trends in fashion.

Despite so many differences, contemporary academics studying aesthetics and fashion do one thing in common—study everyday objects or experience. Fashion has had growing impacts on many domains of everyday life. In the 1990s fashion writer Estelle Ellis, who had rich experience in the industry, gave a public speech on what fashion is at the Fashion Institute of Technology in New York. She treated fashion as a causal agent that had constantly reshaped all material things, from the fabric that surrounds our bodies to the architectural designs (Blaszczyk 2009). More recently fashion scholar Entwistle has emphasized that fashion, as a system of stylistic innovation, is found in other domains as well, such as in architecture and product design (Entwistle 2009). In other words, the objects in fashion studies extend from clothing items to a wider range of designed objects. Interestingly, this echoes the trend in contemporary aesthetic research, which tends to shift the atten-

tion to everyday objects and mundane experiences. In a way, the objects in fashion studies and aesthetic theories, which previously were very different, are now merging. This merge has made discussing both aesthetics and fashion of digital objects possible.

It is no surprise that previous research on the beauty of digital devices tends to discuss how their usage is similar to fashion consumption. Here we focus on mobile phones, which have become one of the most significant gadgets close at hand in our everyday life. Its aesthetic aspects are becoming more important for users, as recorded in the research on mobile phones and fashion. Sociologist Leopoldina Fortunati unpacks the similarities between the consumption of mobile phones and ornaments as deriving from their shared location on our bodies (Fortunati 2005: 41). She argues that mobile phones are increasingly forming an integral part of an individual's look that encloses the material nature of the body and the cultural modernity of fashion (Fortunati 2005: 37). Generally existing research on mobile fashion mainly focuses on mobile adoption as fashion consumption, which express identity and personality (Ling 2003; Katz and Sugiyama 2006; Kasesniemi and Rautiainen 2002).

However, recent institutional views of fashion in fashion studies tell us that fashion exists not only in consumption but also in production and diffusion (Kawamura 2005). There are only a few scattered studies concerning the production of mobile fashion. For instance, Shade (2007) observes the collaboration between mobile companies and fashion designers during the last decade, such as Siemens/Escada, Nokia/Versace, etc. She mentions that strategies utilized in fashionalization mainly include co-branding handset vendors with designers and handsets incorporating fashion elements (Shade 2007). Djelic and Ainamo (2005) focus on the institutional changes within mobile companies, which are influenced by fashion. They show that the mobile industry has been impacted and significantly transformed by the transposition of fashion logics, including symbolic production, mass customization, and short commercial cycles. They also touch upon related issues in fashion production, such as the employment of fashion logics to the mobile industry, but their focus is the organizational changes within mobile companies, rather than the role of fashion in mobile design. Currently there is still a lack of discussion on aesthetics and fashion on the design and production side of digital devices in the existing literature.

In sum, based on the theories of "aesthetization in everyday life," the interests of aesthetics in HCI, and institutional fashion theory, this thesis explores three questions.

Question 1: *Is there aesthetization in the design of digital devices and how does it occur?*

We understand fashion mainly as institutional arrangements that turn an object into a fashion ideal. Production of fashion is then very different from the manufacture of garments. Fashion's connections to aesthetics, its unique

features, and shared position with digital technology on our bodies drive us to explore the role of fashion in the design of digital devices as an example of aesthetization in everyday life.
Question 2: *How does fashion in particular emerge from the design of digital devices?*
Question 3: Once we have sorted out the interplay between fashion institutions and digital technology design, we will further explore: *how can we design aesthetical digital technology to extend the influence of fashion institutions?*

Through these three questions we aim to unpack aesthetization in general and fashion in particular in the design of mobile technology and explore new design space for fashion and technology. The following section discusses the methods and what we have gained through several studies.

1.1 Associative design approach

The three questions framed above will be addressed through a series of methods. Our study does not aim to provide augmented solutions to a well-defined problem, but to explore new design spaces that could benefit HCI research. We are influenced by the approach of "associative design" (Juhlin 2010; Esbjörnsson et al. 2004), which suggests that a design space is likely to emerge from combining and juxtaposing already established domains. According to this method, various studies, design and development activities are tightly associated and participants engage in all the parts to explore a design space.

We have conducted two types of research, which are associated together to explore the design space. The first type concerns empirical studies to investigate the social practices that have led to aesthetization and fashionalization in mobile design. These studies not only help understand the related social practices, but also provide us with design implications, such as proposing a design concept of "outfit-centric accessory". The second type of research applies an approach of Research through Design (RtD). This method emphasizes developing design exemplars that could represent and instantiate design ideas, demonstrate research contributions, and generate new knowledge (Zimmerman et al. 2007; Gaver 2012; Frayling 1993). We have done two design explorations to investigate how to integrate institutionalized fashion values into design.

To conduct the two kinds of research, we have used a mixture of methods, including historical periodization, interviews and qualitative content analysis and building prototypes. They were selected based on their feasibility and the aims of the studies. This is influenced by the sociological research that encourages us to apply a mixture of methods as long as they are suitable to tackle the research question (Flick 2009). In all, combining various ap-

proaches and methods can explore the questions by touching upon a wide range of points, but we are also aware that it could never give a full picture of the area.

1.2 Unpacking aesthetization and fashion in digital technology design

This thesis focuses on how aesthetization in general (Q1) and fashionalization in particular (Q2) shape mobile design. Previous literature on "aestheticization of everyday life," which mainly relies on general observations made by viewing products at a distance, "abounds with folk wisdom but lacks an empirical backing for its theoretical and common-sense view" (Tseëlon 2001: 436). They are important for inspiring new studies, but we need more extensive empirical indications and discussions of both how this trend emerges in particular domains and why it happens.

We mix qualitative methods with quantitative methods for the empirical studies. Researchers in HCI have recognized the uneven use of the two methods in studies on hedonic. They argue that to study the experiential value and the subjective facets of HCI, new methods are needed (Diefenbach et al. 2014). This drives us to apply a mixture of methods in order to study aesthetics, which are not only built on experiential values, but also deeply integrated in social practices. We apply different methods to investigate different questions.

First, we have done a periodization of the changing style of Nokia phones to investigate the connections between aesthetics and mobile design (Paper I). In order to unpack the broader trends that might not be visible in the design of individual devices, we conduct a periodization of a particular history by breaking it into smaller units in order to focus on specific time spans and promote easier recollection (Hollander et al. 2005). We focus on phones designed by Nokia since the company is one of the biggest producers in mobile history and a pioneer in making mobile phones stylish (Djelic and Ainamo 2005). "Aesthetization" is vaguely defined by Featherstone, while Postrel (2004) argues for a slightly more elaborated concept of "stylization" as increased visual variation. Such an approach is also suggested in the design research of interior decoration and cars (e.g. Eskilson 2002). Understanding aesthetization as increased variation allows us to conduct a qualitative content analysis in order to make the periodization. We conduct thorough visual inspections of photos to reveal the visual expression of each model and then use a qualitative approach to group the releases into more generalized categories. The statistics of the phone releases for each year between 1992 and 2013 are visualized diagrammatically (Figure 4-1).

This study provides us with rich empirical materials on the visual trends of Nokia phones. Identification of the visual forms gives insight into the aesthetization preferences of mobile design. Such preferences varied considerably. We have identified four periods: the Candy-bar period, the Color period, the Grand period, and the Slate period. Among them, the Grand period stands out in terms of visual aesthetics, which sees a large variety of forms and an increased integration between fashion and mobile design.

In order to understand why there were such changes, especially regarding why the Grand period emerged, we interviewed some key people from Nokia. The interviews indicate that first, the orientation toward visual aesthetics was initiated in the hope of making the product more personalized and segmenting the market. Second, the increased aesthetization of mobile phones in the period was influenced by an orientation towards fashion institutions. By providing more exclusive and experimental visual features, Nokia attempted to appeal to fashion conscious consumers. The results also show that the demise of visual variations mostly results from the rapid development of touchscreen technology in mobile design.

After the study, we further investigate the emergence of fashion in mobile design (Paper II). To do this we firstly need to clarify how we understand fashion and design. Fashion and design are concepts that contain a variety of perspectives. According to fashion studies and aesthetic theories, fashion differs from aesthetics mainly in that fashion is strictly considered a social phenomenon that is collectively constructed and shaped by various social relations. Drawing from sociologist Yuniya Kawamura's theory of fashionology, we treat fashion as institutional arrangements that involve many individuals and organizations turning clothing into the ideas of fashion (Kawamura 2005). Regarding design, if it refers to all instances of humans making something for human needs (Heskett 2005), it then includes a wide spectrum of categories such as interior, product, fashion, architecture, and system design. If we define design more narrowly as a type of thinking or institutional work, then we can compare it with the institutional view of fashion. Design thinking claims to focus on problem solving (Martin 2009), while fashion thinking emphasizes aesthetics, creativity, and change (Nixon and Blakley 2012). The two forms of thinking make examining fashion in the design of mobile phones possible. More importantly, fashion thinking is nested in a set of institutional arrangements made by relatively stable organizations. Therefore, investigating how fashion emerges in mobile design means examining whether important fashion institutions are influencing mobile design. Institution generally means laws, rules, and conventions that guide social behavior (Scott 2004). Shared institutions are likely where fashion emerges since they are able to turn mobile phones, instead of clothing, into fashion through institutional arrangements that are established in the fashion system.

Based on our interviews with key actors in both the fashion industry and the mobile industry, we find that there are shared institutions between the

two industries, such as trend research. These institutions are embedded into the concrete activities in mobile design that actually lead to the generation of mobile fashion. The concrete interactions between mobile design and clothing fashion reveal an ongoing engagement with fashion in mobile design. However, these influences follow complicated patterns that seem to be different from what Kawamura has discussed regarding the fashion system. Her fashion-ology is oriented around a structural-functional view of fashion institutions and treats agencies and organizations like salient parts within a whole system. However, our empirical materials show that the shared institutions tend to be socially constructed. This evidence points to another perspective in organization theories—constructivism—which interprets reality as socially constructed and contextually dependent (Berger and Luckmann 1991:15). The constructionist view sees organizations as heterogeneous and fluid things that are constantly being made and in which multiple actors face new types of challenges. We are particularly interested in Czarniawska's action net theory, which aims to illuminate how collective actions are tested, repeated, or dropped in a process where actors make "connections" that either dissolve or are stabilized (Czarniawska 2008). Our study shows that fashion in mobile phone design is formed through "action nets," i.e. loose connections generated from repeated actions into which words, images, or ideas can be translated. The action net of mobile fashion coexists with other action nets, which makes fashion in mobile design less explicit than in clothing fashion.

The two studies (Paper I and Paper II) reveal that mobile design piggybacks on the fashion industry through concrete activities, such as shared institutions. After these studies we turn to fashion diffusion to further investigate mobile fashion. We conducted a qualitative content analysis of mobile phones in online fashion media to see how mobile phones are institutionalized into fashion items from the perspective of fashion insiders (Paper III). Online fashion media is one of the important gatekeeping mechanisms in fashion diffusion and also provides available empirical materials for aesthetic experience in fashion practices. We found a limited number of posts on mobile devices in the empirical materials. This finding may mean that something is missing in mobile design. Through studying these limited materials, we propose the concept of outfit-centric accessory and discuss how this could influence the design of fashionable digital devices. The concept emphasizes the following features regarding the visual beauty of accessories:

- Visual beauty that is publicly available
- Visual beauty that matches the ensemble/outfit
- Visual beauty that adapts to variation of outfits

These features reflect a common understanding of fashion accessory, which could be seen as examples for institutionalized values in fashion. Thus, if we

design digital devices that account for these values, the technology would likely gain more interest among fashion conscious consumers.

Through our empirical studies we attempt to demonstrate that fashion emerges in mobile design from concrete interactions with institutions shared with fashion. These interactions are best understood as flexible and dynamic action nets of institutional arrangements that can be selectively used and integrated to make digital devices fashionable. We propose the term "Tech Fashion" to account for these considerations in order to design fashionable digital devices.

1.3 Designing for "Tech Fashion"

To investigate our third question, we take a Research through Design (RtD) approach (Zimmerman et al. 2007; Gaver 2012). The goal of this approach is to generate design implications through a concrete design exemplar, rather than offer a solution to an existing problem. The exemplar emphasizes the designed artifact as an outcome in which the knowledge generated is also embedded (Zimmerman et al. 2007). The knowledge intends to be "generative and suggestive" rather than provide generalization through falsification (Gaver 2012). In the second part of the thesis, we explore the new design space through developing two concrete design exemplars.

Our design work is interdisciplinary. The design process in each case combines the knowledge of related research, inspiring theories from various domains, fieldwork, and consideration of technical conditions, orienting toward an associative design approach developed by Juhlin (2010). Such an approach suggests that different research and design activities are closely associated in exploring new design spaces. Specifically we combine three types of studies.

First, we use fieldwork as a source of design implication. We particularly highlight studying social practices to generate knowledge that has potential design implications. This study does not identify problems through giving the participants tasks nor does it result in detailed design requirements, but rather it observes an activity that is relevant to the topic. In our case, we observe the matching of clothes and accessories in dressing practices. Paper IV focuses on clothing matching practices, while Paper V explores wristwatch and smart watch matching practices.

Second, instantiations are applied as concrete exemplars of design implication. This is the core of the RtD method. The instantiations take the form of possible design concepts embodying an abstract property or feature. Their main aim is to support the understanding of the related abstraction. Our design explorations result in two types of design exemplars. One is the low-fidelity prototype, an imagined shape-switching device represented by a series of mock-ups; the other is the relatively high-fidelity experimental pro-

totype, a functional smart watch application "Watch for Figuracy." Both of them provide instantiations for designing public visual aesthetics that match an outfit and can vary according to the changes of outfits. The former explores new hardware inspired by emerging technology, such as organic interfaces; the latter explores how to design a combination of hardware and software.

Third, user studies are conducted for empirical validity of design implication. Our user studies aim to see how potential users might interact with new designs in order to generate information on desirable experiences and social practices, rather than test how well the design functions. Thus, we use qualitative interviews instead of quantitative measurements to get early feedback on the two design exemplars. Furthermore, we explore how the participants would use the designs in their matching practices. For both cases the participants have created many outfits or ensembles that integrate the design exemplars (Paper IV and Paper V).

In sum, this thesis provides two concrete instantiations, which demonstrate that we can create something innovative and interesting based on learning from the new design space of mobile technology and institutional fashion. Designing fashionable technology should not simply mean accessorizing a device with shells or embed sensors into a piece of fabric. Rather, it should mean entering a complex ecosystem of fashion, including its rules, institutions, and values.

1.4 Contributions

This thesis investigates how aesthetization in general and fashion in particular occur in digital technology design and how we could design digital technology to account for the extended influences of fashion. First, it complements the increasing discussions of aesthetics in the field of HCI. Human computer interaction researchers have recognized that merely focusing on the usability and functionality of new technology is no longer enough. There should be a more holistic understanding of user experiences consisting of both functionality and aesthetical aspects. Aesthetics are seen as playing an important role in fulfilling the demands of emotion, desire, and fulfillment that users have when using technology. While we celebrate the expansion of the vision in HCI, we should also be aware that discussing aesthetics in everyday technology is more complex than simply borrowing notions from the aesthetic philosophy that HCI researchers find relevant to their topics. The pragmatist aesthetic theory has been very influential in HCI probably because some of the arguments from this theory fit well with the vision of HCI. However, in aesthetic theories, the pragmatist approach has been criticized and caused many debates. Furthermore, our empirical studies show that the features of aesthetic experience listed by John Dewey seem unable to fit

some aesthetic experiences, such as those in fashion. Therefore, we argue that more attention should be paid to studying social practices to generate design implications. Doing so would complement the inspirations generated from philosophical thinking.

Second, this thesis contributes to a better understanding of the role aesthetics and fashion play in digital technology design. We understand beauty and fashion as emerging from social relations and cultural contexts, which we term the "relational" view. This is generally lacking in the studies of related topics in HCI. We propose the term "Tech Fashion" to account for an institutional view of fashion in digital technology design. The term suggests that interactions producing fashion in technology design should be understood as dynamic action nets. The flexible integration of institutionalized fashion values turns digital devices into fashionable items in the design process.

Third, the two design cases concretely demonstrate how the new design space at the intersection of institutional fashion and digital technology can contribute to practice-based designs. Designing fashionable technology does not mean making shells, attaching ornaments, or making computers in the form of clothing items like the technology industry has tried, but instead should mean applying fashion thinking and institutions. Our design explorations show the opportunities and challenges designing in this way.

2 Theoretical Background

This thesis aims to investigate the role of aesthetics in general and fashion in particular in digital technology design. It is necessary to examine the theories on related topics before we further investigate the research questions. This chapter deals with the existing research in both topics and is broken into two sections. The first section is on aesthetic theories and the second section is on fashion studies. Each section begins by presenting the main approaches or views and ends with discussions of the studies in HCI literature.

2.1 Aesthetic theories

Aesthetics is generally concerned with grounding or philosophically legitimating judgments about art and beauty (Dickie 1997). It asks questions like what is the essence of beauty? When is beauty generated? Why do we see something as beautiful? How do we perceive beauty? Although art is not the same as beauty, it is perhaps the most important subject of study in aesthetic theories, especially in classical studies. Art theory is here considered as a sub-discipline of aesthetics. This section presents important approaches to the study of beauty and the main approaches of studying aesthetics in HCI. We summarize three views based on different forms of epistemological thinking: (1) beauty in objects or beauty in the visual form and expression of the objects, (2) beauty in minds or beauty as something abstractly constructed in our minds, regardless of whether this beauty is sensuous feeling or intellectual judgment, and (3) beauty in relations or beauty emerging from social relations. These different aesthetical dispositions are presented in three sub-sections. For each of them we introduce the relevant arguments of key philosophers and sociologists. The fourth sub-section concerns the research on aesthetics in the field of HCI.

2.1.1 Beauty in the objects

Some philosophers argue that beauty emerges out of the reason or logic of the form of objects. This means that we judge things to be beautiful by discovering the principles and concepts in the form or expression of an object. The philosophers who hold this view tend to have an objective view of beauty, treating beauty as existing in the form of objects and outside the human

mind. They argue there are universal rules in beauty. If this is correct, the human perception of beauty is passive since we perceive something beautiful when an object presents its beauty in the visual form through a set of universal principles, such as order, harmony, and perfection.

This sort of thinking could be traced back to ancient Greek philosophy. Greek philosophers were generally considered to be the earliest source of aesthetic discussions in western thinking. Plato claims that an object is beautiful by virtue of its participation in the abstract "Form of Beauty," which transcends the world of sense (Dickie 1997: 7). He believes that beautiful objects incorporated proportion, harmony, and unity among their parts. Similarly, Aristotle argues that the universal elements of beauty were order, symmetry, and definiteness (ibid).

The most representative philosophers that held such a view are German rationalists from the 18th century. For example, Christian Wolff defines beauty as the perfection of an object: "Beauty consists in the perfection of a thing, insofar as it is suitable for producing pleasure in us" (Wolff 1968: 420). Perfection is a crucial concept in his theory and means "harmony" or "concordance" of a manifold or multiplicity of objects or parts of objects (Wolff 1962: 390). Another key figure in proposing universal rational principles in beauty is Alexander G. Baumgarten, the initiator of "aesthetics" as a branch of philosophy. According to him, beauty has much to do with the expressions in the form of objects that show rational logics. The order and expressions in the appearance of objects represents "the harmony of the thoughts" (Baumgarten 1750: 8). Perfection is conceivable in the harmony of the order and in the internal consensus of the order with itself and in its consensus with the things (ibid: 9).

In sum, such a view emphasizes the objectivity of beauty in the physical form of an object.

2.1.2 Beauty in the mind

Contrary to the previous view that focuses on objective beauty in material forms, other philosophers argue that aesthetics emerge in the mind of humans through sensory experiences. This is the view of empiricist philosopher Hume who says, "beauty and deformity, are not qualities in objects, but belong entirely to the sentiment" (Hume 1870: 139). There are several focuses within this theory.

First, beauty is argued to exist in our imagination. For instance, Joseph Addison argues that beauty is in the imagination of humans and the pleasure of taste, for example, is a pleasure of the imagination. There are two types of pleasures of the imagination. The first is the "primary pleasures of the imagination," which are generated when we are looking at some physical objects; The second is "secondary pleasures of the imagination," which flow from the ideas of some objects when the objects are not in front of us but are rec-

ollected in memories (Addison and Steele 1879: 122-3). Additionally, Archibald Alison discusses the "association" as a way to evoke imagination. He argues that any part of the material world is able to become beautiful when it is associated with a certain quality of mind, which evokes "the emotion of taste." An emotion produces a thought that is typically represented by an image in the imagination. The first thought leads to a second thought, then a third, and so on, which creates a whole unified train of images formulated by the association of ideas (Alison 1811). Therefore, the association of ideas plays a role both in the construction of "the emotion of taste" and supplying the basis for the expressiveness of the material world (Dickie 1997: 19). Many modern aestheticians who specialize in art theory treat the beauty of art as something in the imagination, such as R. G. Collingwood (1938) who sees art as expressionist imagination.

Second, beauty emerges from sensuous feelings and emotions. For instance, Francis Hutcheson argues that aesthetic perception is not a form of cognition or knowing something but rather sensuous feelings. According to him, humans have a "sense" in perceiving beauty or a power that enables pleasure to "strike us at first with the idea of beauty" rather than pleasure arising from "any knowledge of Principles, Proportions, Causes, or the Usefulness of the Object" (Hutcheson 1726/2004: 25). In other words, the ideas of beauty grant us immediate pleasure. Thus, beauty is connected to sensuous feelings as opposed to rationality or instrumentality.

There is a strong focus on feelings arising from sight in classic aesthetic theories. Traditional objects of aesthetic theories are artworks such as paintings and sculptures and nature, such as mountains and sunset, both of which are visually presented to us. Joseph Addison emphasizes the sense of sight, as he states that the pleasures of the imagination "arise originally from sight" (Addison and Steele 1879: 30).

However, in recent years, a few philosophers attempt to propose a turn from the focus on the sense of sight to other senses. The most representative philosopher with such a view is Richard Shusterman, who emphasizes aesthetic feelings emerging out of bodily interaction. He particularly emphasizes the body as "a locus sensory-aesthetic appreciation (aisthesis) and creative self-fashioning [...], devoted to the knowledge, discourses and disciplines that structure such somatic care or can improve it" (Shusterman 2000: 267). Inherent from Dewey's pragmatist aesthetics, he further proposes that bodily and mental (as well as cultural and biological) dimensions of humans are essentially inseparable. To emphasize this unity, he uses the term "soma" which, unlike "body," does not automatically connote passive flesh contrasted to dynamic soul or mind (Shusterman 2000).

Third, beauty is considered to be a concept originating from intellectual thinking or judgment. Immanuel Kant is perhaps the most representative philosopher that contributes to the theory of aesthetic judgment. He agrees that beauty exists in the human mind. However, he does not believe that

aesthetics is always subjective and completely sensuous. Instead, he treats aesthetics as "reflective judgment," which means that the appreciation of beauty involves intellectual thinking, such as seeking a new concept. Thus, aesthetics is rather mental acts that "bring a sensible particular under some universal" (Kant and Meredith 1988). To illustrate the "universal" in aesthetic judgment, he develops two concepts, "disinterested" and "universal." As one of Kant's most influential concepts on aesthetics, "disinterested" refers to a non-instrumental or purposeless judgment on aesthetic objects. "Universal" refers to the key feature of the faculty of taste. His argument for the universality of the faculty taste rests on the assumption that aesthetic judgment always leads us to expect others to agree with us. It is our faculty of judgment that enables us to have the experience of beauty and to grasp those experiences as part of an ordered, natural world with purpose. Kant insists that universality is the product of features of the human mind and that there is no objective property of a thing that makes it beautiful.

In sum, the view of "beauty in the mind" argues that aesthetics emerge in the mind of humans, such as in the imagination, sensuous feelings, or intellectual judgment.

2.1.3 Beauty in relations

There is another perspective that treats beauty as originating from social relations. This perspective is prevalent in art theory. It looks into the social and cultural conditions that shape and produce art, rather than look at what is going on in our mind as most philosophers do. The focus here is the socially shared and collectively organized practices that underpin aesthetic judgment. Aesthetic judgment is then invoked to endow performances and products with value (Atkinsen 2009: 70). There are basically two approaches to examine the relations where beauty exists.

First, some sociologists emphasize the economical and social structures that determine our taste. For instance, sociologist Karl Marx believes that economic and social conditions and the class relations that derive from them have strong impacts on every aspect of an individual's life. The impact goes from religious beliefs to cultural frameworks, including aesthetics (Marx 1978). This view highlights that an individual's sense of beauty is dependent on the economical, political and social structures of a society. Marxist aesthetics have influenced many contemporary philosophers and sociologists, such as Theodor W. Adorno, Walter Benjamin, Georg Lukács, and Raymond Williams. Although aesthetics represent only a part of their writings, they generally share Marx's arguments on social aesthetics. For example, Adorno emphasizes that art is embedded in society as a whole and argues that modern art is "the social antithesis of society" (Adorno and Kentor 2002: 8). The artwork has an internal truth content, which is historical and firmly tied to specific societal conditions. Benjamin highlights the political functions of

art. In his famous work "The Work of Art in the Age of Mechanical Reproduction (or Reproducibility)" (Benjamin 1968), which is representative of Marxist aesthetic theory, Benjamin intends to construct a theory of art that would be "useful for the formulation of revolutionary demands in the politics of art." He argues that previously art has been invented to serve the needs of distributing traditional and ritualistic values. As those values began vanishing in the age of mechanical reproduction, modern art, such as films and photography, would inherently be built on the practice of politics. He writes:

> Mankind, which in Homer's time was an object of contemplation for the Olympian gods, is now one for itself. Its self-alienation has reached such a degree that it can experience its own destruction as aesthetic pleasure of the first order. This is the situation of politics, which Fascism is rendering aesthetic. Communism responds by politicizing art"(Benjamin 1968:242).

In other words, modern art becomes a weapon for politics. Consequently, beauty emerges from power relationships in society.

Moreover, Pierre Bourdieu, one of the most influential sociologists to write on taste, investigates why people have different individual tastes through extensive empirical studies. He proposes that it is mostly due to the different cultural capitals they own. Cultural capital is a significant notion in his theory and means non-financial social assets that can promote social mobility, such as education (Bourdieu 1984). Those who have a high amount of cultural capital have more influence over what constitutes taste within society, while those with lower volumes of overall capital accept this taste. Through cultural capital the distinction between high and low culture is created legitimately and naturally. Taste functions "as a sort of social orientation," guiding people in certain social spaces towards the social positions corresponding with their properties (Bourdieu 1984: 466). Thus, taste is an important example of how class fractions are determined by the possession of social, economic, and cultural capital.

The second view sees beauty and art as produced in social activities where many actors are involved, such as in institutionalization. This theory is popular in contemporary art theory. Philosopher George Dickie (1974) suggests that the sociological institutions of the art world were the glue binding art and sensibility into unities. He argues that a work of art is on the one hand, an artifact, and on the other hand, it is a set of aspects of which has had the status of candidate for appreciation conferred upon it by some person acting on behalf of a certain social institution within the art world (Dickie 1974). The central notions in the making of art are "inflected, that is, they bend in one, presuppose, and support one another" (Dickie 1997: 92). Howard Becker's *Art Worlds* (1982*)* is a classic work that proposes a systematic sociology of art. He demystifies art as expression of genius artist and instead, argues that art is socially constructed by various individuals and or-

ganizations, such as a network of material suppliers, distributors of art works, fellow artists, critics, and audiences. Artist and curator Nicolas Bourriaud proposes the term "relational aesthetics" to illustrate "a set of artistic practices which take as their theoretical and practical point of departure the whole of human relations and their social context, rather than an independent and private space"(Bourriaud 2002: 113).

In addition, the pragmatist aesthetic theory is worth mentioning. It emphasizes aesthetics' emerging from the interactions between humans and the "environment," or the world in which humans live (Dewey 2005). For instance, Dewey states, "the career and destiny of a living being are bound up with its interchanges with its environment, not externally but in the most intimate way" (Dewey 2005: 12). The environment can be interpreted in many ways, such as the social-historical dimension of our appreciation of art, which is in line with Marxist aesthetics, or as "an integral part of the ethos and institutions of the community" (Dewey 2005: 13-14), which reflects the view that beauty originates in social and collective activities.

Ultimately, beauty originating in social relations has been a crucial topic in modern sociology. The first approach for such a topic suggests that aesthetic judgments are determined by economic and social structures and there is a commodification of beauty in capitalist society. A second view focuses on the social activities that lead to the generation of art and beauty.

2.1.4. Aesthetics in human computer interaction (HCI)

Research in HCI has paid increasing attention to the role of aesthetics in our interactions with technology. Aesthetics is applied to understand the "non-quantifiable, subjective and affect-based experience" of interactive technology rather than usability (Tractinsky 2000: 128). In the following we give an overview of the main approaches HCI uses to study aesthetics.

Beauty in the object

Aesthetics is seen as the quality of beauty in objects (Hallnäs and Redström 2002; Lim et al. 2007). For instance, Sonderegger et al. (2014) argue that the term aesthetics is used to refer to "the objective exterior properties of the product." Hallnäs and Redström (2002) then argue that the exterior properties of products are beautiful if they emerge out of the inner logics of the physical features. They argue that there should be a focus on aesthetics in understanding the ways in which we live with technology rather than merely seeing technology as a tool with specific functions. They understand "aesthetics" as "logic of expressional," which is concerned with how material creates expressive things. They argue:

> Good design from an aesthetical point of view basically is a logical question, not primarily a question of psychology, ethnography, sociology, etc. It is a

> basic axiom here that it is through the force of its inner logic, its consistent appearance that a thing receives depth in its expression and thus its strength to act as a placeholder for meaning. Behind each expressive thing present in our lives there is an expressional with a strong form. (ibid: 116)

Thus, the form of the expressive object represents an inner logic and acts as a placeholder for meaning. This can be seen as a normative approach that defines particular descriptive attributes of the product as expressing inherent "beauty" (Hallnäs and Redström 2002; Ngo and Byrne 2001), such as symmetry or proportion. This approach starts from the materials and results in rules that provide a guide of how to design something attractive. It emphasizes that design styles are inherent by arguing the identification of these rules is independent of the people providing design preferences and the social background. Then the focus is on the appearance of a design.

Apart from design aesthetics is also discussed in computer science. For instance, the term "computational aesthetics" was created in 2005 to revisit the biased view of "aesthetic pollution" as a side effect of computer-aided design and support improving computational methods by adding aesthetic awareness (Hoenig 2005). This concept treats beauty as the inner logic or mathematical principle in the form and design of a system that could be computational and measured. This has greatly influenced the area of Graphics, Visualization, and Imaging within computer science.

Beauty in the mind

Aesthetics is also understood as perceptions of beauty in the mind in HCI. There are different focuses within this perspective. First, beauty is derived from or treated as sensuous emotions. HCI researchers recognize that aesthetics plays an important role in fulfilling users' emotional demands, such as "experience, emotion, desire, and fulfillment"(Wright et al. 2008). They highlight sensuous emotions as key features in identifying "engaged" and "aesthetic" experience, such as satisfying, enchanting, disappointing, or frustrating. This focus is in line with the strong psychological tradition within HCI research. For instance, as early as the 1980s, Donald Norman's works on emotional design, such as *The Design of Everyday Things (2014)* and *Emotional Design (2004),* became very influential in interaction design and HCI in general. By viewing beauty as originating in sensuous emotions, the aesthetic aim of interaction design becomes designing for emotional feelings, pleasure, and attraction and assumes that users "wanna have fun" (Wright et al. 2008). The researchers also suggest an empathetic understanding of materials as well as users in design.

Moreover, some HCI researchers underscore the senses that generate emotions. This is particularly visible in the concept of "aesthetic interaction," which is influenced by pragmatist aesthetic theory. This theory, as represented by John Dewey's work, emphasizes that beauty emerges from

balanced senses. This motivates HCI researchers to examine other senses other than vision, especially touch. Petersen et al. (2004) extend the recognition of the value of beauty to our engagement with technology and suggest that aesthetic interaction should not only concern immediate visual appearance, but also include the interaction. They argue that focusing on visual appearance is "leaving out much of the potential of aesthetics" (ibid: 270), which leads to a focus on bodily movements and touch. In recent years, some HCI researchers follow Shusterman's "somaesthetics," which particularly focuses on the attunement of the body-mind or soma (Shusterman 2000). This concept treats aesthetics as something vividly felt and subjectively savored by affectively absorbing us and focusing our attention on its immediate presence. Its impacts on HCI can be found in practical applications, such as physically engaging mobile services and artworks that trigger reflection on bodily movements and physiological status (Fagerberg et al. 2004; Schiphorst 2009).

Second, some researchers argue that beauty exists in the holistic and complete experiences where sensuous emotions and intellectual thinking are united (Löwgren 2009; Wright et al, 2008; Norman 2004). Beauty in the experience is rooted "in the way in which this object is meaningful and transforms the perceiver's understanding, making enjoyment so much deeper" (Fiore et al. 2005: 130). Wright and McCarthy (2008) see aesthetic experiences with technology as being founded in the interplay between language, sensation, and emotion, and constituted by the processes of sense making. Petersen et al. (2004) argue that an aesthetic experience of an interactive system is comprised of both a bodily sensation and an intellectual challenge. This view derives from the pragmatist aesthetic philosophy, which is represented by the philosophy of John Dewey. Pragmatist aesthetics suggest that aesthetical experience is a unified whole, since it is not only in the emotions, but also includes intellectual thinking, such as sense-making. Each part relates to the total action in a meaningful way and is felt by the experiencer as having a unity or a wholeness that is fulfilling (Dewey 2005: 58). During the meaning-making process, the parts come together to give a sense of culmination or consummation that gives unity to the whole (ibid: 5).

Third, beauty is also considered as judgment made by the users. This perspective is empirically concerned with what users judge to be beautiful (Hassenzahl 2004; Tractinsky 1997). What is important is the judgment of "beauty," rather than qualities in the objects. There is a large amount of empirical research on aesthetic judgments and preferences (e.g. Lavie and Tractinsky 2004; Roberts et al. 2003; Tractinsky et al. 2000). In general, these studies contribute to a better understanding of people's overall impressions or general user satisfaction. Moreover, some studies using this approach also address the question of how people judge beauty in relation to other product attributes, such as usability. The boundary between aesthetics and usability is much less blurred than previously expected since attractiveness plays a

key role in usability ratings some argue (Quinn and Tran 2010; Sonderegger et al. 2014). But attractiveness does not always have a positive effect on what people perceive as useful. For example, Angeli et al. show that the link between aesthetics and usability is more complex than the strong claim of "what is usable is beautiful." The view of beauty as judgment takes a psychological stance. It suggests cognition as the foundation of interaction and sees the designer as an analyst aiming to meet objectively identifiable requirements in design. It mainly applies quantitative measurement in usability evaluation, which has been the main method to study the hedonic aspects in HCI (Diefenbach et al. 2014).

In sum, the view of "beauty in the mind" plays a significant role in the research on aesthetics in HCI. Although these studies agree that beauty exists in the human mind, there are differences among viewpoints. Beauty is understood as sensuous emotions, the aesthetic feelings of bodily interaction, a holistic unity of sensuous feelings and sense-making, or aesthetic judgment and preferences.

Beauty in relations

There is another approach that treats beauty as something existing neither in objects nor in the mind, but in the social relations where we interact with others in specific contexts. Some researchers in HCI suggest that aesthetics are not a priori in the world but a potential that is released in dialogue in which self, others, and technology are constructed as multiple centers of value (Dewey 2005; Wright et al. 2008). Aesthetics are based on valuable use-relations influencing the construction of our everyday life. Similar to some of the viewpoints in previous sections, this approach is also influenced by pragmatist aesthetics, namely that aesthetic experience should account for the "environment" in which it occurs (Dewey 2005: 12). The pragmatist approach of aesthetics provides a new way of seeing experience with technology, a "felt" experience that is "creative, open, and relational" (McCarthy and Wright 2007). Such an approach to the aesthetics of interactive systems also implies that aesthetics are tightly connected to context, use, and instrumentality, all of which circumscribe our aesthetic perspectives. According to this view, thinking of aesthetics of things in themselves is meaningless. Things may contain an aesthetic potential, but its release is dependent on context and use. This view of aesthetics in digital technology emphasizes the individual user's ability to interpret and explore the system in a certain context. The contexts become an invisible container for users' interactions with technology.

In addition, a few studies focus on the social and institutional shaping of aesthetics. For example, in their empirical study of craftsmen in the US and Taiwan, Bardzell et al. (2012) aim to enrich the design research community's notions of quality by turning to the techniques and values of master craftspeople. They find that understandings of quality as attributes and

craftsmanship are mutually constituted through an ongoing social accomplishment. They also discuss the role policies play in the development of a craft, i.e. how they impact the individual and the community.

Many more studies have a holistic understanding of the aesthetic experience, and social aspects thereby become one dimension of such experiences. For instance, psychologist Marc Hassenzahl (2003) proposes a complex model in which "varying situations" is one of the key elements of user experience. Angeli et al.'s (2006) work on the assessment of aesthetics and usability argues that judgments of aesthetics and engaging designs are highly dependent on context. In other words, when the context is less formal, aesthetics can have a strong halo effect; however, this may not be generalized for other more serious user/application contexts. Both these studies consider social contexts as one dimension for aesthetic experience.

Until now, we have presented various views of understanding beauty in aesthetic theories and HCI.

Aesthetic theories in general and aesthetics studies in HCI share the three approaches of understanding beauty: (1) beauty in the objects, (2) beauty in the mind, and (3) beauty through relations. In particular, the first approach on aesthetics in HCI seeks universal principles of beauty in the visual form of designed objects and tends to separate beauty from cultural and social contexts. This is akin to Greek aesthetic theory and German rationalist aesthetics. The second approach concerns beauty in the mind. With this view beauty is said to arise from sensuous emotions and reflects Hume and Hutcheson's aesthetic arguments. Beauty can be derived from a holistic unity of emotions and sense-making, which is shared with the views from pragmatist aesthetic theory represented by John Dewey. Beauty is also argued to derive from judgment, echoing Kant's theory. Beauty is also argued to come from relations, such as the interactions among people, technology, and the world, and this theory is also influenced by the pragmatist aesthetic theory.

Existing studies on aesthetics in HCI have touched upon many important points derived from aesthetic theories. Although theoretical discussions on such topics are relatively few, there are a large amount of empirical studies on aesthetics in HCI that are oriented towards the analytical or psychological views of beauty in the mind. Researchers in HCI have called for a need to rethink aesthetics beyond this view (Fiore et al. 2005). These researchers propose a pragmatist view, which "supports a more artistically oriented idea about design, more able to account for the roles of emotion, engagement, the separation between objects-subjects and events unfolding unplanned as a normal feature of the instability of existence" (ibid: 129). Pragmatist aesthetics, especially John Dewey's theory, has become influential in the field. In seeking an alternative way to explore how to meet human needs and desires when engaging with interactive systems, the pragmatist aesthetic theory has been valuable. On the one hand, we recognize the contribution that pragmatist aesthetic theory has brought to this field, such as highlighting the every-

day aesthetic experience and the social and contextual aspects of experiences. On the other hand, the Platonic features of this philosophy, for example, an experience that is harmonious, sensually balanced, and unified, make us doubt how far we could get if we continue using this theory in design oriented research.

Meanwhile, we are also aware that there are a lot of theories on aesthetics that focus on social relations where beauty emerges from various perspectives. Unlike philosophers that rely on philosophical reasoning to make their arguments, sociologists observe what is going on in the world between people and society. A sociological aesthetics or beauty in relations focuses on the social, cultural, or institutional production of beauty. However, this perspective is still absent in the studies of aesthetics in HCI. Therefore, we call for a more profound understanding of aesthetics in HCI, and for HCI researchers to be unconstrained in their use of aesthetic theory.

2.1.5 Conclusion

This section presented the three major approaches in aesthetic theories and how HCI researchers approach aesthetics, as Table 1 summarizes. If beauty is seen as an objective attribute in an object as the rationalist view suggests, the task of creating beauty for a designer in HCI is to find out the universal principles in the physical expression of that object and attempt to realize it in the design. If beauty arises in the mind from the sensuous experiences of objects, then the task becomes designing an object that has the potential to provide aesthetical appraisals. The view of beauty in social relations emphasizes that beauty is contextualized to relate to other individuals or institutions, rather than being generated by organs and neurons. Then the task of creating beauty becomes accounting for the various relations and using them to build beauty ideals. As far as we see, the relational view of beauty has been underestimated in research on aesthetics in HCI. In this thesis we use a combinational understanding of beauty to explore the aesthetics of digital technology. Similar to the view of "beauty in the object," we attend to the visual forms of digital objects that could be candidates for aesthetic appreciations. However, we do not see visual beauty deriving from the inner logic of a form, but rather from the complex interactions with the environment and contexts, as the relational view of beauty suggests. According to this view, the visual form of beauty in different objects would vary and be presented in diversified ways since it is socially constructed by various actors and institutions.

Table 1 An overview of aesthetic theories and aesthetics in HCI

Beauty	Aesthetic theories	Key philosophers	Aesthetics in HCI
In the objects	Harmony and perfection in the form;	Greek philosopher: Plato; Aristotle German rationalists: Christian Wolff; Alexander G. Baumgarten	Inner logic of expression in the form of objects Design studies/ computational aesthetics
In the mind	Imagination	Joseph Addison Archibald Alison	
	Sensuous feelings; emotions	Francis Hutcheson Joseph Addison	Emotions; Sensuous feelings; bodily interaction
	Intellectual thinking and judgment	Immanuel Kant	Sensuous plus intellectual thinking/sense-making
In relations	Economic and social structures that shape taste	Karl Marx; Marxis aesthetic theorists Pierre Bourdieu	In a dialogue among self, others, technology and the world; Context/ Pragmatist aesthetics' "environment"; Situation as a dimension in a holistic experience
	Social activities or institutions produce art and beauty	George Dickie Howard Becker	

2.2 Fashion studies

Fashion studies is an area with a strong focus on aesthetics. As fashion theorist Elizabeth Wilson puts it, fashion is "an aesthetic vehicle for experiments in taste" (Wilson 2003:8) that "molds our concept of what is considered beautiful" (Kawamura 2005:79). In the following we will present the key perspectives of understanding fashion in fashion studies, including the perspectives that focus on clothing, the mind, or social relations. Simultaneously we reveal their connections to aesthetic theories. We also review the studies related to fashion in HCI.

2.2.1 Fashion in clothing

The focus on clothing items is clearly evident in studies of fashion design. Fashion designers have to consider color, fabric, silhouette, and proportion to create an attractive clothing item. There are basic rationalist principles that designers have to consider. Some studies reveal those principles in order to facilitate the fashion design process. For instance, McKelvey and Munslow (2011) argue that the "proportion" of designed product is a basic factor to create appeal for consumers. The proper combination of asymmetrical and symmetrical elements in the product and proper rhythm can lift it to the highest level of desirability. This type of study often aims to provide an efficient way for students to grasp basic knowledge in fashion design.

However, fashion design is far more than using rational principles to make clothes. More importantly one needs to be innovative and creative. To reach this goal, deviating from norms and rules is one efficient way. Thus, in fashion, one may see clothing or styles that look "ugly" when assessed using rational principles. Ingrid Loschek (2009) discusses "vestimentary provocation" as one of the strategies to be creative in fashion design. It functions on complex levels of design: "through extreme overforming and/or extreme sexualization of the body, through political-religious associations, or through a provocative presentation of clothing" (Loschek 2009: 39). She argues that creativity in fashion could be reached through a provocative forming or presentation of the clothes on bodies. For instance, Japanese designer Rei Kawakubo shifts padding in dresses until it actually deforms the body, thereby challenging customary aesthetics (ibid: 42). In the Spring/Summer 1997 collection for Comme des Garçons which was named "Body Meet Dress," she under-laid close-fitting jersey dresses asymmetrically at the back, shoulder and hip areas with big pads of cotton wadding. Through the strategy of abnormal deformation, she succeeded in a fundamental provocation (ibid). These provocative designs won her great fame during the Paris Fashion Weeks in the 1970s. This is one of the many examples in fashion showing that, "ugliness," according to rationalist rules, can nevertheless be "beautiful" or attractive.

In sum, the view of "fashion in clothing" sees fashion as manifested in physical garments. It concerns the sartorial practices in fashion design. There are very few studies focusing on the inner logic of the appearance of garments or styles in the academic field of fashion.

More research emphasizes the creative and unconventional aspects in the design of garments. It seems there are hardly any stable universal principles of "fashion" in the form and expression of clothing. We see a great variety of visual expressions of fashionable clothing or looks, which can be contradictory, inharmonious, and imbalanced. The richness of styles and looks is driving researchers from various disciplines to examine the meanings of clothing. Instead of finding universal rules or inner logic, perhaps investigating

why there are so many different forms of beauty that deviate from supposed universal rules is more important.

2.2.2 Fashion in the mind

Some studies argue that fashion is in the mind of humans. This is typically represented in the view of treating fashion as self-expression and a key player in identity construction. According to this view, fashion is seen as the expression of the inner self through clothing and appearance, a way to construct personal identity. Fashion allows you to express who you are and who you want to be. Clothes are treated not only as a shield for the body but rather as an extension of it (Cixous 1994). This enables us to use clothes as an extension of the abstract self. Philosopher Thomas Carlyle (2009) argues that the inner self is to correspond to the outer look and that one's outer self ought to be the expression of a genuine spirituality. According to him, the clothing we wear is a reflection of the inner part of ourselves. A kind of consistency is required so that clothing becomes a communicative tool. In a similar way philosopher Lars Svendsen focuses on fashion as identity construction. He claims "it is the question of fashion's relevance for the formation of identity that has preoccupied me in this investigation, although fashion can of course be analyzed from many different angles" (Svendsen 2006: 11). He claims that fashion is much about expressing one's individuality and clothing is part of the individual, not something external in relation to personal identity. Those studies treat fashion as visual representations of inner self.

2.2.3 Fashion in relations

Fashion historian Christopher Breward provides a broad explanation of fashion:

> It is a practice, a fulcrum for the display of taste and status, a site for the production and consumption of objects and beliefs; and it is an event, both spectacular and routine, cyclical in its adherence to the natural and commercial seasons, [innovative] in its bursts of avant-gardism, and sequential in its guise as a palimpsest of memories and traditions. (Breward 2004:11)

He suggests that fashion is not clothing, but a practice, the production and consumption of objects and beliefs, and the events of a particular kind. His definition of fashion represents another type of approach to understanding fashion, which treats fashion as something originating from social relations. Such a view, which is dominant in fashion studies, has been discussed in various theories.

First, garments become meaningful only when they are in relation to social values and changes. This is particularly evident in the semiotic account of fashion, which treats clothing as signs. A sign is comprised of both the signifier, which is the form; and the signified, which is the content or symbolic meaning. Philosopher and cultural theorist Roland Barthes (1983) proposes a semiotic system of fashion through studying the language of fashion magazines. He argues that the written form of clothing consists of two interrelated classes of utterance. One includes all vestimentary features signifying clothing, like fabric, forms, color and so on, and the other consists of circumstantial features, such as evening, weekend, shopping, and lifestyle. The environment and contexts of clothing are intrinsically part of the language system of fashion. Moreover, Barthes argues that fashion, as a form of "taste," both reflects and inflects people's way of thinking and represents a form of historical and sociological "mentality" (Barthes 1983). He emphasizes that in the semiotic system of fashion, the individual elements never have any value and the signifiers make sense only when they are linked by a group of collective norms. The connotational meaning is a product of cultural beliefs and values. Different beliefs and values generate different meanings. Therefore, as social contexts change, the signs also change.

Clothing as a sign of "taste" enables fashion historians to investigate the transformation of society and culture through studying clothing. Breward (1998) argues that clothing is read and decoded, through which associative meanings are combed out and cultural systems are established. The cultural systems constructed include the symbolic power of the textiles, elements of decoration, and the value entailed in its material and production that might together offer evidence of status, nationality, age, sexuality or date (Breward 1998). In her influential work *Adorned in Dreams*, fashion scholar Elizabeth Wilson focuses on the changing aesthetic styles and their social and cultural meanings. She points out that a key feature of fashion is "rapid and continual changing of styles"(Wilson 2003: 5). She argues that fashion "enacts symbolically the most hallucinatory aspects of our culture" (Wilson 2003: 63). The evolution of aesthetic style reflects the discords in society, such as "the confusions between the real and the not-real, the aesthetic obsessions, the vein of morbidity without tragedy, of irony without merriment, and the nihilistic critical stance towards authority, empty rebellion almost without political content" (ibid). Ultimately, fashion is a mirror of society.

Second, fashion is in the ambiguous area between individuals and society—between differentiation and imitation. Fashion is intrinsically ambivalent. This ambivalence is typically shown in one's desire for being unique while simultaneously belonging to a social community. Sociologist George Simmel claims that people use fashion to satisfy both the need for social adaptation and the need for distinction (Simmel 1997:189). Wilson has similar discussions. She states that fashion "can be a way of intellectualizing visually about individual desires and social aspirations"(Wilson 2003: 9).

Fashion expressions sit uncomfortably between the private territories of our physical body and our social and public beings because "to dress fashionably is both to stand out and to merge with the crowd, to lay claim to the exclusive and to follow the herd" (Wilson 2003: 6). Thus, there is a tension between the requirements of differentiation and imitation, between individuality and society. In this sense fashion is not an individual action but rather an ambiguous social phenomenon.

Third, fashion is communicative to other people in the surroundings. This view treats fashion as a particular type of communication through which people make public fashion statements. This view also emphasizes fashion as personal expression, which is shared with the view of "fashion in the mind." But it does not stop here. It continues to discuss an individual's communication to other people. This communicational view highlights that the aim of fashion is to impress others through making a fashion statement. This statement is inherently *public*. Otherwise it makes no sense to be "in" fashion. Thorstein Veblen's famous notion of "conspicuous consumption" indicates that in order for the consumption to be symbolical, it should be publically visible to others (Veblen 2007 [1899]). Overt consumption in fashion, especially luxurious fashion, is presenting one's tastes for others to see. Wilson also emphasizes the importance of interaction with others in fashionable dressing, as she claims that every person is "a walking collage, an artwork of 'found items', or perhaps something closer to a contemporary installation, changing as it interacts with its audience" (Wilson 2003: 248). Kawamura also argues that fashionable dressing shows one's wishes to "win approval or respect by appearing stylish, sophisticated or chic" (Kawamura 2005: 94). These studies demonstrate that fashion is intrinsically public since its aim is to stand out in front of others. "To be seen" becomes the strong motivation of fashion.

In addition, the publicity of visual aesthetics in fashionable dressing is paid great attention to in the studies that concern social contexts of dressing. Entwistle employs Erving Goffman's theory to discuss the way in which dress is routinely attended to as part of the "presentation of self." She argues that, as an essential part of the public presentation of a person, dressing should take settings into consideration. Most situations, even informal ones, have a dress code, and these impose particular ways of being on bodies in such a way that a social and moral imperative is carried with them (Entwistle 2000: 337). Thus, one needs to consider settings when they select clothes from their wardrobes to create a look.

Fourth, fashion is argued to exist in collective ideals and collective activities. Entwistle argues that fashion is about "clothes that are promoted and popularized as 'attractive', 'beautiful', 'stylish', or 'chic'"(Entwistle 2009: 9). The promotion and popularization usually contain a set of collective activities. John C. Flügel argues that fashion cannot be entirely accounted for through individuals, regardless of whether we look at producers or consum-

ers. For a new style of dress to become fashionable, it must in some way appeal to a large number of people (Flügel 1930: 40). The diffusion of fashion lies in a realm of collective ideals, aspirations, and emotional dispositions. The presence of shared ideals ensures that a distinctive set of forms, both material and mental, will be in circulation at any particular moment, and it is collective ideals that shape the style of any group (Flügel 1930).

Other scholars discuss the collective activities of fashion. Herbert Blumer argues that fashion is a result of "collective selection" and is socially produced by institutional, social, and cultural relations between a number of key players in the industry. In particular, designers choose what garments to show in their collections, while journalists and retail buyers select items as the trend and the fashionable "look" for the next season (Blumer 1969). Diana Crane studies the social construction of fashion and examines the people, networks, and institutions that make up the fashion system. She treats fashion as collective activities, such as "the output of deliberation, conflict, and negotiation within a complex network of institutions and individuals" and as "a symbolic product that anchors cultural dreams and social aspirations" (Blaszczyk 2009:9). Similarly, Regina Lee Blaszczyk argues that fashion is a cultural phenomenon growing out of interactions between individuals and institutions (Blaszczyk 2009:10).

Recently, Kawamura recognized there is a lack of research on institutional factors in fashion studies and consequently attempted to provide a systematic sociological investigation of institutional fashion in her research. She proposes a "fashion-ology," which treats fashion as a system of institutions that produce the concept as well as the practice of fashion (Kawamura 2005: 1). The way garments are transformed into fashion is done through this fashion system, which means institutional and cultural arrangements cause particular cultural objects to be adorned in a specific way. It is this social system that in intricate ways creates the constant fluctuation of taste, and links industrial production to the variations in consumer values (Kawamura 2005). The institutions of fashion can turn any item of clothing into fashion (ibid: 45). Kawamura highlights the role of designers in the system, but meanwhile argues that their works should be legitimized or "recognized" by other members in the cooperative activities through which their works are produced. This is called a star designer system. The legitimization is done by fashion gatekeepers, such as fashion editors and journalists who hold the power of discourse in the industry and can influence the taste of public.

The four types of "fashion in relations" are in line with the social approach to aesthetics. All these discussions reflect the pragmatists' emphasis on the social and cultural "environment" where the interactions among people, objects, and society occur. Specifically, the first type of "fashion in relations" is oriented towards Marxist views of aesthetics, namely that art and beauty are determined by social structures and cultural contexts. The second type that concerns the ambiguous relations between the individual and socie-

ty in fashion corroborates with Bourdieu's theory on the social shaping of taste. The fourth type that refers to the collective activities of fashion is closely related to the institutional view of aesthetics, which argues that creative works in contemporary society are the results of collective production and become art or fashion because they are legitimized by social institutions in the art and fashion world. Only the third type that focuses on the public statement of fashion in social interactions is not well-represented in aesthetic theories.

2.2.4 Fashion in HCI

"Fashion" does exist in HCI literature. There are different ways of understanding fashion in related works, such as fashion in the visual form of objects, fashion as expressing selves, and fashion in relations.

First, a lot of researchers in HCI treat fashion as the visual appearance of objects. Fashion is seen as fabric and clothing. For instance, Fernaeus and Jacobsson (2009) argue that fashion studies is relevant to tangible computing because it essentially deals with physical features such as fabric, texture, transparency, shape, and so on. Some researchers study virtual networks or online social activities that concern clothing and accessories. For instance, Bardzell et al. study fashionistas' shopping for clothing items and content creation behaviors in an online community "Second Life" (Bardzell et al. 2010). Yamaguchi et al. (2014) apply a big-data approach to quantitatively study social influences in an online social network called "Chictopia," a network specialized in fashion, which for them equals clothing. Moreover, there is a large area on fashion in interactive technology within HCI, called "wearable technology," which combines informative technology with textiles or clothing. "Fashionable wearables" refer to designed garments, accessories, or jewelry that combine aesthetics and style with functional technology (Seymour 2008). Some works on this topic investigate the technical challenges that can enable new functionality, such as smart clothes like the "Know Where Jacket," which incorporates GPS technology, and the "Life Shirt" which measures health (ibid). Some works focus on innovative aesthetic expressions generated by new materials or technology, such as color-changing materials or data-driven variations in displays (Dunne 2011). Wearable technology provides publicly available displays that enable immense variations of visual expression. Dunne argues that wearable technology "allows our personal devices to understand our context, activities, and needs implicitly, and shift color, texture, and shape to provide endless customization"(ibid: 42). Fashion is particularly relevant to interaction designers within this context since they start to deal with soft material properties, such as texture, transparency, and shape in objects carried close to our bodies, which are typical design materials for clothing fashion. Fashion is also considered to cover aesthetic qualities in the visual appearance of an object.

For instance, Pan and Blevis (2014) argue that fashion entails visual appearance and qualities of form (hereafter, formal qualities, in the design sense rather than the mathematical sense).

Second, fashion is commonly understood as a key element contributing to identity construction and self-expression. For instance, Perovich et al. (2014) argue that fashion is closely tied to identity and functionality, and the clothes we wear affect our feelings and express them to the world. Pan et al. (2012) explain that their interest in fashion is more closely related to the ways that products are used to express identity and lifestyle. Fashion is considered as a legitimate avenue for identity construction and self-expression that determines how one is perceived and accepted.

Third, there are also some studies that see fashion in relations. A few works concern the public presentation of fashion and attempt to design interactive systems to account for that. For instance, Fernaeus and Jacobsson (2009) argue that fashion concerns how people present themselves to others through their surface appearance. Clothes serve a range of communicative functions, indicating, for example, appropriate behavior, group belongings, and expected interactions. Similarly, Liu and Donath (2006) also claim that fashion should be defined as a public display of signals that sends messages about any valued entity such as money, time, energy, reputation, etc. Fashion exists in a communication process. If one has access to information, such as going to the right places and communicating with the right people, one may disclose this "fashionable" quality in variably recognizable ways.

More researchers understand fashion as social activities or construction, but they use fashion studies as an inspiration to inform other types of design or examine the role of technology in specific social practices. For instance, Pan and Stolterman (2015) were influenced by Kawamura's fashion-ology theory and recognize that "fashion is a social constitution that consists not only of fashion designers, but also consumers, models, advertising, media, and branding." Consequently, they propose that interaction designers should pay more attention to the social constitution of meaning making. Pycock and Bowers (1996) conducted ethnographic work on fashion design in the fashion industry and investigate the role of technology in collaborative work, specifically for Virtual Reality (VR) technology. They aim to study the real world work of design to inform the development of systems.

There are a lot of design studies on new services or systems to support fashion activities, such as trend analysis or dressing and shopping practices. However, they do not study new services for designing digital technology that itself could be fashionable and integrated into the fashion practices. For instance, Shintami et al. (2014) propose a novel algorithm that automatically discovers visual style elements representing fashion trends for a certain season, based on studying fashion show videos. Hayashi and Masuko (2013) develop an innovative system of fashion coordination to help users select clothes from virtual stores or the users' own wardrobes. Their system re-

quires users to manually select clothes and put them together. Other designs provide recommendations for matching clothing items. For instance, Iwata et al. have designed a system that recommends another clothing item from the user's wardrobe, given a separate selected item. The design draws on analysis of outfits available in full-body photographs from fashion magazines (Iwata et al. 2011). Wardrobe has also attracted attentions from HCI researchers and interaction designers. For example, Hughes et al. (2012) design an emotional wardrobe that uses crowdsourcing mechanisms and multimodal language to engage consumers in enriched tactile experiences of garments. Some researchers find that dressing is a social activity and have attempted to design for this feature. Burton et al. (2012) focus particularly on people with visual impairment and test the feasibility of providing them the advice of dressing through crowdsourcing using VizWiz, which is a mobile phone application where participants receive nearly real-time answers to visual questions.

2.2.5 Conclusion

Existing research on fashion in HCI reflects the three approaches in fashion studies (Table 2). First, in HCI fashion is largely seen as the visual appearance of an object or clothing items, which echoes the first approach in fashion studies that sees fashion as the physical garments and accessories. Fashion studies highlights style and aesthetics in fashionable clothing. However, the view of fashion as clothing seems to treat fashion as merely a textile and a medium, emphasizing the functionality of interactive clothing while undermining the aesthetical aspects. Second, fashion is also understood as identity construction and personal expression, which is in line with the second approach to fashion studies. Third, fashion is discussed in relation to social relations. A few works concern the public presentation of fashion and attempt to design interactive systems to account for this understanding. More researchers understand fashion as social activities or construction. However, they only use fashion studies to inform design that is not aesthetically oriented, such as sustainable design. Or they design and implement technology to support social practices through fashion. In sum, fashion in technology, according to HCI researchers, mainly emphasizes visual qualities and personal expression or points to technology that is in the form of clothing or fabric.

By comparing these HCI studies with those in fashion studies we find that, although the three approaches used in fashion studies are all visible in the studies on fashion in HCI, there are differences in focus between the two areas. There are a limited number of studies focusing on fashion in clothing and expressing personality in fashion studies, while both these views are prevalent in the research on fashion in HCI. Furthermore, fashion studies emphasize the relational view of fashion, which consists of four types of relations, while such a view of fashion is significantly less discussed in HCI

Table 2 An overview of approaches in fashion theories and fashion in HCI

Fashion	Fashion theories	Key areas and scholars	Fashion in HCI
In the objects	Visual features of clothing, such as color, textile and silhouette; Proportions; vestimentary provocation	Fashion design	Clothing or fabric (wearable technology) Visual appearance of objects
In the mind	Expression of inner self	Philosophy Thomas Carlyle, Lars Svendsen	Self expression; identity construction
In relations	The meaning of clothing is related to social values and changes.	Semiotics: Roland Barthes Fashion history: Elizabeth Wilson, Christopher Breward	
	Ambiguity between individuality and social conformity	George Simmel, Elizabeth Wilson	
	Public statement to impress people	Thorstein Veblen, Diana Crane, Joanna Entwistle	Technology as public presentation of fashion
	Collective activities and ideals that produce fashion	John C. Flügel, Herbert Blumer, Regina Lee Blaszczyk, Yuniya Kawamura	Fashion as social construction and practices Technology as a supportive tool

research. Within the limited amount of work on the relation view, most of the studies aim to investigate or develop supportive technology to help fashion practices rather than design digital technology that is itself fashionable.

Additionally, the contributions of fashion studies in HCI research are not distinguished, since many of the insights inspired from fashion studies in HCI are not necessarily gained through studying fashion. For instance, the

importance of visual forms and their communicative meanings has already been highlighted in industry design. Gui Bonsiepe (1963) states that the communicative aspects between users and products are some of the most important parts of a theory of industrial design. Meanwhile, the most distinguished features of fashion, such as change, novelty, the ambiguity of fashion identity, and social production are still absent in HCI research.

Based on the literature review, we believe that a more profound understanding of fashion is still needed in HCI. What fashion studies can offer to HCI should not be limited to the existing approaches. HCI can also benefit from the fashion theories such as Kawamura's theory of treating fashion as an institutionalization comprised of cultural arrangements and mechanisms or insights on how to make things beautiful and desirable.

2.3. Fashion studies and aesthetic theories

We have examined the three main approaches in fashion studies. We find that each of them echoes certain points in aesthetic theories. However, we could not conclude that fashion is the same thing as aesthetics in academics. This section concerns the distinguishing features of fashion studies in comparison to aesthetic theories.

First, the objects discussed in fashion studies are dominated by clothing items worn on human bodies, while the objects in classical aesthetic theories are artworks or nature. In a sense, fashion studies mainly concern the aesthetics of human appearance, such as clothes, styles, and decorations on our bodies. In this thesis we focus on fashion when we study beauty derived from digital technology design. This focus is motivated by digital devices' shared position on bodies with traditional fashion items and fashion's long history of creating adornments for our bodies. These devices may need features of fashion items for them to become beautiful and desirable.

Recent fashion studies argue that fashion is seeping into various product domains in consumer society. Entwistle claims that fashion, as a system of stylistic innovation, is found in other domains as well, such as in architecture and product design (Entwistle 2009). Nixon and Blakley (2012) propose that a form of "fashion thinking," defined as a means of generating stories, experimentation, and open-sourcing, is used in the innovation of a broad range of consumer products and services, such as food packaging and automobile design. Therefore, the objects in fashion studies now extend from clothing items to a wider range of objects in everyday life and can include digital devices, such as mobile phones. Interestingly, some theorists, such as pragmatist philosophers, attempt to turn the focus of aesthetic philosophy into everyday experiences where we interact with objects in mundane life. If this focus is followed, aesthetic experience could occur in our way of dressing, gardening, or interacting with mobile phones. By doing so the boundary

between the objects in fashion studies and aesthetic theories becomes more obscure than ever. This obscuring enables us to study the fashion of digital devices as an example of the aesthetics of everyday life.

Second, aesthetic theories concern the issues around beauty. Fashion is also about beauty, but it focuses on particular forms of beauty and taste, such as those that have are characterized by novelty and change. Fashion emphasizes the newness and variation of both the styles and the ideas of beauty. Compared to aesthetics, fashion is changing and looking for new trends. The concept of fashion indicates the latest trends and ideas about what is beautiful and desirable. Beauty in fashion contexts could be obsolete and then its values are decreasing. Fashion's emphasis on variation also influences non-clothing domains. As Nixon and Blakley (2012) argue, non-clothing industries are forced to embrace faster manufacturing cycles if they want to tailor products to the needs of well-informed consumers.

Third, the most influential theories within aesthetics focus on the internal state or psychology of an individual towards an object (i.e. the influential theories focus on the perception and judgment of beauty, sensuous emotions, and imagination). However, fashion is rather a social phenomenon and it only makes sense when it is circulating around people. Fashion is characterized by ambivalence because it not only concerns the expression of a unique self, but also concerns the desire for social conformity. Moreover, fashion in social relations also emphasizes the social construction of the phenomenon. It is an institutionalized system that turns clothing into abstract fashion (Kawamura 2005).

In sum, fashion's connections to aesthetics allow us to study fashion as an aesthetic approach. Its strong emphasis on the relational view indicates that fashion studies might be able to contribute to how we understand the beauty of digital devices in social relations. In this thesis we particularly highlight that fashion is distinguished from clothing. The production of fashion is not equal to the manufacture of garments or accessories. We are influenced by the institutional perspective of fashion and treat fashion as produced through institutional and cultural arrangements that can turn things into the idea of fashion. We also underscore the features of change and novelty in both fashion items and the concept of fashion. For instance, temporal variation will be a key discussion point in both the empirical studies and design explorations of this thesis.

2.4 The body

> Clothes are among the most fraught objects in the material world of things, since they are so closely involved with the human body and the human life cycle. They are objects, but they are also images. They communicate more

> subtly than most objects and commodities, precisely because of that intimate relationship to our bodies and our selves. (Wilson 2003, Foreword vii)

Clothes are important because they are so intimate with our bodies and construct part of the self. Our interests in mobile fashion and wearable devices are highly motivated by the shared body position between the devices and fashionable items. A few sociological studies on the aesthetics of mobile devices show that people's interests in beautifying mobile phones are increasing due to a phone's closer proximity to our bodies (in a manner like clothing items). However, HCI's understanding of human bodies in general differs a lot from the understanding in fashion.

In fashion studies the importance of the body never lays in its biological qualities. The body in fashion studies is a display, an expression, and an image. The naked body is clothed and dressed. As a whole, they construct an appearance of a person, as Arnold puts it, "fashion and make up are used as sexual tactics, to construct an alluring contemporary body, in reference to fashion images"(Arnold 1999: 490). Some argue that dress can enhance sexual attraction because it both reveals and conceals the body (Wilson 2003: 91). In most societies the naked body has to be covered by clothes, and therefore, the dressed body is the actual social front. Meanwhile, clothes not only reveal parts of the body, such as the neck, back or legs for sexual attractiveness, but also shape the silhouette of a body, such as the corset that keeps women's waists tiny or the wide shouldered suits from the 1990s that enhance the masculinity. It might be true that previously women dressed mainly for the gaze of men, but in contemporary society dressing has become more autonomous. Feminist author Faust writes:

> High heels and corsets provide intense kinaesthetic stimulation for women, appealing to the sense of touch but extending more than skin deep. These frivolous accessories are not just visual stimuli for men; they are also tactile stimuli for women . . .(Faust 1981: 49)

The author argues that fashion accessories could also satisfy women's own bodily pleasure. With these stimuli, fashion conscious people treat the body as the place for aesthetical experiments. It is like a piece of white paper where people can paint and draw pictures. Mike Gane argues that the body "… is the site of the action of signs of the fashion system" (Gane 1991: 107). For fashion what matters is the visual look, instead of the internal bio information. The bodily experience in fashion often yields to the public aesthetic appearance. Thus women are willing to sacrifice comfort to appear sexier and more attractive, for instance, by wearing high heels.

On the contrary, the body in HCI, especially when studying or developing wearable technology, is treated as the source for bio-data. Thus, sensors are embedded to get internal bio-information. This kind of technology is devel-

oped mainly for the purposes of health and sport (Dunne 2011; Farren and Hutchison 2004). It is almost taken for granted that the "smartness" of smart clothing lies in getting information of the biological body in order to provide some sort of function. Wearable technology, although in the form of clothes, seems to underestimate the intimate and subtle relationship between bodies and clothes. Instead, it brutally exerts power on bodies, treating them as sick subjects, and a collection of cold, objective numbers. Even in some aesthetics-oriented wearable designs, the variation of display is mostly driven by biometric sensor data or environmental data.

This dissertation tries to shift the excessive attention given to the body as a collection of data to an aesthetically dressed body seen as a site of aesthetical experiment and statement. We understand fashion in a broad way, not as clothing, but as institutional arrangements in social constructions that turn clothing or any item into the abstract concept of fashion. Production of fashion, in this sense, is not the same as garment making, but is a social construction of fashion ideals. This is why we focus on institutional activities in the empirical studies on the generation of fashion in mobile design.

Although mobile phones are becoming closer with our bodies, they are not particularly designed to establish meaningful relations to the fashion items on our bodies. Mobile phones are still something separated from our looks. We emphasize the close relationship between mobile devices and bodies, not in an ergonomical sense, but an aesthetical, vision-oriented sense. We aim to explore how we can design a mobile phone or wearable device with relation to dressing bodies. For us, devices hold equal positions with other fashion items in making an outfit, such as clothing, jewelry, and shoes. The "smartness" of these devices could be derived from how they communicate with other objects on the body, and how they could as a whole contribute to a fashionable outfit. This puts us in the same position as a fashion designer who experiments with different designs on a mannequin to create an idealized look. For us, the body is that mannequin.

2.5 Conclusion

In this chapter we have summarized the related works on aesthetic theories and fashion studies and their applications in HCI. Aesthetic theories include considerable philosophical discussions and some sociological research. There are mainly three approaches of understanding beauty in aesthetic theories, "beauty in the object," "beauty in the mind," and "beauty in relations." We turned to fashion studies in the second part of this chapter since fashion studies particularly emphasize the beauty of people's appearance. As fashion and aesthetics share the same interests in beauty, the approaches to understanding fashion in fashion studies unsurprisingly reflect the three approaches of studying beauty in aesthetic theories. Meanwhile, we also recognize the

differences between the two areas. The literature review reveals that aesthetic theories treat beauty largely according to individual perception while fashion is particularly seen as socially constructed in various relations. However, studies on aesthetics and fashion in HCI seem to have missed the most important differences between fashion and aesthetics. HCI has mostly focused on the perspectives of "in the object" and "in the mind" while little has been studied on the relational approach of beauty and fashion. Even though there are many studies in HCI that concern relations in fashion practices, they tend to separate fashion and technology, using available technology or designing new technology to support the practices. In this way, fashion is considered as a particular context like many other contexts discussed in HCI, such as games, work and school. Digital technology works only as a supportive tool that meets various demands of targeted users. However, if we have a different understanding of digital devices, such as treating them as fashionable items, we might gain new insights on their design. We need to learn from fashion studies in order to make something fashionable and desirable.

Our literature review shows that both aesthetic theories and fashion studies have multiple views and approaches. If HCI wants to benefit from interdisciplinary theories to generate new design spaces, it should have a more thorough understanding of theories on related topics. We should be aware that there are so many different angles in aesthetic theory. Consequently, HCI researchers should not be constrained by one theory. For instance, we could investigate the view of "beauty in relations," which is seldom seen in HCI. Moreover, if we want to investigate relational beauty in digital technology design, we might need to learn from fashion studies, as there is a strong focus on the relational approach to beauty in fashion studies. Because fashion studies theories are more specialized than aesthetic theories, fashion studies provides knowledge of a more concrete aesthetic experience in particular contexts.

3. Methodology

This chapter presents and discusses how the research questions have been investigated and answered in this thesis. The study does not aim to provide augmented solutions to a well-defined problem. Rather, it explores new design spaces based on the social practices that are not sufficiently understood in HCI.

The concept of "design space" is understood as a conceptual space and "a space of possibilities" (MacLean 1991: 203) that designers navigate in order to understand design problems and find satisfactory solutions. The exploration of design space can be understood as a process that sorts out the associations of a lot of heterogeneous forces. This process is in the form of "associative design" proposed by Juhlin (2010). This approach is influenced by Bruno Latour's social theory.

Latour's sociology underscores three points. First, society is formed through individual practices. He argues that society is not the referent of an ostensive definition discovered by social scientists, but is rather performed through everyone's efforts to define it (Latour 1986: 273). Second, non-human materials should hold equal positions as humans in linking us together to form the society. Each performative definition of what society is about is reinforced, underlined and stabilized, by bringing in new and non-human resources. It is the heterogeneous forces that link us together (ibid: 276). Third, he defines sociology as the study of associations. The heterogeneous forces are bound together to create machines and machinations that keep us all in place (ibid: 277).

In accordance with Latour, Juhlin (2010) suggests that a heterogeneous net of studies, including empirical studies, design, and development activities should be associated in order to investigate a particular space. Participants with different backgrounds and expertise in a design project engage in all the parts of the exploration. A design space emerges per se from combining and juxtaposing already established domains. He argues that this approach best suits research that is exploratory as opposed to research attempting to solve a predefined problem.

In our case the domains that offer a lot of possibilities include aesthetic theory, fashion studies, and human computer interaction. We aim to explore *how aesthetization in general and fashion in particular occur in mobile design* and *how we can design digital technology to extend fashion's influences*. The aims are best understood as exploring the design space emerging

from the intersection of aesthetics, fashion, and human computer interaction as opposed to offering a best solution to a predefined problem. We undertake the task by associating two types of research together (Figure 3-1).

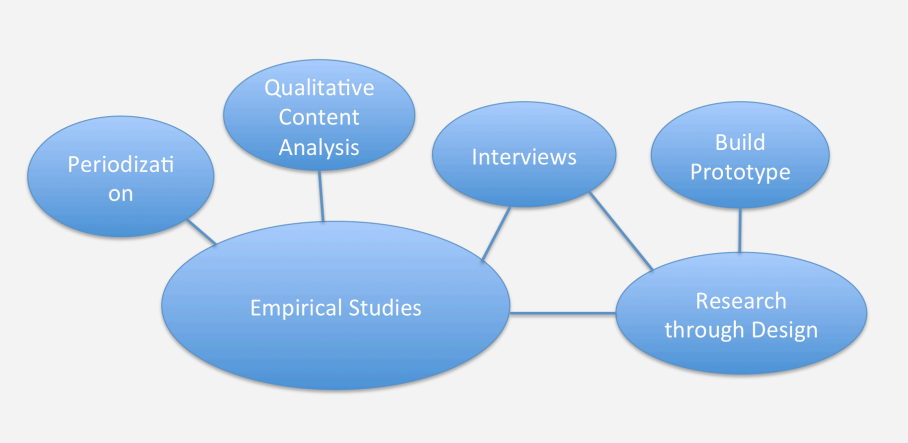

Figure 3-1 An overview of methods

The first type of research consists of empirical studies. They are carried out in order to investigate the concrete social practices that have led to aesthetization or fashionalization in mobile design. Doing such studies is motivated by a lack of empirical support in previous literature on "aesthetization of everyday life," which mainly relied on general observations made by viewing products at a distance (Tseëlon 2001: 436). They are important for inspiring new studies, but we need more extensive empirical indications and discussions of how this trend emerges in particular domains and why it emerges. This analysis is done through a mixture of methods, both quantitative and qualitative. Researchers argue that linking different qualitative and quantitative methods is essential (Kelle and Erzberger 2004). Research topics in sociology tend to be more interdisciplinary and there is a trend combining different methods in sociological studies. For instance, Flick identifies the trends of "hybridization" and "triangulation" in qualitative research. The former is evident in many of the research perspectives and schools, such as ethnography, cultural studies, and grounded theory research. Researchers select multiple methodological and pragmatic approaches to avoid being restricted to a specific methodological discourse. The latter goes beyond the limitations of a single method by combining several methods and giving them equal relevance. Combing or taking into account more methods is becoming more fruitful (Flick 2009). Researchers of one discipline should not avoid using the methods and modes of analysis of other disciplines when these could contribute to an understanding of a particular problem under investigation (ibid). In our case, the studies with different methods not only help understand related social practices but also provide us design implica-

tions. However, although combining various methods can explore the questions by touching upon a wide range of points, it still cannot examine all possibilities. Biskjaer et al. (2014) argue that a design space is a construct based on constraints. The constraints are shown, for example, through the designer's knowledge and experience in response to external conditions, such as the terms of a contract, a design brief, or the materials at his or her disposal. Thus, the methods used to explore new design spaces never give a full picture of the area.

The second type of research consists of design explorations that aim to explore how to design digital devices that can extend the influences of fashion. Design has been shifted from merely problem solving and usability engineering to a broader area that contains creative and explorative practices (Löwgren and Stolterman 2004). The method of RtD was introduced to HCI to emphasize the designed object as an outcome in which the knowledge generated is also embedded (Zimmerman et al. 2007). The knowledge intends to be "generative and suggestive" rather than provide generalizations through falsification (Gaver 2012). We have done two design explorations that investigate the concrete problems emerging out of the empirical studies, such as how to design for public visual aesthetics that can match outfits and adapt to variations.

The following sections present the main methods that have been used to conduct the two types of research in more detail.

3.1 Periodization

We apply a historical perspective to study the everyday object, mobile phones. In order to unpack the broad trends of the changing styles of mobile phones, which may not be visible in the design of individual devices, we conducted a historical periodization. This method is "the process of dividing the chronological narrative into separately labeled sequential time periods" (Hollander et al. 2005). It is not employed simply to disconnect single historical facts or divide time into smaller parts but in order to emphasize the key features and turning points of each period so the variations and evolutions are blatant. Periodization is often performed as a form of historical investigation, and the divisions are based on large amount of empirical material. It can facilitate our understanding of a particular history by breaking it into smaller units and promoting easier recall (ibid).

Taking such a view is influenced by a strong focus on history within fashion studies. Fashion history deals with the changing styles and looks of people in certain historical periods, in which clothing and costumes as the important carriers of social values and meanings are central objects of discussion. Fashion historians have written a lot on the drastic changes of styles, from "New Woman" in 1900, the "poor look" created by Chanel in the

1910s, Dior's ultimate feminine design of "New Look" from after the Second World War, to the "Grunge" style in the 1990s (English 2013). The visual styles of clothing and people become the central features marking a period. The styles of clothing usually integrate particular visual elements, such as the full skirt and tight waist of the "New Look."

We then turn to the historical research of mobile phones. Existing research on such a topic focuses on the technological development of mobile phones, which is like discussing the sewing and pattern making techniques in clothing production, as opposed to the final presentation of the clothes. However, if mobile phones were treated as aesthetical objects, it would be necessary to examine aspects other than instrumental ones, such as the visual features that stimulate pleasure. Some sociologists have argued that historical methods can be very valuable in sociological research since, "if we are to expand our understanding of contemporary life, we must look to the transformations through which we have already passed" (Gray et al. 2007: 243). Similarly, we can argue that if we are to expand our understanding of aestheticization in mobile design, we should look to the transformations of visual appearance through which mobile design has already passed.

We choose to focus on phones designed by one company, Nokia, since the company has been one of the biggest producers in mobile history, and it has been recognized as a pioneer in making mobile phones stylish (Djelic and Ainamo 2005). In order to identity the key features of a period, we conducted a quantitative analysis on images of Nokia phones we have collected. Quantitative methods have been used in the research of dress history. Clare Rose (2010) studies the making and selling of schoolboys' clothes in late-Victorian England by applying a quantitative method to analyze photographs. She argues that the quantitative analysis of separate sources provided a multi-dimensional picture of the topic and gave a firm evidential base for the discussion of clothing practices and their meanings (Rose 2010). In our case, we collected pictures and information of all the models and the release year for each phone via online materials. We were unable to access all physical phone models from Nokia released over the two decades. However, the product photos and information on the looks of the Nokia products are widely available on the Internet, offering another way of accessing the visual features of Nokia phones. The increasing importance of digital technology in everyday life has great impacts on both the content and methodology of sociology. Flick (2009) argues that the Internet could be used as a tool, resource, and issue of research. We argue that online materials can be used as secondary sources for historical analysis.

Online materials in this study include online catalogues and manufacturer information of Nokia phones, official documents from the company and online museum. The diversified information of these materials makes our analysis possible even if the actual objects are absent. In order to facilitate the validation of data, we have collected and cross-verified materials from

four sources. In total 627 models of phones released between 1992 and 2013 were collected. Next we analyzed the form of each item and then developed a set of fourteen aggregated categories (see Figure 4-1) that bring out salient characteristics of the phones' visual expressions and represent all the manifest forms in our corpus. The aggregation is conducted following a qualitative approach whereby themes are developed by attending the visual expression of each item (Patton 2002). The number of releases of the Nokia phones with different forms for each year are grouped and visualized in a diagram. The diagram shows the trends of changing styles of Nokia phones in a direct way, for instance, by showing when there were "ups and downs".

3.2 Interview

Interviews are one of the most pervasive qualitative methods. They offer an easy way to access activities that are momentary, or activities that take place in settings in which recording or observing would be difficult (Brown and Juhlin 2015: 196). This is an effective way for researchers to get people to recall their experiences, actions, or behavior.

This method is appropriate because the social practices that we aim to investigate are somewhat "momentary" or in settings where "observing would be difficult." For instance, the practices done in the past were "momentary" and therefore direct research participation was not possible. Dressing practices are privately done in a setting where observing is difficult, as the field studies before the two design explorations. Interviews are used in three ways in this thesis:

First, interviews are used to gather information from participants that took part in past activities or events in mobile design. These oral reports are valuable materials because they preserve knowledge, experiences, and objectives of past events (Mårtenson 2012: 113). This kind of interviews is used in the periodization study of style changes in Nokia phones (Paper I).

Second, interviews are used to gather empirical material from the participants of social practices. In order to understand aesthetization and fashionalization in mobile design, we interviewed people who are involved in the mobile design process from both the mobile industry and the fashion industry. Our questions focused on the concrete details of what the interviewees do in their daily work, such as which activities are connected to the fashion industry, who they meet, and where they go. If we want to observe and record these activities like an ethnographer normally does, it means we need to spend significant lengths of time following a few targeted people in various companies, which would be difficult in practice. Thus, interviews are a practical way to collect empirical data of such practices. Furthermore, in our design explorations we highlighted studying social practices before we began designing concrete things. We did so is not to identify problems through

giving the participants tasks nor to gain detailed design requirements, but to observe and better understand a social activity that is relevant to the design ideas. To reach this goal, qualitative methods are more suitable than quantitative methods. Both of our design explorations started with interviews with fashion conscious people on matching and dressing practices.

Third, we used interviews to acquire initial user feedback for our designed exemplars (Paper IV and Paper V). In HCI research, usability tests, which are usually quantitative measurements, are commonly used to examine whether a design is successfully implemented or not. However, our initial user studies are an essential part of the associative design exploration and aim to gain early feedback on our design concepts, instead of testing the functionality. Explorative design drives us to use qualitative interviews to gather user feedback. Since we explore the visual aesthetics in matching and dressing practices, our attention is directed toward the visible features, such as the positions, textile, shapes, and colors of the exemplars, which are to be seen at a glance. Specifically, the interviews for the shape-switching device were done in situ, i.e. at the participants' home next to their wardrobes so that they could easily create outfits with the mock-ups. The interviews were done during their activities, including selecting clothes, and matching the mock-ups to them. The many outcomes from these activities, including mock-ups being situated on different outfit positions, were made possible because the interviewees laid their outfits on the bed or floor so that they were not constrained by practical problems, such as being unable to attach it to the outfit. The interviews getting early feedback for the app "Watch for Figuracy" were mostly conducted outside of the participants' homes, since using the app was not affected by the proximity to their physical wardrobes. Four out of five participants tried the app in the researchers' office. They all used their own clothes as input data and created outfits that matched the color of the smart watch face with their clothes. In both cases, the users created many outfits or ensembles that integrated the design exemplars.

3.2.1 Sampling

For this thesis we needed to look at two groups of people. First, in order to investigate the aesthetization and fashionalization in mobile design, we needed to look at the insiders or experts who play a key role in the design of mobile phones. The second group is fashion conscious people, who we needed to interview for their dressing practices and investigate how they use the design exemplars we have built. Fashion conscious people are those who pay great attention to their external appearance and are passionate participants in image-driven consumer cultures (Wan et al. 2001). They value the brand names of the products they consume; they spend money on clothing and appearance-related products (ibid); they desire up-to-date styles, frequent changes in one's wardrobe, and pleasurable shopping experiences

(ibid). One does not have to be a fashion opinion leader or a fashion innovator to be considered fashion conscious (Nam et al. 2007). To recruit relevant interviewees, we applied different sampling techniques.

First, in order to examine what is going on in mobile design, we applied the method of "snowball sampling" to gather interviewees. Our studies focus on the design of mobile phones, where many individuals are involved. People in different positions may have different impacts on the final products. It is then important to interview the people who play a key role in the process since one in a high position may have a stronger influence on the decision-making process. The interviewees are selected through "snowball sampling," a method in which interviewees are asked who the researchers should meet next. This enables researchers to "follow the patterns of established networks, friendships, and acquaintanceships with like-minded individuals" (Gray et al. 2007:117). It is an invaluable tool for "gaining access to informed and experienced people who may provide in-depth information available nowhere else" (ibid). In our studies we were able to start with someone in a high position in the mobile industry. For instance, in the periodization of Nokia phones (Paper I), we started with Tapani Jokinen, who joined the Nokia design team in 1995 and was head of the mobile phones design portfolio planning at the time of interview. With this method we interviewed five people in total who used to be in critical positions on the company's design group. In the study of fashion's impacts on mobile design (Paper II), we began by interviewing Jeanna Kimbré, a highly relevant person who was head of color and material design at Sony Ericsson at the time. In this position she managed important parts of design at a major mobile producer. In this industry color and material designers are responsible for making the appearance of a mobile device, a process which is aesthetically oriented. Based on her recommendation, the next interview was with Louise Klarsten, CEO of Color House who had sold many trend books to Kimbré's group. Continuing with this method, we interviewed a total of eight people with expertise in either mobile design or fashion trends. Ultimately, interviewing key people in both industries offered rich empirical material. Although they cannot represent all views from either Nokia or the mobile industry, their comments are valuable as they express themselves in concrete terms and provide additional weight to the discussion of "aesthetization of everyday life."

Second, we recruited fashion conscious people through two ways, recommendation or self-report. We did two fieldwork studies on matching and dressing practices before carrying out the design implementations. One focused on matching clothes (Paper IV); the other focused on matching wristwatches and smart watches with an outfit (Paper V). After the prototypes were built, we interviewed fashion conscious people when they were trying out the mock-ups. In most of these studies, the interviewees were recommended as stylish people by our colleagues and friends. Recommendation

indicates that these people have already had some impacts on the people around them and have been recognized by other people as dressing attractively. One exception was the study of wristwatches in dressing (Paper V). Since we could not find any acquaintance with wristwatches, we recruited strangers. The requirements of the interviewees were confirmed through emails when we further contacted those who were interested. In the end, the interviewees selected were self-reported as fashion conscious.

3.3. Qualitative content analysis

Content analysis is a common method for studying all types of content, including language. It enables the researcher to study a large amount of textual information and systematically identify its properties through coding, such as the frequencies of keywords (Krippendorff 2004). This approach could be very quantitative or computer-based, but we use a *qualitative* content analysis. It is a research technique for making replicable, valid inferences from texts (or other meaningful material) from the contexts of their use (ibid; Patton 2002). It aims for the "qualitative data reduction and sense-making effort that takes a volume of qualitative material and attempts to identify core consistencies and meanings" (Patton 2002: 453). The concept of "qualitative," rather than quantitative, makes clear that the analysis moves beyond systematic data coding in identifying trends, and also allows us to interpret the material with theoretical preconceptions (ibid). In our case, the interpretations are informed by fashion studies.

In this thesis we have used qualitative content analysis to analyze two types of materials in written form. The first materials analyzed are the interview transcripts. All the interviews were audio recorded and transcribed into texts. After making them into texts, we read the texts and categorized them into themes that were drawn from fashion studies. For instance, in the study on fashionalization in mobile design (Paper II), we have made three themes: (1) the fashionalization of mobile design, (2) interactions between the fashion industry and mobile design departments, and (3) marginalizing fashion in mobile design. There were sub-categories, such as trend forecasting as a joint locus in the second theme.

The second materials analyzed are the posts collected from online fashion media. We collected posts to investigate how mobile phones are institutionalized into fashionable items. Nowadays, digital technology has drastically changed fashion gatekeeping. Almost all paper fashion magazines have online versions now, and influential bloggers have become a new group of fashion gatekeepers (Kurutz 2011). Both fashion editors in online fashion magazines and fashion bloggers are seen as new fashion gatekeepers who play a significant role in legitimizing the ideas of fashion. Meanwhile we are also aware that these people generate discourse, which is of great importance

for fashion diffusion. In our study we have examined a large number of online fashion magazines and blogs and ultimately collected 145 text entries concerning mobile phones in online fashion media. We then categorized them into six themes according to fashion studies.

Studying online fashion writing is different from interviews. Interviews provide an effective way for getting details of the activities, feelings, and perspectives of a set of participants. Our online data is only in the form of text and image. Because of this data form, capturing detailed feelings of these fashionable people on mobile phones is made more difficult than if we had followed some of them in their ordinary lives or had interviewed them. However, our method has its advantages. First, blogs and online magazines provide readily available empirical materials in areas where gathering data is often a challenge, such as aesthetic experience. Bloggers and editors write down their experiences of looking at a new fashionable phone or holding one in hand. Hence, personal experiences are transformed into words capable of being content analyzed. Second, the Internet provides detailed empirical data from a lot of invisible people compared to qualitative interviews, which only uses a limited number of participants. For this study, what the fashion gatekeepers say about mobile devices, instead of who says, is important. This is different from the other two empirical studies in which we had to find important people. Third, online writings can break the geographical restraints and offer gatekeepers' descriptions and opinions from various places. In a way, the researcher can "reach distant people without traveling" (Flick 2009: 178), while field studies or interviews are usually constrained by geographical locations. Therefore, studying online writings may give the widest range of opinions.

3.4 Building prototypes

In order to investigate how to design for fashion institutions and extend the impacts of fashion, we have done two design exercises in which we turn the design ideas and insights from other studies into concrete instantiations by making prototypes.

We applied a research through design approach to explore how to design digital technology that can account for fashion's institutionalized values. Research through design (RtD) is a method that emphasizes designing instantiations that embed and visualize new knowledge (Zimmerman et al. 2007; Gaver 2012). Instantiation takes the form of possible design concepts embodying an abstract property or feature (Gaver 2012). Its main aim is to support the understanding of the related abstraction. Design objects or exemplars, which can be seen forms of instantiations, are described as physical objects constituting, containing, and constructing knowledge (Pierce 2014). They can be directly understood and used by users as one possible solution

to relevant topics. The core of the RtD approach is that design exemplars are treated as outcomes where the knowledge generated is embedded (Zimmerman et al. 2007). The goal of building the exemplars was to demonstrate a research contribution or a production of knowledge rather than making functional systems.

We have built prototypes that could exemplify the design ideas of "outfit-centric accessory." This idea means to design digital devices for public visual aesthetics that match outfits and increase aesthetic variation. Our goal is to generate design implications through concrete design exemplars, rather than offer a solution to an existing problem.

Our design explorations result in two types of design exemplars. One is a low-fidelity prototype. The other is relatively high-fidelity experimental prototype. The different forms are selected according to the goal of each exploration. A low-fidelity prototype is the visualization of design ideas at very early stages of the design process (Sefelin et al. 2003). The result is a simple prototype developed in a short time. This method has received great recognition in the field for its ability to validate designs and predict large problems at an extremely low cost (Virzi et al. 1996; McCurdy et al. 2006). Inspired from the emerging organic interface technology, we have designed a concept of "shape-switcher," which is a device that could potentially match outfits and adapt to outfit variations. The concept was instantiated in twenty-two shapes made of different textiles and in four colors. Since the technology that may make our design idea possible is in an early development stage, making low-fidelity mock-ups, such as those made of textiles, visualize our design ideas and makes exploring the future use of innovative technology with users at a very early stage possible.

The shape-switching device explores the three dimensional hardware design of a mobile device to create varying public outfit-centric visual aesthetics. More opportunities possibly exist in that hardware is combined with software. Since the combinational approach involves software, we need to develop a functioning prototype that can explore the idea in a manner more like the intended final product. Our second exploration turns to wearable technology, which could provide public visual surfaces with possibilities for endless variations of aesthetic expressions. We focused on smart watches and have developed a smart watch application called "Watch for Figuracy." This design explores the potentiality of designing fashionable wearables through a mixed approach, instead of making an end product with perfect usability. The application can make changes to watch faces in response to the garments people wear. Thus, it provides some fashion "smartness" that is contextually dependent on the wearer's current dressed ensemble. Unlike the shape-switching design that concerns all visual features of a device such as size, color, material, and shape, the smart watch application focuses on one particular visual feature, color, and aims to explore color matching between the smart watch face and the clothing people are wearing. This design is a

functional experimental prototype that makes use of available digital wardrobe software and available algorithms based on color principles. It is a higher fidelity exploration compared to the shape-switcher but is still far from being a mature commercial product.

3.5 Ethical issues

Ethical issues can be discussed from different stages during the research. In the phase of data collecting, we had to consider the ethical issues concerning data collection from individuals and from companies. First, all the interviewees in pre-design studies and initial user studies were informed in advance and signed consent forms (Creswell 2013). Giving the participants consent forms ensures that they know what the interviews would be about and allows us to record the conversations and use them for research. The forms also guarantee that their privacy would be protected during and after the research. Each interviewee signed two copies. He or she kept one and the researcher kept the other. The concrete interview questions, which were highly influenced by the research questions of the thesis, mainly concern visual aesthetic experience, such as matching and dressing, or experiences of our new designs. These questions do not cause physical or mental damage. Second, we had to consider intellectual property when we used materials produced by a company. For example, in the periodization study of Nokia phones, some of the interviewees at Nokia showed us various materials, including power points and videos of general strategies and design decisions for specific phones. We received permission to use these materials for research by signing a contract with Nokia.

When presenting the data in our papers, the participants mentioned are anonymous in most cases, but in two studies (Paper I and Paper II), we gave the names of the interviewees and their titles in the companies. Those two studies aim to provide support for the view of aesthetization in mobile design. The positions of the interviewees (i.e. the insiders of the fashion industry or the mobile industry) were of great relevance in order to contribute to the topics. Therefore, we had to reveal the information of the interviewees to prove that they were in critical positions in the companies. They were informed in advance that we might quote their words in the papers.

This chapter deals with how we investigated the three research questions. We are oriented around an associative design method to investigate the new design space of fashion and technology. In the design process we combined different resources, including theories, empirical data, and available technology. We combined and recombined various studies that consist of both empirical analysis and design prototyping. A multi-disciplinary group of researchers collaborated and communicated in the whole process.

4. Unpacking Aesthetization and Fashion in Mobile Design

This chapter addresses questions on *how aesthetization in general and fashion in particular are taking place in mobile design*. We will start with discussing the history of aesthetization in mobile design. Then we continue to investigate fashion in mobile design and how we can understand the connections between them. Lastly, we turn to fashion institutions to see how mobile phones are turned into fashionable items in the fashion system.

4.1 Aesthetization in the history of mobile design (Paper I)

We have studied aesthetization in digital device design. Cultural critic Virginia Postrel (2004) suggests that there is an ongoing trend of stylization or aesthetization of objects that began in the 1990s. In other words, there is an increased design variation among products of the same type. There is an "aesthetic abundance," and "co-existence of many different styles," as well as heterogeneous and constantly changing manifestations of beauty (Postrel 2004: 9-10). Aesthetization of everyday objects is also a topic in design research. For instance, Cushman and Rosenberg (1991) argue that aesthetics is becoming an additional critical dimension in product attributes. The visual form is a way to impress consumers because it provides sensory pleasure affecting quality of life. Such a trend is visible in the style variation of a single consumer product (e.g. in color variation). The mid 1920s saw an explosion in the use of color for interior fixtures, kitchen appliances, and floor coverings (Eskilson 2002: 26). On a more abstract level, sociologist Mike Featherstone argues that there has been an "aesthetization of everyday life" over the last century where the boundary between art and life is increasingly blurred, which is visible, for example, in the increased attention to media images (Featherstone 2007). These readings of aesthetization in everyday objects motivate a detailed, empirical study on the availability of increased visual aesthetics in everyday objects, such as the ubiquitous mobile phone.

There are some studies in sociology on how mobile phones are consumed as fashionable items (Fortunati 2005; Ling 2003; Skog 2002; Katz and

Sugiyama 2006). But when it comes to the role of aesthetization in the production, we know very little about the mobile industry in general and its connection to fashion in particular. To better understand these relations, we conducted a historical study focusing on the transformations of the visual styles in mobile design in its short history to see the visual trends of mobile phones. We chose Nokia phones for the study because they are one of the largest producers of mobile phones in history, and are recognized as a pioneer in making phones stylish (Djelic and Ainamo 2005).

We develop fourteen aggregated categories that bring out the salient characteristics of the phones' visual expressions and represent all the manifest forms in our corpus, as Figure 4-1 shows. The term "manifest form" is used to refer to a particular type of visual appearance, including shape, silhouette, color, and materials available on inspection of either a single mobile phone model or a series of models.

A mobile phone model points to a specific version of a Nokia phone. Dif-

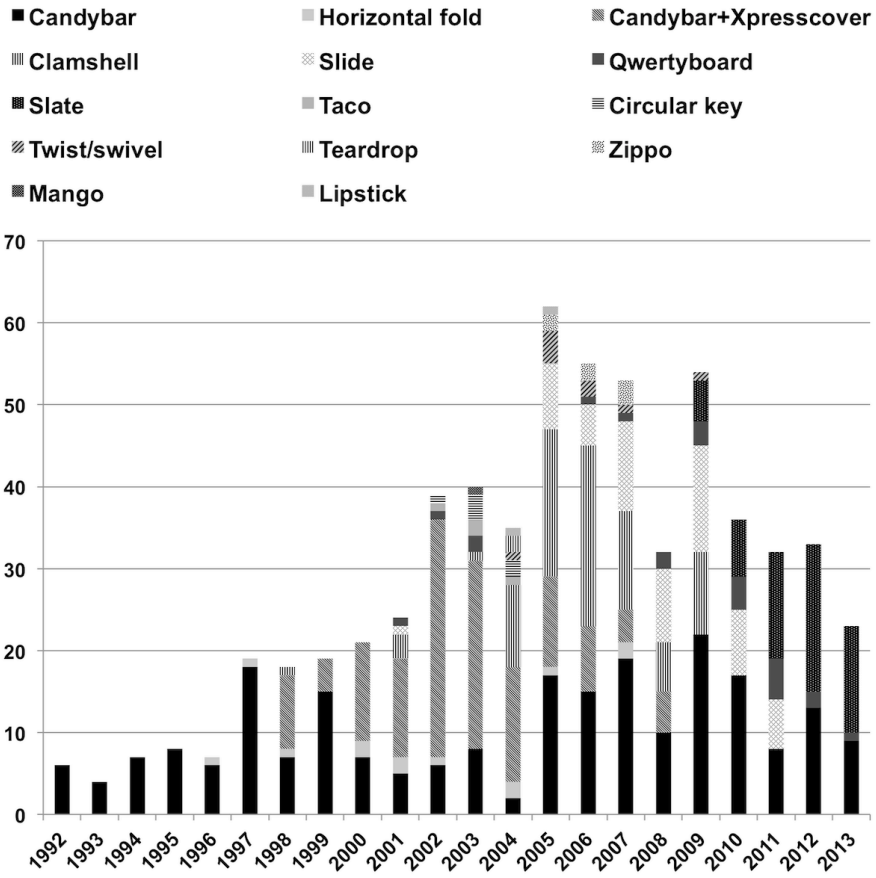

Figure 4-1 The number of models in manifest forms each year between 1992 and 2013.

ferently styled columns in Figure 4-1 represent different manifest forms. Based on the statistics, we further divide the two decades of Nokia phone releases into four periods, which we named, Candy-bar, Color, Grand and Slate (see Figure 4-2). These names reveal the periodization categories, which refer to a higher level of terminology than the manifest form.

1) *Candy-bar period*: From 1992 to 1997 most Nokia phones had a long rectangular shape, similar to that of a chocolate bar, hence the name. The devices had a number of physical keys, and at the beginning of the period some had a visible antenna.

2) *Color period*: In 1998 the Candy-bar shape was complemented with a new design feature, changeable cases, thereby changing the visual expression drastically. The number of models with this feature was 66 out of 121, more than half of all the models in the period. The changeable cases, which are officially called "Xpress-on covers," are removable, allowing consumers to choose a color for the back of their phones from a collection of covers in

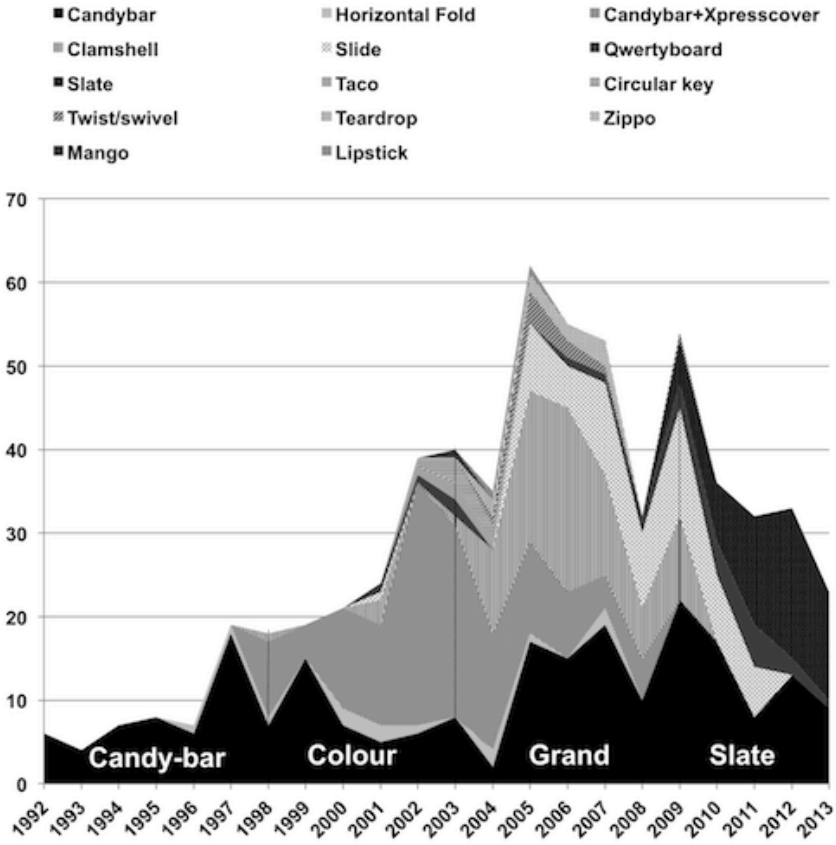

Figure 4-2 Grouping the manifest forms into periodization categories

different colors. Users can easily snap the Xpress-on covers on and off in seconds without any tools.

3) *Grand period*: This period had a much-hyped variation in mobile phone releases combined with a marked orientation towards fashion. The first defining feature is the introduction of new manifest forms. These forms include one manifest form with a large number of models (i.e. the clamshell model) and seven manifest forms, each of which included only a few models and were released during a short time. The second feature is a continuous increase in the number of manifest forms, reaching thirteen in total. In 2004 the release of nine manifest forms marked the peak of visual variation when compared with the both previous periods. Lastly, in this period there was an evident orientation toward the fashion industry.

4) *Slate period*: This period is defined by a decrease in both the total number of releases and the variety of visual expressions. Between 2009 and 2013 the number of models released declined. More importantly, the number of manifest forms was reduced from six in 2009 to three in 2013. From 2009, slate smart phones became the dominant form of Nokia phone releases. These phones take the form of a flat thin slate and rely on touchscreen technology for interaction.

We here emphasize that what is shown in Figure 4-2 is an overall trend, rather than specific aesthetic considerations in the design of a single product. The periodization reveals key features and turning points of visual styles for each period during the decades. The figure also tells us that there were interests in visual attraction in the design of Nokia phones during the past two decades. However, those interests varied considerably. Periods with more variety in appearance indicate that there was more attention and interest in the visual styles of mobile phones. Standing out as a key period is the Grand period. It was preceded by a period where color variation was made possible and succeeded by a decline in the variety of visual aesthetics. This indicates that what previous scholars have discussed as aesthetization of everyday life is not a continuously proceeding trend, but something that varies over time.

In order to understand why there were changes as our periodization depicts, we interviewed a few key people who used to work or were still working at Nokia when the interviews were carried out. Our interviews show that the increasing variation of aesthetics in Nokia phones was socially constructed. Before the Grand period, the visual variation was made possible by the invention of "Xpress-on covers." They were initially designed as a way to visually differentiate one device from another, rather than for beauty. Consequently, the idea of personalization appears to have preceded the orientation toward fashion.

Treating a mobile device as a personal handset indicates that designers need to take into consideration different demands from different consumers. This resulted in the customer segmentation system used internally by the Nokia design team to target different groups. It became a core capability of

the company during the 1990s (Karjalainen and Snelders 2010). Frank Nuovo, the Chief of Design in the 1990s, was the key person in establishing this system in a project called "99." The project was started in 1997 with the goal of designing phones for different customer categories within the next two years. The vision was the result of years of accumulated knowledge. The project proposed a new vision that treated mobile phones like existing wearables, such as watches and pens. This was a mental leap forward in time and predicted what would happen when this emerging technology becomes more stable. The idea of segmentation then became the core idea of this vision. The result was six categories, basic, expression, classic, premium, fashion, and active. Nokia's large customer base was sorted through these abstract categories. The establishment of this system contributed to the birth of the Grand period.

During the Grand period the hyped visual variation was much related to Nokia's intention of getting closer to the fashion industry. By doing so Nokia could gain some influence in fashion and appeal to fashion-oriented consumers. They did this through the following ways: They employed fashion concepts in mobile design, such as the term "collections," used the same trend books as clothing fashion, and collaborated with star fashion designers in designing the hardware of accessories for mobile phones. All these approaches, borrowed from the fashion industry, contributed to the variations of visual aesthetics of mobile phones.

After 2009 the models and visual variation of Nokia phones were remarkably reduced and the category system gradually collapsed. The touchscreen technology has played a critical role in accelerating the process. The designers combined all their previous experience (e.g. customer segmentation and color variation) to create the strategy of rebuilding the brand through focusing on only a few models. However, they seem to have misjudged the stability of the industry. As new touchscreen technology in the Slate period changed visual trends, the mobile device changed from a reliable mobile phone to a device that also supported Internet services. The design team may have rightly understood consumer desires but balanced them poorly with technical innovation. The aesthetization of everyday things seems to be more dominant when the level of technical innovation is relatively low, such as in clothing manufacturing, and becomes more complex when it merges with technical areas.

4.2 Unpacking fashion in mobile design (Paper II)

The historical study of Nokia phones shows that the aesthetization in mobile design was connected to clothing fashion in some ways. This motivates us to further examine the concrete connections between clothing fashion and mobile design.

To unpack the role of fashion in mobile phone design, initially it is essential to discuss the relations between fashion design and other types of design. They all belong to *design*, which is generally defined as humans shaping the environment in ways not present in nature in order to serve our needs and give meaning to our lives (Heskett 2005: 5). Therefore, design is a broad concept that contains a wide spectrum of practices, such as interior design, clothing or fashion design, and product design. Because of this broadness, the identification of fashion practices in mobile design is conflated with the argument that mobile phones are becoming increasingly "designed," despite already having been "designed." If we define design more narrowly, such as ways of "thinking" or institutional work, we will get a different understanding of the overlaps and distinguishing features.

In this thesis we understand fashion as defined by Kawamura (2005): cultural mechanisms or institutions that make objects aesthetical and desirable (Kawamura 2005: 1). If we want to understand how fashion emerges in objects other than garments, we need to understand institutions, such as established and legitimized law, norms, and values (Scott 2004) that make this happen. Thus, we can treat both fashion and design as kinds of institutional work. Meanwhile, we are also aware of the obvious differences between fashion thinking and design thinking. The former focuses on aesthetics, creativity, and innovation in the domain of appearance while the latter emphasizes problem solving and uses a user-centered research method to frame problems (Martin 2009; Pacione 2010). From an institutional perspective, it is the distinctive institutional work in fashion and design that leads to their differences.

4.2.1 Shared institutions between mobile design and clothing fashion

In the case of the emergence of fashion in mobile design, mobile design and fashion design overlap in the sense that they draw on shared institutions. Joint institutions engaged in the concrete interactions between the mobile industry and clothing fashion are especially indicative of the role of institutions, since fashion values in the design objects can then be understood as emerging out of institutional work in the production of said objects.

Our study first shows that institutional work in mobile companies takes the form of concrete activities in the daily routine of designers' work, such as buying fashion magazines and trend books, reading fashion blogs, going to fashion fairs or runway shows, and talking to fashion experts. The mobile industry wants to stay close to the fashion industry to better understand how the fashion industry seduces consumers and hopes to gain a bit of seduction just by being associated with fashion.

Second, the institutional work is socially constructed through coordination and synchronization among different actors. We focused on one particular case of convergence between fashion institutions and mobile design, namely, the use of shared trend agencies. There are basically two perspectives for understanding fashion trends. One is trend analysis, which is a way to analyze where the world is going. It is an analytical process often referred to as "research," in which phenomena are dissected to achieve an aggregated understanding of their components (Brannon 2005: 68). The other perspective sees trends as constructed by social communities or organizations. For example, a color palette is agreed upon at a meeting where specialists bring their own color boards to discuss with each other (Diane and Cassidy 2005: 31). If trends are negotiated in meetings, it is not far-fetched to characterize them as designed or constructed through concrete acts of communication and coordination. The fact that mobile companies intentionally share trend research with the clothing fashion industry, rather than setting up their own trend agencies inside the design department, shows they want a sense of fashion in their design. They know that trend agencies have been creating fashion trends for a long time. Our interviews indicate that the reason why they are especially good at predicting trends might be precisely because they themselves construct the trends.

However, the institutional work generating mobile fashion is marginalized by many other activities and values in mobile design. This makes incorporating fashion more complicated. First, there are stable aesthetic principles that do not have to do with trends, like the "Golden Ratio." This refers to the inner logic through which a thing gains depth in expression. These aesthetic values have sometimes been summarized as principles for product design, such as contrast, symmetry, and harmony (Noble and Kumar 2010: 645). Second, visual design should go together with technical solutions, which in a way restricts creativity in visual design. Finally, material technology constrains color choice. These concerns show that, although institutionalized fashion values have some influence on mobile phone design, they have to compete with other values. This might explain why fashion is less visible in mobile phone design than in clothing. Furthermore, the interaction that leads to fashionable devices occurs not only between the mobile and clothing industries, but also between mobiles and other products, such as automobiles and interior design.

In sum, the concrete interactions we found between mobile design and clothing fashion strengthen the argument that we are increasingly experiencing a diffusion of fashion values in other areas of product design. However, these influences follow complicated patterns that reflect the underlying institutional work.

4.2.2 Mobile fashion as action nets

Since we follow the recent institutional account of fashion, fashion-ology, looking at the research on institutions is relevant. Institutional theory generally studies the processes by which structures, including schemes, rules, norms, and routines, become established as authoritative guidelines for social behavior (Scott 2004). There are various perspectives within institutional theory.

Kawamura's fashion-ology represents one approach to studying fashion, structural-functionalism. Kawamura argues that "a system of institutions that produces the concept as well as the phenomenon/practice of fashion" (Kawamura 2005:1). Although she discusses interactions between individuals, her approach is mainly structural-functionalist, which suggests that institutions have a unified purpose derived from the overall rationale of the system. The institutions are conceived as "organisms" that work towards the proper functioning of the entire "body" of society (Urry 2000: 23). Developing sub-organizations is "the key factor in the process of institutionalizing" and building the fashion system (Kawamura 2005: 53). This is particularly representative in the Parisian system. In fashion studies critics have already claimed that the Paris-centric approach is too simplistic and competing systems such as those in Tokyo or Milan should be added (Skov 1996; Volonté 2012). Although those studies allow for more "parts," they are still not well suited to account for the relation between mobile design and fashion.

There is also a constructionist view in institutional theory. Constructionism understands reality as socially constructed and contextually dependent (Berger and Luckmann 1991:15). It focuses on the concrete activities that sometimes make social interaction and technology look like functional machines (Latour 2010). In institutional studies, the constructionist view understands institutions or organizations as heterogeneous, fluid, and constantly made (Robichaud and Cooren 2013). A good example of a constructionist theory is Czarniawska's action net theory. The concept of action nets aims to illuminate how collective actions are tested, repeated, or dropped in a process where actors make "connections" that either dissolve or stabilize (Czarniawska 2008). Her "action nets" are intended to display the importance of particular situations, although they do not always develop into stable organizations.

The constructionist view of fashion already exists in previous fashion literature. For example, Blumer argues that fashion is a result of "collective selection" and is socially produced by institutional, social, and cultural relations between a number of key players in the industry. Blaszczyk argues that fashion is a cultural phenomenon growing out of interactions between individuals and institutions (Blaszczyk 2009:10). They highlight the social construction where interactions among different actors lead to the production of

fashion. We follow this direction and attempt to use institutional theory to explain the concrete connections between fashion and mobile design.

The interviews have helped us better understand what is happening in the mobile industry and the fashion industry. The dissemination of fashion into mobile design can be seen as emerging from shared social practices or institutional arrangements, such as color trend research. The understanding of shared institutions helps us understand where and how overlaps emerge. If trend research is a methodologically objective form of analysis, then its results should represent consumer trends. The trend agency is then an important sub-system that can be used to design both clothes and mobile phones. However, if we consider trend research as a form of construction that creates trends, we are looking at a social practice where things are molded, like Kawamura's explanation of the generation of fashion. If trend research creates trends, the question becomes how to understand this particular form of social practice. It is not self-evident that those social practices can be understood as a hierarchical "system" which Kawamura proposes (Kawamura 2005).

Our study shows that the concept of "action nets," which highlights heterogeneity and flexibility, might be more appropriate to interpret fashion produced in mobile design. With a much longer history than mobile design, fashion design is based on more stable institutions, such as coordinating color selection. In contrast, the mobile industry is young and expansive with a foundation in engineering. The interviews show how organizational work within mobile phone companies interacts with ongoing fashion production in an ad hoc way. This is because interactions with fashion need to be balanced against other considerations such as functional and material requirements. Furthermore, the institutions of fashion seem to already depend on negotiations, such as how color trends are understood as being formed and synchronized in meetings. Thus, mobile design, with its balancing acts, is linked to fashion design, which is also generated in situated constructions. With such a detailed, empirical perspective, seeing a hierarchical "system" among this is difficult. Therefore, the concept of "action nets" by Barbara Czarniawska seems to be more appropriate. It sees organizations as assemblages of various forms of activities and interactions. Rather than focusing on what will eventually appear as an independent institutional object, this constructionist view further makes visible the actions that create independent institutional objects.

In sum, the unsystematic character of institutional activities that generate fashion in mobile design makes the discussion of similarities and differences from an institutional perspective more complicated. Institutional work that turns mobile phones into fashionable items is better understood as action-nets blending with other actions, instead of being constrained by stable and hierarchical systems. The similarities and differences must be seen as embedded in heterogeneous and complex situations, which makes deciding

whether we are witnessing a merge between fashion and mobile design even harder.

4.3 Mobile phone in the fashion system (Paper III)

Previously we have addressed the question of how fashion emerges from mobile design by investigating the shared institutional arrangements between the mobile industry and the fashion industry. It reveals that the mobile industry intends to make their products more fashionable by actively engaging in the established institutional activities in the fashion industry. Drawing from the fashion-ology theory, we continue investigating the diffusion of fashion into mobile phone design.

We have studied online magazines and blogs, which can be seen as new types of fashion gatekeeping mechanisms, in order to explore how mobile phones are treated as fashionable items in the fashion system.

4.3.1 Online media put fashion into mobile phones

Online media is an appropriate place to investigate aesthetic interaction and digital computing. Our study shows that there is a link between the fashion system and mobile phones. First, the mobile industry invites people from fashion media to join the launch parties and test the new phones. Thus, mobile companies seem to treat fashion gatekeepers as an important group of consumers. The fact that they give phones to bloggers specifically shows how they are valued as gatekeepers between consumers and producers. Second, the language with which online media discusses mobile phones is rooted in the fashion world. It fits with Roland Barthes' semiotic theory on the linguistic system of fashion. He argues that there are two ways of representing fashion, a language of visual features and circumstanced appearance. This language is essential in making clothing and phones fashionable (Barthes 1983). When it is utilized on mobile phones, it increases the possibility these digital objects are adored and shows another link between fashion and the mobile world. Our corpus shows that the language through which mobile phones are described overlaps with the lexicon of clothing fashion, such as elegant, chic, fashionable and sophisticated. These words are used to describe the aesthetic feelings about the visual features of mobile phones. These descriptions are important in the sense of aestheticizing mobile phone as a fashion object. In this way mobile phones are approached aesthetically almost in the same way as clothing.

Bloggers' opinions on mobile phones are not simply user evaluations of the technology, but are also locations where phones are made fashionable. We argue that these social practices (e.g. fashion writings and gatekeeping) are important for understanding aesthetic interaction and how to design at-

tractive interaction. They are part of the "environment" in Dewey's theory (Dewey 2005). More precisely, design attractiveness is created places other than hardware and software design centers. This is similar to the way fashion is created in a system that extends beyond the clothing manufacturer. In this case, mobile phones become fashionable in and through online media.

4.3.2 Understanding experience with mobile phones in fashion practice

Since the pragmatist aesthetic theory has predominated discussions of aesthetic interactions and experiences in HCI, we examined whether the theory could be applied to interpret fashion practices, which we see as common aesthetic experience in everyday life. Online fashion writing is easily obtainable empirical material in an area where gathering data is usually very difficult, such as studying aesthetic experience. The gatekeepers enthusiastically write down their experiences of looking at a new phone or interacting with it. They use the same vocabulary they use to describe fashionable clothing; hence, personal experiences are aesthetically transformed into words. Our study shows that fashion experiences might not fit all the characteristics of an aesthetic experience proposed by Dewey.

First, in the discussions of aesthetic interaction in HCI, there is a tendency to focus on physical or bodily interaction as a compliment to visual expressions. This draws on Dewey's claim that aesthetic experience depends on a balance of all senses (Dewey 2005). However, what we learn about user experience in this area does not seem to fully support such an approach. The online fashion writers focus on visual features when they comment on the aesthetics of mobile phones. Their comments on style are about visual appearances rather than the appeal of physical and bodily interaction.

Nevertheless, physical interaction does play an important role when our use of the phone is publicly visible. In fashion media, celebrities are mentioned when using their phones or posturing at public events. The way that phones are presented as parts of the "environment" makes the social and cultural discussions in aesthetic interaction visible. It puts mobile phones into a context and cultural background and thus makes them glamorous and desirable as fashion items. These ways highlight some of the arguments from the pragmatist aesthetic theory. Although our empirical study also underscores that physical interaction is part of the aesthetic interaction, it more importantly is a means to support visual appearance. Thus, what we see here is an aesthetical interaction that is not sense balanced, but is very much devoted to visual stimulation.

Second, Dewey and the pragmatists argue that aesthetical experiences should be harmonious (ibid), but the aesthetics of fashion are ambiguous and unstable. The gatekeepers emphasize the features of "new" and seasonal

change of mobile phones they think are fashionable. This is one of the most important features of fashion. What's fashionable today will not be fashionable tomorrow. Thus, fashionable people are always somewhat uncertain and must look for the next desirable object. Old phones become replaced by new phones for many reasons, such as going out of style or lacking the newest functions. We have seen how common temporal patterns within clothing fashion, such as "seasonal change," are evoked as a reason to change phones. However, there are temporal differences between how people change mobile phones and how they change their wardrobes. We change our phones and clothes on a temporal basis, and we look for ways to combine these two types of commodities into ensembles or outfits. But the temporal variations differ and make the combinatory work difficult. This variation adds to the inherent ambiguities for this particular aesthetic practice.

Ultimately, the way in which fashionable people relate to mobile digital devices provides interesting findings that make explicit certain limitations in the pragmatist approach to aesthetic interaction.

This chapter addresses the questions of whether and how aesthetization in general and fashion in particular occur and exert influences on mobile design. First, we investigate the visual trends of mobile phones in their short history by doing a periodization of Nokia phone visual styles. We learned that there was an aesthetization of mobile design in history, but the aesthetic concerns differed over time. Then we focused on fashion and studied its impacts on the mobile industry in general, as opposed to in a particular company. We address the impact of fashion in general through two studies. The first examined the concrete institutional arrangements between the fashion industry and the mobile industry. We find there are joint institutions turning electronics into fashionable objects, such as trend research. We view the institutional arrangements in fashionable technology as rather flexible action nets that integrate fashion values, norms, and mechanisms. The action nets of mobile fashion coexist with more complex networks, which make fashion less visible in the mobile industry. The second study investigated how mobile phones become fashionable through fashion gatekeeping. The language of clothing fashion is employed to mobile phones to make them fashionable. Visual aesthetics and temporal variations are emphasized. Moreover, fashion experience where digital technology is involved seems to underscore some points of pragmatist aesthetic theory but also undermines some characteristics of aesthetic experience that pragmatist aesthetic theory has argued.

5. Designing Fashionable Technology

This chapter deals with the question of how to design digital technology that can account for fashion mechanism and extend fashion's impact. We will discuss the concept of "outfit-centric accessory," introduce the two design exemplars, and present the design implications from the explorations.

5.1 Conceptualizing "outfit-centric accessory" (Paper III)

The concept of "outfit-centric accessory" is derived from the study of fashion editors and bloggers' comments on mobile phones (Paper III). In that study we found that posts on mobile phones are few, which implies that something is missing in mobile design. Based on our empirical materials, we propose the design concept of outfit-centric accessory to approach designing a digital device that accounts for fashion institutions. In fashion an accessory is something that adds to an outfit or ensemble. They are often watches, bags, or jewelry. We term this an outfit-centric accessory because it starts from the wearer of clothes. In this perspective a mobile phone becomes an accessory that should be an integral part of the outfit. However, in the mobile industry, it is often the device that is the center of attention. The concept of outfit-centric accessory contains three features.

First, the accessory should match the outfits of a person. In fashion practices people create a whole look composed of different pieces. Thus, they care about the aesthetic value of a clothing ensemble, not a single item. Similarly, if we design a mobile phone as a fashion accessory, the phone should be able to provide an aesthetic that matches the outfit of the wearer. This is potentially an interesting opportunity.

Second, the visual features of digital devices should be publicly visible. This argument is grounded in the observation that the surface of a phone (a screen) is normally facing toward the user and not visible to people nearby. The back of a device is public to others, but has a fixed color and shape, similar to garments and other fashion objects. The study reveals that the visual interaction with the more concealed areas of the phone was seldom commented on in aesthetical terms. The fashion gatekeepers explicitly commented on how phones appear in public situations, such as runway shows.

These findings are in line with fashion studies, since fashion is necessarily "public" (Reynolds 1968). Making visual features publicly available will be a critical problem if a user wants to make a fashion statement with a phone.

Third, the public visual aesthetics should have temporal variations. Fashionable people must consider the appeal of an object in relation to time and change. Borrowing from fashion's terminology, words such as new "season" used to introduce a new mobile phone imply that this phone is "in" while the old ones are "out." Fashion trends are traditionally released on the runway bi-annually or, in other words, as two seasons (spring/summer, autumn/winter) (Kawamura 2005). Here the mobile phone is placed within a similar temporal pattern. Both clothes and mobile devices become obsolete because they fall out-of-style, often well before they break or fall apart. However, there is a tension between the desire for variations when using a mobile device as a fashion accessory and the current role of our phones in dressing. Presently, the ways to change the visual look of a phone are limited. Garment variation, however, is easily achieved through switching between different clothing items. There can be many variations in terms of silhouette and style in clothing. We can change our outfits on a daily basis, but not our phones. This also explains why mobile devices are usually not something considered in our everyday dressing practice.

The gatekeepers appreciate the abovementioned features of fashionable phones and clothing. Their limited interests in mobile devices might be explained by the restricted opportunities to create and vary visual appearance of mobile phones. In sum, taking the considerations of matching ensemble and temporal variation together, we argue that the outfit-centric approach should provide mechanisms that increase the turnaround of the impression of digital devices, and do it in such a way that it fits with a person's ensemble. We believe that designing with this concept held as an ideal will increase the interests of fashion conscious people.

5.2. Design exemplars

The concept of outfit-centric accessory tells us there would be opportunities to design for public visual aesthetics that match an ensemble and adapt to the variations of looks when designing fashionable digital technology. We have made two design exemplars to further investigate the design idea.

5.2.1 Shape-switching device (Paper IV)

The first design exploration examined how to account for methods used by fashion to create items that people adore, in particular, how a garment is institutionalized into a fashion item (e.g. through designer cults and design by style). It resulted in the concept of a shape-switching digital device, whose shape can be changed in twenty-two different ways to match various outfits. The shapes that the imaginary device could provide were presented as a series of twenty-two mock-up samples that are in themselves hard to the touch, which vary in color and shape (see Figure 5-1). Inspired by the soft fabric folds in the local fashion style in Stockholm, the design exercise points to what variations based on organic interfaces could potentially look like when applied to mobile design. Whereas stickers and covers also meet the demands of being publicly visible and being Prêt-à-porter, the explora-

Figure 5-1 The 22 mock-ups that represent different shapes and colors for a shape-switching device (photo by Rickard Sahlén)

tion presented here goes a step further by using an approach specifically inspired by emergent technology, and grounded in a particular local style.

5.2.2 "Watch for Figuracy" (Paper V)

The design exercise of the shape-switching device explores the possibility of new hardware for an outfit-centric design, inspired from the emerging organic interface technology. This was an investigation before we could actually look into the interactivity of this design. After that we continued to explore software that could account for fashion institutions or values, such as match-

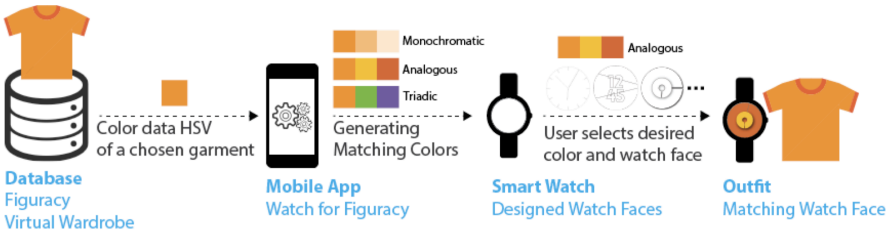

Figure 5-2 The system of "Watch for Figuracy" (image by Jinyi Wang)

ing an outfit. This time we focused on smart watches, which have become increasingly popular in the market of wearable devices. We built a smart watch application called "Watch for Figuracy" as an experimental prototype to help design according to the outfit-centric concept. This is a service that enables the users to choose a desired watch face and match its color with the clothes he or she is wearing.

The implementation of color matching algorithms was used to illustrate the potential to make software for the outfit-centric accessory concept. We used color theory to develop the algorithm in the design. We chose color theory because the use of color theory has been established as an institutional norm in fashionable dressing for a long time, dating back to two centuries ago (Nicklas 2014). Fashion writers in mid-19th century applied the color theory concepts of "harmony" and "contrast" from the French color theorist M-E Chevreul to everyday dressing decisions and gave advice on color combinations. Contemporary dressing requires even more knowledge of color combinations. Color principles are widely used in fashion media to teach readers how to combine different colors when making an outfit. The color theory provides rules for color groupings and the color wheel is the simplest illustration of the matching principles. This theory is an articulated aesthetical theory that describes how color matching should be done. Consequently, it is easily used for designing matching algorithms. Our "Watch for Figuracy" app serves as an example for making smart watch applications with color theory behind the algorithm. We did so through a mixed approach of combining hardware and software.

The system can roughly be described as consisting of three components (Figure 5-2):

1) A database where the users' clothing items are digitally represented and stored. We made use of an existing mobile application "Figuracy." It is both an online website and a mobile application where the users create their virtual wardrobes by uploading information (e.g. brand, color, size, and photos of their favorite garments). We extended the service by creating a way to select items that were worn on users' bodies.

2) A controlling mobile app through which the users choose a clothing item they want the smart watch to match with. After choosing a clothing item, users choose from color combinations proposed by the app. The app recommends colors via an algorithm based on color matching principles. These color principles usually have around seven to nine common categories, of which we chose three, monochromatic, analogous, and triadic.

3) An output watch face that matches the wearer's outfit that the user selects from a set of designed watch faces. In sum, it provides fashion "smartness" that is contextually dependent on the wearer's current outfit.

5.3 Design implications

Through the two design exemplars we have explored how to design fashionable technology that accounts for fashion mechanisms. In this section we discuss the insights of the specific instantiations.

5.3.1 Mobile fashion beyond hard covers and stickers

In mobile design there have been explicit attempts to create designs that target a fashion-conscious market. The historical study on Nokia phones styles discloses the ways of making a mobile phone fashionable from the perspective of design. "Fashion" in mobile phone design has been mostly displayed on hardware (e.g. the selection of colors, shapes, and materials used for different handsets). The materials that are commonly used in fashionable clothing items were used in mobile design, such as leather and fabric, as seen in the L'Amour collection. Another example is the use of precious materials such as crystal and gold in some limited versions of the Nokia 8800. Apart from the phone, the most visible way in which the mobile design has approached fashion has been through cases, charms, stickers, shells, and other decorations (Katz and Sugiyama 2006). We have applied two approaches in the design instantiations to expand on the previous possibilities. The first exploration focuses on the hardware of the digital devices while the second one attempts to combine the hardware and software. These approaches extend existing possibilities in several ways.

First, we have a three-dimensional exploration of hardware design that moves beyond a rectangular device, and the variety of shapes offers greater diversity in appearance. This is driven by the hardware restrictions that phones currently have. These hardware restrictions make it difficult to create support applications that fully embrace the concept of outfit-centric design. We got inspirations from the emergent technology of organic interface, which gives more freedom to experiment with public visual design. Regardless of the potential of this new material, this design exercise is still a step below the actual exploration of a functional shape-changing device.

The low-fidelity mock-ups come in different shapes and sizes to allow for experimentation with locations on the body. This design exercise displays the outfit-centric concept that is inherent in the device (i.e. a mobile device that could change its shapes to match outfits). This would allow for more extensive variation than selecting from hardware gadgets or accessories that are fixed in form and appearance. Most importantly, the exercise also reveals the potential to design applications that connect visual aesthetics of mobile devices to dress ensembles. For instance, the participants' interests in color variation can be utilized in design solutions that do not support shape switching. Such an interest inspired us to do the second design exploration on smart watches.

Second, we develop the smart watch application "Watch for Figuracy" to investigate how to design software and services that could make variant public visual aesthetics for digital devices. This exploration not only concerns the temporal variation of a devices visual appearance, but also suggests that the variation could be driven by "intelligent" software that can detect objects in the vicinity.

Fashion literature tells us that fashion is strongly motivated by an individual's constant variation of clothing items in combination with a continuous pursuit of new value. This leads to a wide variation of an individual's visual appearance. In this design exercise we focused on the role of the watch in matching practices. Currently, visual variation of an analogue wristwatch is mainly driven by changing watches or straps. A smart watch has the additional potential of providing more variations on the watch face. Moreover, Android Wear also provides the opportunity to manually change between pre-designed watch faces. Our application extends these opportunities by making the smart watch adapt to the current outfit and uses color theory to build the algorithm. Thus, the visual output on the screen is controlled by a software service. Naturally making the watch display visible to the public all the time is challenging. Although this prototype can only display the color when the watch is turned on, this problem will likely be solved in the future when innovative material is used, such as color e-ink.

In sum, our design instantiations provide new opportunities increasing variations of public visual aesthetics in digital technology.

5.3.2 Designers and styles

In the exploration of the shape-switching device, we are particularly interested in the styles and collections that fashion designers create. Here we focus on Prêt-à-porter, or ready-to-wear, which means clothing fabricated for mass distribution and consumption (Mazza and Alvarez 2000). In fashion studies it is widely accepted that garments and accessories for the most part are not made by consumers, but bought in stores (Wilson 2003). Prêt-à-porter designed by fashion designers displays a large variety of styles. Fashion histo-

rian Valerie Steele states that the empire of fashion has fragmented into hundreds of competing looks (Steele 2000). Fashionable people choose to be in different style tribes, epitomized by different fashion labels, such as The Modernists as represented by Jil Sander, The Rebels as represented by Alexander McQueen, or The Romantics as represented by John Galliano (ibid).

The idea of a shape-switching device was visualized into a set of low-fidelity mock-ups. Their visual appearance was inspired by the local style in Sweden, which emphasizes visual aesthetics as a local and historically dependent style. The Swedish style is minimalistic, clean, streamlined, and jeans oriented (Falck 2011). Moreover, it is characterized by monochrome colors, with most items in grey, black, beige, and denim blue (ibid). The twenty-two mock-ups represent the different visual presentations within one device. Ideally, the interaction is provided by an organic interface, which might provide an infinite number of shapes. Nevertheless, we decided to provide only a limited number of shapes, aligned with fashion logics (i.e. designers' seasonal collections). Designer expertise therefore plays a specific role in this exploration: to investigate a matching mechanism that restricts users' possibilities, following the tradition in fashion where people buy Prêt-à-porter from stores, instead of making clothes themselves (Wilson 2003). The user gets to choose the appearance of the device from limited options provided by a designer.

Second, the exploration of "Watch for Figuracy" investigates designing fashion services that could make variations in visual aesthetics and calls for further collaboration between the interaction designer and fashion designer. If we understand design as some sort of thinking or institutional work, designing fashionable technology seems possible for any designer to do. However, we should be aware that fashion design is nested in a series of institutional arrangements that may have been established for a long time. Thus, if we aim to design fashionable technology, we must consider fashion values and norms. Extensive collaborations between HCI and fashion design might be beneficial in tackling concrete problems and taking advantage of their expertise in different areas.

In sum, our design instantiations emphasize the role of designers and the employment of institutions. We also call for a more extensive collaboration between fashion designers and interaction designers to create fashionable technology.

5.3.3 The social contexts of fashion aesthetics

Aesthetics in fashion practices are visually dominant. The visual presentation of an individual is not just a reflection of his or her inner self, but more importantly, a silent interface that speaks to the world. Fashionable dressing is a performance that concerns the activity of an individual marked by his or

her continuous presence in front of observers and which has some influence on the observers (Goffman 1990/1959:13).

The concept of outfit-centric accessory provides the design principle that stresses the objects' visibility to others and its role in an ensemble. Our attention was therefore directed towards visible features such as shapes and color. In the design case of the shape-switching device, the user study shows that our participants' adherence to the same principles was perhaps most apparent in the attention they paid to the placement of the design items on the body. The mock-ups were used in an outfit as necklaces, brooches, a ring, a small bag, etc. (see the images from the user study in Paper IV). The possibility to change the position of the mock-ups on the body and the importance of this aspect were not pre-conceived in the design. We were surprised by the creativity. Different uses bring different amounts of visibility in social encounters, and place the items in different contexts (e.g. next to the trousers when used as a belt or next to a blouse when used as a necklace). The participants also linked the visual forms of the mock-ups to social occasions. For instance more wrinkled shapes, which look more fun, were considered suitable for a party. The participants' experiments show that public visibility is a relevant concern among these fashion-conscious participants, and that our samples can serve to meet that demand.

The design of "Watch for Figuracy" also emphasizes the importance of public visual aesthetics. Fashionable people are interested in the "backside" of a mobile phone instead of the screen side since the backside can display a public visual statement. However, a smart watch provides a platform that has a publicly visible screen. Thus, it has huge potentials to provide limitless visual expressions. The screen is in the hybrid design space between fashion and mobile technology, a space that this study shows has both potential and creates challenges. In our initial user feedback study, the participants showed strong interests in the idea of making the watch face change according to what they wear (see the images from the initial user study in Paper V). But they also expressed concerns in terms of the concrete interactions with the application. They seemed to prefer the monochrome color principle, which might indicate that they tended to follow the color selection they had already used in their daily dressing. Thus, in these cases they did not prefer the "fashion intelligence" provided by the app. Meanwhile, they also selected the analogue and triadic mechanism, which reveals an interest in the new ability to match the watch face with their clothing using other principles. In sum, the participants for the user study partially rejected and accepted the hybrid suggestion.

Moreover, public visual aesthetics indicates a desire to be an individual and a member of a group. This ambivalence is representative of fashion. The ambivalence implies that it is not enough to use customization as a way to evoke endless personification. Designs should also account for social conformity through institutions, which will formulate common grounds for a

community. The shape-switching design emphasizes the role of designers and the concept of ready-to-wear in the fashion industry, which provides an example of accessing fashion institutions. The "Watch for Figuracy" application uses three color principles as computational institutionalized fashion rules. The software provides fashion intelligence that allows users to follow fashion institutions. Although we recognize that fashion practices have to do with more than just vision, our user studies of the design exemplars tend to emphasize the properties that can be shared with others or the publicly visible appearance.

5.3.4 Designing for variations in dressing practices

Fashion-conscious people are part of a culture thriving on continuous change and transformation (Wan et al. 2001). In particular, the concept of outfit-centric design grew out of the identification of a difference between how often we change items of clothing and digital devices. People change their outfits on a daily basis and add new garments to their wardrobes more often than they change their mobile phones. To be in line with the observations in clothing fashion, our concept of "outfit-centric accessory" requires the visual aesthetics of digital technology to adapt to the temporal variation of outfits. Both of our design exemplars aim to provide increasing variations of visual expressions, but through different approaches.

The shape-switching device offers a collection of designer shapes to match different outfits. The variations exist in the color, textile, and shape of the imagined device and its location on the body. Our user study shows that temporal variation can be of different kinds. First, there are daily changes depending on context (e.g. working at an office or going to a party). The participants varied the shapes of the items in a way that matched how they changed outfits. Second, the variation depends on the range of shapes available, in a way like the number of clothing items of a particular type in one's wardrobe. The way in which our participants varied their choice of clothes and accessories was not the same for every item. The range of variation is influenced by how we perceive the shapes. This suggests that the range of variation for a fashionable mobile phone will be smaller if it is perceived as a bag than if it is perceived as a shirt.

The smart watch application "Watch for Figuracy" focuses on the color matching of a watch face. The visual variations of the hardware are enabled by "smart" software that responds to the clothes people are wearing. The application applies color principles to generate an algorithm and provides three color combinations for each color picked on a photo. This is combined with three designed watch faces that can present a set of colors instead of a single color. This increases the visual variations of the watch face. Its ability to make variations seems to be further strengthened when the face needs to match a clothing item that has a variety of colors itself. Our user study shows

that some participants manually picked the color to be matched from the small part of a garment, such as the pattern. In these cases, one could select various colors for matching that exist in one garment. Thus, this approach not only increases the variations of watch face color according to the change of clothes, but also offers variations of visual presentation to match a single item.

This chapter presented the design concept of outfit-centric accessory, two design exemplars, and the implications generating from them. Through making concrete instantiations we explore ways of using fashion institutions to influence mobile design. We particularly focused on the idea of making digital devices a part of an ensemble and matching them to clothing items. The two design explorations include futuristic hardware for a new mobile device and an "intelligent" wearable device that combined hardware and software. These two explorations show both the opportunities and challenges of integrating fashion and interaction design.

6. Discussion

In chapter 4 and 5 we presented the results from five studies. They investigate the questions of how aesthetization and fashionalization take place in digital technology design and how to design digital technology that accounts for extended fashion impacts. This chapter further discusses the key findings and implications for HCI. They include understanding the role of aesthetics, especially visual aesthetics in our experiences with digital technology, and unpacking the concrete relations between fashion and digital technology design. Finally it includes discussing implications of designing for "Tech Fashion."

6.1 Pragmatist aesthetic theory revisited

The role of aesthetization in our everyday life has become increasingly important. The discussion of "aesthetization in everyday life" not only concerns contemporary sociology and philosophy but has also influenced the field of HCI. Although there have been different views for understanding aesthetics, pragmatist aesthetics has become much more influential than others. We focus on this theory to discuss how we should study aesthetic experience in everyday life.

Recently, HCI researchers intended to shift the focus of aesthetics from the analytic tradition in HCI to a pragmatist perspective of aesthetics. The former view, as represented by "beauty in the mind," treats humans "as disembodied processors able to construct independent realities in the mind," and the latter, in contrast, emphasizes "how people experience the world dialogically as embodied subjects" (Fiore et al. 2005: 129). Pragmatist aesthetic theory is proposed as an alternative way for understanding aesthetics. We certainly recognize the contributions that pragmatist aesthetic theory has offered. However, we question how such a constrained philosophical formula could bring continuously growing insights to the field of interaction design.

Pragmatist aesthetic theory focuses on everyday aesthetic experience. Fashion practices, such as putting on a fashionable garment, are a type of aesthetic experience that ubiquitously exists in our everyday life. Thus, we chose to study these kinds of practices to investigate how we should understand everyday aesthetics. Fashion practices are aesthetical because all the

activities in these practices lead to certain aesthetic ideals for human bodies, such as beauty, elegance, sexiness, glamour, etc. Specifically we study fashion bloggers' writings and dressing practices. According to our empirical studies, fashion experiences may not have all the qualities of aesthetic experience listed by Dewey.

First, Dewey's aesthetic theory lays strong emphasis on understanding aesthetic experience in the interaction between humans and the aspects of the world in which a person lives (Dewey 2005: 45). According to him, in order to understand aesthetic experience, we need to account for the "environment" in which it occurs and the ways in which we interact with it (Dewey 2005). Our study of online fashion media (Paper III) emphasizes the importance of environment, in line with Dewey. Mobile phones become fashionable when they are situated in a fashionable context, such as at a fancy launch party, in fashion catwalks, or in the hand of a celebrity. The bloggers take an interest in the aesthetics of a social context (i.e. where it is seen and who is using it). Furthermore, fashion media uses a specific vocabulary to fashionalize mobile phones. We found two cases of such language in the empirical materials. One case regarded the appearance of mobile phones and the other regarded fashionable circumstances. These findings are in line with Barthes' work on the linguistic system of fashion (1983). When fashion vocabulary is utilized to represent mobile phones, the chance of these digital objects being adored by readers increases and demonstrates another link between fashion and the mobile world. Therefore, writings on mobile phones are not simply user evaluations of the technology, but are rather locations or cultural contexts where phones are made fashionable. They are part of what Dewey would refer to as the "environment" from which aesthetics emerges.

Second, Dewey emphasizes the abstract quality of "inner" experience that leads to an idealized harmony. Such an experience has to be unified, continuous, ordered, harmonious and complete. The experience possesses internal integration and fulfillment reached through ordered and organized movement, which can lead to satisfying emotions (Dewey 2005: 38). Order is particularly emphasized here. Order emerges out of complexity to become something harmonious (ibid: 13). Our empirical data shows that many aesthetic experiences related to the appeal of clothing are not harmonious and balanced. For instance, Paper III highlights the temporal ambiguity that emerges out of constant change. Fashionable people seem to hardly ever feel harmony since they are always chasing the next desirable object. Aligning the mechanisms of fashion desires with the use of mobile phones seems to add another object to the list of disordered considerations in fashion because fashionable clothing items and mobile devices have different paces in temporal variation.

Third, Dewey's aesthetic experience highlights balanced sensuous feelings, including not only visual feelings, but also all other feelings coming from the five senses. This idea drives the research of "aesthetic interaction"

in HCI, which gives significant focus to bodily interaction and the sense of touch. However, according to our study, fashion experiences, as part of aesthetic experience, tends to be visually dominant. For instance, the study on online fashion media (Paper III) shows that comments on the visual features of phones are the most recurrent. Fashion writers enthusiastically reveal the stylish visual looks of mobile phones, such as their colors, materials, and forms. Physical interaction sometimes plays an important role when it becomes a means to support the visual appearance of mobile phones. However, the way they comment on interaction is not on the same level as visual aesthetics. Thus, such an aesthetic interaction is not balanced, but is visually dominated.

Therefore, the fashion experiences we analyzed do not seem to match Dewey's pragmatist aesthetic experience very well. In fact, there has already been a debate within pragmatist philosophy about problems in Dewey's aesthetics. Shusterman (2000) argues that much art fails to generate Dewey's aesthetic experience. Contrary to Dewey's emphasis on harmonious and unity, Shusterman also thinks that the aesthetic experience is fragmented and ruptured.

This debate leaves us in an awkward position. The gap between the conceptualization of aesthetics in pragmatist theory and the ways in which aesthetics is of importance in fashion practices calls for revisiting the foundations of the current discussion on aesthetic experience within HCI. To us it seems that many of the ordinary experiences of which Dewey speaks, which for us includes the appeal of clothing, are not as complete and balanced as argued in this theory. Beyond the empirical analysis in our thesis, there are more examples in fashionable dressing that point to the fragmented, inharmonious, and imbalanced experiences. For instance, high-heeled shoes cause pain but still offer aesthetic fulfillment. "Bricolage" in dressing deconstructs the designers' united runway looks. The unkempt and asymmetric Japanese style brings wearers the enjoyment of rebelling against the norms of harmonious beauty, etc. However, if we discount these parts of fashion as aesthetic experience, pragmatist aesthetics would remain relevant. Since defining "aesthetic experience" in Dewey's theory is obscure, its value in the discussions of aesthetics in HCI may be limited.

The other possibility is to see Dewey's philosophy as a source of inspiration for studies of ongoing and naturally occurring aesthetic practices in the world, but transcend his set of guidelines. McCarthy and Wright have made initial efforts to change the traditional view of technology in HCI by using pragmatist aesthetics in their book *Technology as Experience* (2007). They propose to see technology as "lived and felt experience." They greatly value much of Dewey's theory of everyday aesthetic experience, but they also use another scholar, Bakhtin, to complement Dewey. Dewey proposes a holistic unity, which is an idealized vision, while Bakhtin "resists reifying any social structures" and focuses on a "particular moment" in "small personal lives"

(McCarthy and Wright 2007: 57). The combined view of McCarthy and Wright indicates that they find Dewey valuable at some points, but that he also does not explain everything.

We suggest that focusing on pragmatist philosophy might be of limited value for design-oriented research. The key book on pragmatist aesthetics *Art as Experience* has been dismissed as a "hodgepodge of conflicting methods and undisciplined speculations" (Isenberg 1950/1987:128). Dewey makes argument or reasoning without grounding them in concrete empirical material. The aesthetic experience in pragmatism is also criticized as so "evanescent and discursively elusive" that could hardly define or analyze (Shusterman 2000). Thus, when it comes to design-oriented research, the use of such philosophical approaches might be less beneficial in generating concrete design ideas. Therefore, we might be better off with taking a closer look at what is going on in ordinary people's lives, instead of pursuing "useless and confused metaphysical phantom" even further (Shusterman 2000).

6.2 Proposing "Tech Fashion"

Previous studies in HCI treat fashion in digital devices like clothing, or particular individual experiences of objects, such as identity construction and personal expression. This thesis offers new insights of fashion for HCI research. We emphasize that fashion provides a unique way to make something desirable.

Drawing from the fashion-ology theory (Kawamura 2005), we understand fashion as being different from clothing. We see fashion as institutional arrangements that turn objects into fashionable items. Thus, our task is to find the institutions in mobile design that are shared with fashion design, since those are likely to be where fashion is generated in mobile design. The enquiry of investigating the impacts of fashion institutions in mobile design is not arbitrary, but built upon a study of mobile design as a case of "aestheticization of everyday life."

Previous studies on such a topic tend to be generative and abstract. Our study focuses on aesthetization for a specific type of object and provides empirical materials, adding additional weight to the discussions. Paper I demonstrates that historically there was an aesthetization of mobile design. It was sometimes strongly influenced by clothing fashion trends. However, this aesthetization was unstable and inconsistent and so were fashion's influences. The study shows that piggybacking on the fashion industry has been a strategy in the mobile industry during specific times and has strongly fueled the aesthetization of mobile design. This connection to fashion is not a coincidence. A style in fashion, be it heterogeneous or homogeneous, is constructed and shaped by social and institutional arrangements (Kawamura 2005). Moreover, the fashion industry has a rich history of creating beauty

and promoting new styles. The rapid variation in styles indicates that stable and universal aesthetic principles are less applicable than relational aesthetics. This bolsters the argument that relational aesthetics, which sees beauty as socially constructed (Dickie 1997), is more appropriate in accounting for the increased variation of mobile phones. This study not only provides an empirical analysis of mobile design to discuss "aesthetization of everyday life," but also directs us toward further studying fashion's impacts on mobile design.

Next, we investigated the impacts of fashion institutions on mobile design. Our interviews identified an orientation toward the specific design values in mobile design, which are also very important in clothing fashion. These values include increased beautification of objects, creation of desire, and increasing variation through frequent product releases. These concrete observations strengthen the argument that fashion is leaking into a wider range of domains and also motivate moving beyond the identification of industrial resemblance.

From an institutional perspective, mobile design and fashion design differ because they rely on different institutional arrangements. But they also share institutions. Joint institutions that are engaged in the concrete interactions between the mobile industry and the clothing fashion are especially indicative of the role of institutions, since the presence of fashion values in the design objects can then be understood as emerging out of institutional work in the production of said objects. According to institutional theory institutions include schemes, rules, norms, routines, etc., which become established as authoritative guidelines for social behavior (Scott 2004). Fashion institutions can be understood as the rules, norms, or mechanisms that become authoritative guidelines for fashion design and practices. Our study shows that it is through shared institutional work that clothing fashion exerts influence on the aesthetics of mobile design. These institutions take the form of concrete activities in the daily routines of designers' work.

The results of our study also make us hesitate to draw a generalized conclusion since it reveals the non-existence of stable institutional "subsystems." It also shows the heterogeneous and ad hoc character of the interaction between the mobile industry and the fashion industry. It is more complicated than simply saying fashion exists in all things since the ways it appears and emerges in various domains seem to be very different. For instance, clothing fashion can have a hierarchical and structural system while fashion in technology-oriented industry exists in a more dynamic action net. It might be that the design of digital devices interacts with fashion in particular situations and the interactions vary over time. Fashion comes and goes from one product to another and from one period to another.

Here we propose "Tech Fashion" to understand the dynamic and concrete interactions during fashion institutionalization in digital technology design. This is distinguished from Kawamura's fashion-ology, which is a hierar-

chical and machine-like system represented by how fashion is traditionally organized in Paris. We understand the institutional arrangements in fashion technology as being rather complex and dynamic action nets where individual fashion values and mechanism are flexibly integrated. The action net of fashion has to coexist with other action nets where different actors and organizations are involved. This multiplicity of action nets makes fashion less visible in technology than in clothing.

Tech Fashion can be summarized as flexible and dynamic action nets, where fashion institutions are selectively used and integrated. It opens up new opportunities and makes possible deeper interactions between the two industries. Fashion in digital devices should not just be shells or additional ornaments, but rather, fashion should more deeply influence digital technology design. The concept is constructed to highlight the complexities of fashion production and calls for studying the fashion institutions that can be integrated into digital technology design. This should not be misinterpreted as randomly selecting a single value and then superficially adding it to the action net because of the net's flexibility. In sum, Tech Fashion offers new perspectives of fashion for the field of HCI, such as what fashion institutions could be integrated into the action nets of designing digital technology or what actors, whether they are organizations or individuals, could be teamed up to fashionalize the design.

6.3 Designing for "Tech Fashion"

"Tech Fashion" is proposed as a new design space for designing fashion oriented digital technology. It emphasizes the dynamic institutional arrangements that could make digital devices fashionable. Designing for "Tech Fashion" means that designing fashionable and desirable digital technology needs and take into account the institutional arrangements embedded in the fashion industry.

Previous studies on aesthetics in HCI reveal many insights. For example, technology is not just a useful tool but something embedded and meaningful in our social life. Indeed, technology has developed rapidly. People are now demanding more than simply "technology." They care about aesthetics of devices, which obviously includes its visual appearance. The interests in visual aesthetics are likely to increase in our experience of digital devices, especially wearable technology. These devices are increasingly worn on our bodies in ways similar to clothing. The screens of devices are no longer privately located, but become part of the public presentation of ourselves. Such a change in position makes fashion more significant for designing these devices since fashion has a long history of creating beautiful and desirable items for people to wear and show off in public.

Previous studies in HCI understood fashion as either personal expression in fashion consumption, the importance of appearance, or as something made of fabric. These views represent a relatively narrow understanding of fashion. First, visual appearances and their meanings are already an important aspect of industrial design (Bonsiepe 1962). It is not clear how fashion's contribution differs from that of industrial design in studies of technology. Second, in wearable computing fashion is mostly equated with clothing or fabric, which is rather shallow. There are many so-called fashionable wearables that are actually just computers in the form of clothing or accessories. Those researchers and designers ignore that, although fashion usually takes the form of clothing, not all clothing is fashion. In this thesis we treat fashion as institutional arrangements that make things beautiful, fashionable, and stylish. Using such a view to understand fashion allows us to go beyond physical clothing, but still takes into account fashion institutions, such as established fashion values and norms.

We focused on designing mobile phones and wearable devices to account for fashion mechanisms. We studied fashion gatekeepers to explore what features are emphasized when mobile phones are treated as fashionable items. Our empirical materials collected from online fashion media show a limited number of posts on mobile devices, indicating that something is missing in mobile design. Based on the analysis of empirical materials, we propose the concept of outfit-centric accessory as an approach to designing digital devices that accounts for a few important institutionalized norms in fashion practices, such as public visual aesthetics, matching outfits, and adapting to varying styles. We argue that designing digital devices as outfit-centric accessory would create more interests among fashion conscious people.

We have made two design exemplars to investigate this concept. One is a number of mock-ups that represented an imagined shape-switching device; the other is a smart watch application called "Watch for Figuracy." With the two design cases we explore possible solutions for outfit-centric accessory designs. We investigate different approaches to reach the goal, including hardware design using emerging technology and a combination of hardware and software design. From mobile phones to wearable technology, our computer interfaces and garments literarily touch each other through the introduction of technology worn on our bodies. This orientation demands more collaboration between fashion designers and interaction designers.

Although both fashion design and interaction design belong to *design*, they have different orientations. Fashion design focuses on aesthetics, creativity, and innovation in the domain of appearance, while interaction design emphasizes problem solving. Moreover, fashion design is nested into institutional arrangements that together create desire, beautification, and variation. This is different from other types of design, such as interaction design, which uses a user-centered method to frame problems. Fashion design,

which has a long tradition, is based on rather stable organizations, such as trend agencies coordinating color selection. Therefore, in order to generate fashionable wearables and supporting software, we need to link design to fashion thinking and its specific supporting institutions.

Furthermore, designing digital technology in consideration of fashion institutions or mechanisms indicates an alternative method to the trend of promoting customization to reflect personality in interaction design. Following fashion institutions and mechanisms actually requires that we follow others, as well as ourselves. On the one hand, fashion expresses uniqueness and personality; on the other hand, fashion shows our desire to belong to a social community or conform to social institutions (Wilson 2003). This becomes a challenge when designing fashionable wearables since designs needs to account for both uniqueness and conformity. It is important that fashion design is embedded in institutional arrangements that create desire, beautification, and variation. Therefore, both the differences between the two types of design and the ambiguity of fashion must account for fashion thinking and its supporting institutions in the design of fashionable technology. Hence, our design exemplars such as "Watch for Figuracy" allow users to not only personalize their watch faces, but also have them match their clothes.

The ambivalence of fashion needs further recognition in HCI where allowing user control of the presentation of the interface is often considered a hallmark. Recent studies, such as Marathe and Sundar's (2011), also show that customization might not help enhance a sense of control if the user does not feel a connection with the interface (ibid: 788). They argue that instead of simply deploying the coolest new customization features, we should ask questions like "what does customization fundamentally entail?" "What are users experiencing when they change interface features?"(ibid). Hence, customizable interactive features do not necessarily lead to user satisfaction. In our case, an orientation toward fashion implies a need to account for users' demands to follow others and reject their own individuality.

If we want to design digital devices for fashion contexts where people are always looking for novelty and change, we need to generate new software for fashionable wearables to investigate and articulate more extensive ways of accounting for institutionalized values or norms in the future, such as matching based on brands, tactility, and patterns, and the principles that are in line with tomorrow's fashion. The quest for fashionable wearables requires new technical offerings, which could come from computational technology where innovation is much faster than that in clothing technology. Linking the need to consider fashion institutions in digital technology design to the strength of computational technology in technical innovation requires more extensive collaboration between HCI and fashion design. It is time to unpack how we can combine these areas of design in order to create desirable technology.

7. Conclusion

This thesis explored how aesthetics in general and fashion in particular occur in digital technology design. Our interests in the aesthetics of digital technology are derived from the increasing discussions on the "aesthetization of everyday life" in contemporary sociology and the growing research on aesthetic experience in the field of human computer interaction. We understand aesthetics as "beauty in relations," which sees beauty as socially constructed, (e.g. by people who have the expertise of making it.) Drawing on some scholars in sociology and design research, increased visual variation could be considered a crucial feature for aesthetization. To investigate the aesthetics of digital technology, fashion is focused on as a way to approach it because fashion places great emphasis on aesthetics. Moreover, digital technology's shared positions with clothing and accessories drives us to examine fashion in digital technology.

Previous studies on fashion in mobile technology focused on mobile devices in fashion consumption, despite a few research touching upon the styling in mobile design. However, institutional fashion theory tells us that there are a whole set of activities, including production, diffusion, and consumption, that turn clothing into fashion. In this way, fashion is generated not only through individual's personal expression and identity construction in consumption, but also by social activities in production. Thus, we here investigate fashion on the design side of digital technology.

To examine these issues we apply an associative design approach, which combines and recombines different materials, such as empirical studies, design prototypes, available technology, and theories, to inform new design spaces. Our results support an aesthetization in mobile design, but more importantly, they reveal many complexities regarding this topic. The aesthetization in mobile design experiences ups and downs. An increasing aesthetization leads to an increasing connection to fashion in mobile design, such as what occurred in the Grand period in Nokia design history.

When we further investigated the emergence of fashion in mobile design, we found that there are concrete connections between the fashion industry and the mobile industry. These connections, which reveal the institutional arrangements that make mobile phones fashionable, are best understood as action nets, as opposed to a structure-functional system. "Tech Fashion" is

proposed as a concept to describe flexible and dynamic action nets of institutional arrangements that make digital technology fashionable and desirable.

The thesis also provides concrete design cases that explore how to design new mobile and wearable devices that account for "Tech Fashion," (e.g. institutionalized fashion values). Designing fashionable technology does not mean making shells, attaching ornaments, or making computers in the form of clothing, as existing approaches of understanding fashion in HCI have believed. Designing fashionable technology should consider fashion thinking and institutions. It could be approached through a combination of hardware and software. Importantly, the institutional approach to fashion requires HCI researchers to recognize the ambiguity of fashion, including the importance of social belonging, which is evident in fashion institutions that regulate people's values and ideas about fashion. The challenge then becomes balancing individuality and institutionalization, instead of calling for limitless self-expression as a way to make sense of technology. Ultimately, we believe that HCI researchers could benefit from studying fashion to gain insights on how to make digital technology desirable and possess fashion "smartness." Thus, we call for a more extensive collaboration between fashion design and interaction design.

8. Summary of Papers

In the final chapter we briefly summarize the publications that are included in this thesis and those that are relevant to it. In all, two conference papers (Paper III and Paper IV) and one journal article (Paper II) have been published. Another journal article (Paper I) has been accepted and is forthcoming in publication. The fifth paper (Paper V) is a conference paper in submission. The first and the second papers aim to investigate the aesthetization and fashionalization in mobile design and how they take place in the design process. The third study explores how mobile devices are institutionalized to be fashionable items through gatekeeping practices. It frames a concrete design concept, which is outfit-centric accessory. The fourth and fifth papers present concrete design exemplars, which explore the new design space at the intersection of institutional fashion and digital technology. In the following, we present the abstract of each paper, along with a note on this author's contribution to the work reported.

8.1. Paper I: The life and death of great Finnish fashion phones- A historical periodization of changing style in Nokia phone design between 1992 and 2013

Zhang, Yanqing and Juhlin, Oskar (2016) The Life and Death of Great Finnish Fashion Phones- A Historical Periodization of Changing Style in Nokia Phone Design between 1992 and 2013, in *Journal of Mobile Media & Communication.* Forthcoming

This article investigates whether an aesthetization of mobile design is taking place and, if so, how it is being pursued through institutional practices in organizations. We conduct a visual analysis of all Nokia phone releases between 1992 and 2013 complemented by an interview series with key actors. The study reveals a continuous increase in aesthetic variation between 1998 and 2008 and a decrease between 2009 and 2013. The interviews reveal how the visual design was driven by organizational strategies and an orientation toward the fashion industry. The study reveals how aesthetic variation is weaved into a complex innovation system with sometimes conflicting demands deriving from e.g. technology and use interaction.

The empirical materials, including online corpus and interviews of the five key persons in Nokia company, were collected and analyzed by this author. Both the authors share the formulation of arguments and paper writing.

8.2. Paper II: Fashion in mobile phone design– The emergence of beautification, desirability and variation through institutional collaboration

Zhang, Yanqing and Juhlin, Oskar (2016) Fashion in Mobile Phone Design– The Emergence of Beautification, Desirability and Variation through Institutional Collaboration, in *Fashion Practice: The Journal of Design, Creative Process & the Fashion Industry,* Volume 8, Issue 1, pp. 63–84

This study investigates if and how fashion values, such as beautification, desirability through symbolic interaction, and high variation, are increasingly visible in mobile phone design. We unpack such possible inter-linkages by interviewing eight representatives of both industries. Our findings indicate that fashion values are visible in the design of mobile phones and are accounted for in design. Fashionalization can thus be seen as emanating from institutions related to clothing that extend to and become shared with the mobile industry. This interaction, ad hoc and heterogeneous, resists being modeled as a "system," which has been suggested as a way to explain institutional work within clothing fashion. Drawing on Barbara Czarniawska's institutional theory, we propose conceptualizing the emerging institutional work in terms of "action nets."

In this study, the authors share the conduction of interviews, the analysis of empirical materials and paper writing.

8.3. Paper III: Unpacking social interaction that make us adore- On the aesthetics of mobile phones as fashion items

Juhlin, Oskar, and Zhang, Yanqing (2011) Unpacking Social Interaction that Make us Adore- On the Aesthetics of Mobile Phones as Fashion Items, in *Proceedings of ACM Mobile HCI 2011*, ACM, New York, USA, pp.241–250.

We report on a study of fashionable people's expressions of opinions on mobile phones in online fashion media, such as blogs and magazines. First,

the study contributes to our understanding of the role of pragmatic philosophy, which is now dominating HCI as a guide for design. As part of aesthetic experiences, fashion practices diverge from this theory, as they can be visual, ambiguous and incomplete. Our findings suggest a less theoretically oriented approach to do design-oriented research. Second, the study provides valuable insights on how we should design mobile experiences to attract more attention from fashion conscious people. Mobile phones can for example be designed to relate to the visual appearance of outfit of a person.

The authors were listed in alphabetic order. This author contributes much to data collection and analysis. Conceptualization of findings and writing were shared between the two authors.

8.4. Paper IV: Fashionable shape switching: Explorations in Outfit-centric design

Juhlin, O., Zhang, Y., Sundbom C. and Fernaeus Y. (2013) Fashionable shape switching: Explorations in Outfit-centric design, in *Proceedings of CHI 2013*, ACM, New York, USA, pp.1353–1362.

We present a design exercise illustrating how fashion practices and the fashion design process can be used to create new opportunities both in the mobile domain and in wearable computing. We investigate the concept of outfit-centric design by extending the support for social and visual interaction with digital devices beyond shells and stickers, and drawing on the ways in which people vary their outfits. We designed a set of mock-ups in a local fashion style, as a first step to explore the outfit-centric accessory concept.

This author was responsible for conducting the pre-design user study and the initial user study of the designed mock-ups. The design idea of a shape-switching device was collectively done by the first, second and third authors. The third author conducted the design implementation by making the low-fidelity mock-ups. The writing was shared by this author and the second author, but with significant contribution from the fourth author.

8.5. Paper V: Fashion intelligent wearables: Apps and services for smart watches

Juhlin, O., Zhang, Y., Wang, J. and Andersson, A., Fashion intelligent wearables: Apps and services for smart watches, submitted to *Nordichi 2016*, in submission

This study explores how to apply fashion thinking in designing wearable devices, which are located similarly to clothing items. In an explorative design study we triangulate three methods, including a small study on the use of smart watches in dressing practices, a design of a service called "Watch for Figuracy", with a watch face contextually dependent on the wearer's dressed outfit, and finally an initial user feedback study. Altogether they indicate both the potential of fashion wearable hybrids and the shortcomings in utilizing color theory for clothes matching practices.

This author was responsible for conducting the pre-design user study and the initial user study of the application. The design concept was collectively framed by the four authors. The third and fourth authors implemented the prototype. Paper writing was mainly conducted by the first author and this author, with significant contribution from the third author.

8.6 Related publications:

Zhang, Yanqing and Juhlin, Oskar (2011) Fashion as system or action net in "Fashion in All Things": A case in color design of mobile phones, in *Fashion: Exploring Critical Issues (E-book),* Inter-disciplinary Press, ISBN: 978-1-84888-148-8

Zhang, Yanqing and Juhlin, Oskar (2012) A fashion phone for Swedish style- Exploring Outfit-centric design, in *Proceedings of Global Fashion Conference 2012*, Madrid, ISBN: 978-989-20-5336-3

Zhang, Yanqing, and Juhlin, Oskar (2015) Using crowd-sourcing to solve the fitting problems in online fashion sales, in *Proceedings of Global Fashion Management Conference 2015*, Florence, Italy

Zhang, Yanqing, Constructing Swedish fashion identity, Exhibition Review: Svenskt Mode (Swedish Fashion): 2000–2015, in *Journal of Fashion Theory*, August 2015, DOI: 10.1080/1362704X.2015.1071072

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