EXTRACT

Concept for a Coordinated Print Collection for Mass Customization

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Abstract

The topic of my Master’s thesis is positioned in the intersection of mass customization (MC) and collection coordination (CC), in the context of digitally printed home textiles. MC creates a variety of added customer value through active customer engagement that results in more personalized products and services, as well as many experience-based benefits. While MC always includes an active input from the customer, CC is by nature a strongly designer-led and/or company-led process. A printed textile, inherently highly aesthetical, is a challenging product for combining customer co-design and designer/company-led CC. Amongst services that offer customized printed textile products, this combination is not currently in use.

The aim of this thesis was to explore how the two strategies, MC and CC, can be combined, in the context of digitally printed home textile products. The work consists of a written component and a production part, which includes the creation of a concept and three prototypes. Prototypes were tested with four users.

The concept Extract combines the strategies of MC and CC into a digital product that can be used for similar purposes as a traditional coordinated print collection. Extract is a vision of a digital “print collection composition” that engages the customer in co-designing the physical end products. It creates added value characteristic to MC through customer engagement but ensures aesthetic brand consistency of the end product through designer-led coordination. The concept is strongly based on digitality: (1) Digital textile printing enables the production of unique made-to-order products. (2) Moreover, the concept’s essence lies in the nature of a digital content (the image to be printed), which is not bound by any physical limitations, such as requirements set by production methods. The concept describes the digital image as the primary product—and the produced final product is seen as an application of the originally digital product.

This thesis brings new insight into the field of digital textile printing and participates in the discourse of the potential of digitality in the field of print design. It studies what is needed for a joint approach of MC and CC, and proposes one way that this can be done. A variety of benefits can be created through coordinated customer engagement. Joining the two strategies will optimally result in a combination of both the value of MC and of collection coordination. The concept prototypes and gathered feedback show that the concept has potential and that it can create added value through the process as well as towards the end products. The prototypes also imply practical features worth refining or exploring in the future.

Keywords: mass customization, collection coordination, printed textiles, digital textile printing
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"Extract"

Extract comes from the Latin word extrahō, to draw out or forth.¹

verb

to draw forth⁴

to remove or separate²

to derive (pleasure, information, etc.) from some source or situation²

to deduce (a principle or doctrine); construe (a meaning)³

to derive (pleasure or comfort) from an experience¹

noun

a solid, viscid, or liquid substance extracted from a plant, drug, or the like, containing its essence in concentrated form³

part taken from a longer work⁴

³ http://www.dictionary.com/browse/extract?s=t
⁴ https://www.merriam-webster.com/thesaurus/extract

All retrieved 22.8.2017
INTRODUCTION
A painting crops a picture of reality and a photograph captures a moment. Into a story, one often chooses either a piece of life flavoured with imagination, or a piece of imagination flavoured with life. Who can decide when and where destiny begins? Isn’t it often so, that it has been affected by someone or some seemingly insignificant event long before we even existed? Who can then decide where the beginning of this story is and where it will end? Where something ends, something else is just beginning. Hereby, dear reader, I give you this full stop (.). I authorize you to place it wherever you want and declare that place to be the end point of the story.

- Alexis Kouros, in Gondwanan lapset (Gondwana’s Children), 1997
(Translation by P.L.)
I became interested in digital textile printing (DTP) during the very first years of my textile studies, and explored the topic deeper in my bachelor thesis (Lauri, 2014). I also had an opportunity to work as an assistant in the printing studio at Aalto University right around the time the school purchased a printer of its own. This led to a variety of inspiring tasks revolving around the printer.

DTP enables an exceptional freedom of expression for the print designer e.g. by removing most limitations in applying color and requirements for repeats. But even more than that, to me, DTP appeared as the better and more sustainable option in the bigger picture - the way of tomorrow. Indeed, it is a clean and in many ways a more sustainable manufacturing method, compared to traditional printing methods. But it also is very characteristic for me to be fascinated about the bigger picture: the concept, the scenario, the convention or the meaning are all closer to my heart, than for example designing a single product (although I do enjoy that as well).

Realizing the bigger picture, related to mass customization in the context of printed textiles, took me a while. I had pondered over the possibilities of customized print products during the time I first got interested in DTP, but I have to admit having a quite negative attitude towards them. For a long time, I saw customizing print products having only two kinds of potential. Firstly, a potential for intense personalization of products. By intense personalization I mean linking the product to one specific individual through e.g. a family photograph or the customers name. The other potential I could think of, was enabling the customer to design her own print. There is much value to be found in both approaches, but the value is not designer-led. Both of these approaches decrease the designer’s control over the quality of the product. I do think that there is much value in customer engagement, but as a designer, I feel that product quality is my professional responsibility. In this thesis I argue against my old self, by suggesting that mass customization of prints can be a designer-led process. Working on this project has been exactly what I enjoy the most: trying to understand reasons and meanings, envisioning scenarios and creating concepts.

DigiPrintNetwork

This thesis has its roots in a customer value research conducted at Aalto University as part of the DigiPrintNetwork1 (DPN) project (2015-2017). DPN is the birthplace of the inspiration that led me towards the final topic. Aalto University’s2 contribution to DigiPrintNetwork project was the research, centered in value creation processes in a digital printing service (Arvonmuodostuminen digitaalisessa tulostuspalvelussa).

DigiPrintNetwork research focused on customer-perceived value in a mass customization service, based on digital printing. The study included several customer group interviews, where the topic was addressed through two online service concepts (designed by Master’s students at Metropolia University of Applied Sciences, Helsinki). Both of these concepts were based on digital printing on textiles and other materials, and focused on customer participation in the creation of the print. (Niinimäki, Paavilainen & Lauri, 2017.)

Four the most relevant insights for me, regarding this thesis, from DigiPrintNetwork project are:

1. Customers appreciate unique products. This is widely confirmed by academic research and market trend forecasts, as will be presented later.
2. There are consumers who, despite their high valuation of product uniqueness, consider co-creation, especially of the aesthetics of a product (such as a print) challenging, risky, and to demand much effort, skills and other resources. This observation is also confirmed by several scholars, as will be discussed further down the line.
3. Some contemporary consumers associate digital printing strongly as an enabler of a unique, non-continuous surface composition, rather than a continuous pattern that consists of repeating elements, as is traditionally the case with printed textiles (or any other kind of textiles).
4. The consumer’s ability to anticipate the outcome of the mass customization process and the preconception’s perceived accuracy play a major role in value creation. In other words, from the consumer’s
point of view the product has to match what ever the consumer imagined it to be.

The latter two observations as such are only side notes from the research and will not be of great focus in this thesis, but have worked as a source of inspiration in concept creation.

Research Context and Objectives

Participation in the DPN research project raised questions that I wanted to explore further in this thesis. I wanted to build a background research that would inspire and guide me in the production phase of the thesis. The background research is based on a literature review, one interview, and benchmarking of products and services. I set the focus of the literature review to mass customization and collection coordination. The production part includes a concept, inspired by and derived from the background research, and a process of practical design exploration, resulting in three concept prototypes. Finally, I use the prototypes as tools to reflect on, to gather user feedback and to open further discussion. Figure 1 encapsulates the whole thesis process.

Research Question

How can mass customization benefit from collection coordination, in the context of digitally printed home textile products?

Research Objectives

In order to answer the research question I set the following objectives for the thesis:

- Benchmark what kind of mass customization options for home textiles and textile products currently exist.
- Identify what academic research related to mass customization (MC) has been conducted, especially related or could be applicable, in the context of printed textiles or home textiles and collection or collection coordination.

- Ideate a concept for printed home textiles that combines the benefits of collection coordination and mass customization.
- Create prototypes that embody the concept in practice.
- Gather feedback and test the concept with at least one customer.

Structure of this Thesis

This thesis includes a written component and a production part, both of which are presented in this book. In addition, the outcome of the production part (a concept, three prototypes and several co-designed products) is showcased concisely and mainly visually, in the separate EXTRACT -Lookbook.

Part I of this thesis introduces the background research. It starts off with chapter (1) Printed Home Textiles, in which I briefly present the markets of printed home textiles and discuss current market trends. In chapter (2) Coordinated Print Collection, I observe collection coordination from the point of view (POV) of the company and the customer, but in particular from the POV of the designer. I examine why and how collection coordination is done. In chapter (3) Digital, I depict a digital way of production (i.e. digital textile printing) and address the nature of digital content (i.e. the digital image to be printed). In chapter (4) Mass Customization, I dive into the concept of mass customization (MC). In addition to presenting a general overview to MC as a strategy, I concentrate on perceived customer value in MC programs. Part I concludes with chapter (5) Benchmarking, in which I present current examples of companies offering mass customization possibilities in the context of printed home textiles.

Part II presents the production part of the thesis. In chapter (6) Concept I describe the concept creation process, as well as the final concept EXTRACT. I created design guidelines based on the background research, after which I created the concept based on these guidelines. Chapter (7) Prototypes portrays, both verbally and visually, three
The production part of this thesis includes ideation of a concept and a process of practical design exploration, resulting in three concept prototypes. The concept was initially inspired by some observations I made during an earlier project (DPN research project) and it is strongly influenced by the background research. In the concept, I suggest that combining collection coordination and mass customization can result in a kind of added value that is based on benchmarking not yet offered in the context of printed home textile products. In other words, the concept aims to propose a new meaning for buying mass customized, digitally printed, home décor products. I considered the theory of radical innovation of meanings to correlate nicely with this aim and I used it to guide and inspire the process.

Innovation of meaning, according to Verganti (2014), is a strategy to not only create added value to products and services but to create added emotional value, “to make people fall in love with them” (Verganti, 2014). Product meaning as Verganti & Öberg explain, refers to “the purpose of a product or service as perceived by the user. It is about the purpose for why a product is used, not how it is used (the user interface), nor what the product consists of (its features)” (Verganti & Öberg, 2013: 87.) Unlike for example the performance of a product, meanings are contextual, co-generated and they cannot be optimized, “they can only be made sense of” (ibid.: 88-89.) Innovation of meanings is an iterative process of “re-interpreting” and “envisioning” new scenarios for the meaning of a product or a service - and it leads naturally towards needed practical solutions, but is not based on them (ibid.: 89-90).

Innovation of meaning requires a new vision for why consumers would buy a product. This vision, Verganti argues, cannot be found through customer surveys or user interviews, but by observing how people act (Verganti, 2014). Within innovation of meanings, technology holds the role of an enabler rather than an initiator and the innovation can stem from both new as well as existing technologies. (Verganti & Öberg, 2013: 88). It does not build on performance optimization, details or technical issues, but is rather about broader perspective and concept and scenario creation (ibid.: 91). Despite the prototyping, this project has a clear focus on the “why” (the concept) and it concentrates less on the “how.”

Part III of this thesis starts with (10) Discussion, in which I return to my research question and reflect on how well I met my objectives. I analyse the concept and the prototypes, and reflect on the user feedback I gathered in user tests. In addition to the outcome, I also contemplate on the design process and the whole journey of making this thesis.

In (11) Conclusions I specify the next logical steps for this project. I also describe practical implementations for the concept EXTRACT and discuss its benefits. Lastly, I ponder on potential aspects for future research.

Methods

For the background research of this thesis I focused on mass customization, customer-perceived value in the context of customer engagement or co-design, and print collection coordination. In addition, I discuss digital printing of textiles, the nature of digital textile print, and take a quick glance at the current markets of printed home textile products. Background research is mostly based on reading academic articles and other publications, as well as one interview. I studied the market trends through several internet based sources, such as published trend reports and, for example, blogs that discuss trend forecasts. I benchmarked current examples of companies offering mass customization possibilities in the context of printed home textiles. In practice I conducted web searches with related keywords such as “customized bedding”.

prototypes and their design process. Each of the prototypes is a slightly different interpretation of the concept EXTRACT. I open up the design process and discuss reasons behind design decisions. Chapter (8) Products showcases the prototypes “in action” by displaying user tests with four third-party participants and several exemplary products, each co-designed by a participant. All exemplary products presented in the thesis are co-designed by a participant. In chapter (9) Feedback, I describe some of the most interesting user feedback and observations I made during the user test sessions.
Prototype designing was an iterative process of interpreting the concept into practice. I use the prototypes as tools to reflect on, open discussion, and gather user feedback. The concept includes a designer-led part (collection design) and a customer-led part (product extraction). By product extraction I mean the process where the customer is engaged in co-designing the end product. I acted as the designer and it was essential that someone else - a potential consumer - did the actual extraction of the products. In fact, all exemplary products presented in this thesis have been extracted by someone other than myself. Arranging for a couple of these potential customers to do their part, also gave me an opportunity to gather feedback. Thus, I organized four, rather casual and small scale, user test and feedback sessions. The feedback is not systematically analysed, but most interesting observations are discussed.

By product extraction I mean the process where the customer is engaged in co-designing the end product.

- P.L.
Part I

BACKGROUND RESEARCH
Introduction to Background Research

The focus of my thesis is situated in the intersection of mass customization, collection coordination and digitally printed home textiles. An intersection that based on benchmarking does not exist yet. In addition to these three areas, the background research also discusses digital production (textile printing, DTP) as it is an enabler of mass customized textile products. For the purpose of creating a basis for the concept creation phase of this thesis, I also discuss the nature of digital content (digital image to be printed), which I will argue is an enabler of coordinated mass customization in the context of printed home textiles. The current state of the cross-section of mass customization and printed home textiles is presented through benchmarking companies offering mass customized home textiles. Positioning the topic of this thesis is presented in figure 2.

The market of home textiles is growing and becoming increasingly more fashion sensitive. This is largely due to growing variety in supply and the boom of more personalized options, enabled by flexible production methods such as digital textile printing. In chapter 1 I tell more about these trends and offer visual examples of current home textile products.

Collection coordination, a fundamental concept in fashion and textile industries, is a highly beneficial tool for both; it is the creator and manager (e.g. a designer or a company), as well as the customer. Collection coordination in its core is about strategic management of an entity of individual parts. It can also be described as storytelling, as I present in chapter 2.

Advancements in more flexible and digital manufacturing technology, such as Digital Textile Printing (DTP), lead to new business possibilities and strategies. In addition to a quick glance at DTP as a manufacturing technique and industry, in chapter 3 I discuss the nature of digital content or a digital image, especially in the context of DTP.

In chapter 4 the concept of Mass Customization (MC) is introduced. One objective of this thesis was to identify what aspects and findings in the existing research of MC relate to the field of printed home textiles or collections. I did not come across any that would address MC directly from the perspective of a collection or a cohesive group of products. I found some experimental studies that address the mass customization and co-design of aesthetics (e.g. color, surface design or style) of a product. However, they are all based on single, quite simple products (e.g. T-shirt or cell phone case). A variety of reasons why mass customization increases perceived customer value have been identified by scholars. I will present all that I found to be applicable in the context of this thesis.

Finally, chapter 5 concludes the Background Research of this thesis with some current examples of companies offering mass customization possibilities in the context of printed home textiles.
1 Printed Home Textiles

The EU home textiles market is valued around 14 billion €, and it's experiencing rapid growth (Home Textile Investments..., 2016). According to the Global Home Textiles Market Outlook forecast, the sector of home textiles "has become one of the most attractive segment in the textiles industry" (Global Home..., as cited at fibre2fashion.com).

Prints are used across a manifold of market sectors: fashion apparel, interior, home, stationary, packaging, to name a few. Interior textiles include e.g. upholstery textiles and curtains. Printed home textiles include all textile product categories closely related to home life, such as textiles for bedroom, kitchen, and bathroom. Bedding and bath textiles are the biggest sectors of home textiles (Martin, 2016).

Print, in general, is an extremely creative industry and it has more artistic dimensions than many other industries. During recent years the home textiles market has become more fashion sensitive and brands are ever more closely related to home textile products. (Martin, 2016; Global Home..., as cited at fibre2fashion.com; Innovations in Home Textiles..., 2017.) Even though there is always a constant demand for classic textiles with a familiar look (Ujiie), fashion sensitive consumers are now increasingly demanding also more distinctive and fashionable prints, not just in their wardrobes, but also in their homes. (Global Home..., as cited at fibre2fashion.com; Innovations in Home Textiles..., 2017.) The fashion brand Gucci has recently launched a home décor collection with which "customers can dress their own spaces" (Gucci press release as cited at Vogue, 2017).

Despite the growing variety in home prints, some common characteristics that separate home prints from prints for other purposes can be found. One of them is the scale, which is usually bigger in home prints than e.g. in fashion prints. In addition, home textiles are more often observed as bigger and (almost) flat surfaces compared with fashion prints, which puts extra emphasis on the composition. The composition (usually the repeat) will often be more visible in a home product, than on a piece of apparel.

1.1 The Intangible Value of Home Textile Products

The need for individuality, meaningful experiences, and wellbeing are global megatrends. They fuel the global market trends that manifest through consumer behaviour - also in the sectors of home décor and home textiles. Current market trends include e.g. customization, storytelling and "new luxury" products. (CBI Trends, 2016.)

The need for individuality leads today’s consumers to crave for unique and original products. Enabled by the internet and e-commerce, consumers are increasingly developing their "brand identity" and connecting with others that share similar preferences and way of life. They want to make individual choices about the products and services they consume: owning and co-creating customized products support the quest of individuality and uniqueness. Textile Outlook International (2016) state digital printing as the major factor in satisfying customer needs in the future textile markets, largely due the coming of age of millennials1, who regularly invest on home décor products and especially demand more personalized products for the home. Companies use storytelling in order to appeal to and connect with their customers on an emotional and meaningful level. And it’s working: contemporary consumers are highly attracted to stories and marketing that utilizes interactive narratives and game-like features. (CBI Trends, 2016.)

The trend of "new luxury" derives from the trend of wellbeing and refers to consumer needs such as seeking pleasant and meaningful experiences, learning new and status lifting skills and living eco-friendly. "New luxury" products are beautiful, comfortable, functional, and of good quality. (CBI Trends, 2016.)

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1 Millennials refers to a demographic group of individuals born roughly between 1980's and early 2000's, i.e. who reached adulthood either around the change of the millennium or they are reaching it now, in the late 2010's. (Techtarget.)
At first glance, the sector of home décor should be all about physical products and materials. However, today’s customer value is “hidden” in intangible experiences, meanings and messages. Products need to bring about experiences and communicate the consumer’s values, taste and persona to others (CBI Trends, 2016). The European textile industry has, indeed, understood the importance of added value creation and companies are reportedly moving away from mass production and focusing on high product variety and high value added products (Textiles and clothing in the EU).

Lastly, this spread (picture 1) presents a collage of visual research of contemporary home textile products. The research was quite superficial by nature, it is rather a glance at some popular home décor retailer’s (e.g. H&M, Zara home, IKEA) newest additions to their home collections.
2 Coordinated Print Collection

The literature on print collection coordination or collection design in general is rather limited. Therefore, in addition to the few sources especially about print collection development (from the designer’s perspective) and literature on product portfolio management (which is closely related to collection coordination) I interviewed (28.6.2017) Creative Director and Adjunct Professor in 3D Surface Design in Aalto University, Maarit Salolainen. Salolainen has a 15-year experience in collection design, especially in the field of textiles, and she could thus bring a valuable addition to the content of this chapter. Much of my own knowledge about print design and collection coordination originates from my textile design studies at Aalto University, a course called Pattern Lab in particular. Pattern Lab is a yearly course of surface design and collection coordination, in Aalto ARTS. The student-led, but supervised, project works like a professional company and sells patterns in Finland and internationally.

Product portfolio management (PPM) is a widely researched and refined business strategy (Cooper, Edgett & Kleinschmidt, 1999: 334-335). In the context of fashion and textiles, the terms collection management or collection coordination are more commonly used than PPM, but fundamentally they follow the same logic (Salolainen, 2017). PPM, or collection coordination, is the core of a company. It is strategic management of the variety of product supply and stocks. Product portfolio management is a strategic and iterative decision-making process regarding resource allocation and prioritization. (Cooper et al.,1999: 334-335; Salolainen, 2017.)

2.1 Collection Coordination is Storytelling is Branding

Collections and collection coordination are fundamental in the contexts of fashion apparel or textiles. A coordinated collection of products compared to merely a group of individual products is a completely different thing. A collection basically embodies it all into one story: the company brand, market, end-use and customer objectives, the theme or concept set for a season, as well as requirements set by production. (Russel, 2011: 138; Salolainen, 2017.) According to Howell (2015: 128), a print collection has “a feeling, a thread, and an essence running through and between the patterns”. My own definition of a coordinated collection is: a collection is an inspiring and cohesive entity that is bigger than the sum of its individual parts.

Storytelling is a powerful branding tool, marketing tool, and a way to inspire and engage the customer. The company communicates its brand through the whole of its supply - for example through collection coordination. A coordinated collection tells a story through and by combining individual elements. All of the individual elements (prints) affect how the whole (collection) is perceived, and shape the story that is being created. Salolainen (2017) gives an example of a floral print combined with a square print. The style of the square print (e.g. whether it’s a strict black and white “rock’n’roll” check or a softer gingham check) affects the story of the floral print (I have visualised this example in picture 2). A good collection includes enough variation (different prints), as variation attracts many different customers, but also serves a single customer as broadly as possible. Variety in the context of collection coordination does not mean slightly different variations of the same, but a diversity of clearly different designs that “go together”, that can be combined. Carefully designed variety leads to quantitatively bigger customer purchases, as trade-offs between too similar products decrease, while the amount of easily combinable products increases. The customer wants the whole package, instead of a single product, e.g. s/he takes the whole outfit, instead of just the blouse. (Salolainen, 2017.)
2.2 Collection Coordination in Practice

A print collection is usually designed in response to a design brief but can be also created without any requirements set from outside, e.g. by a freelance designer to build up a cohesive design portfolio section. Even in this case the freelance designer normally starts by creating a concept and therefore ends up creating a design brief for him/herself. A design brief is followed by a research that consists of both artistically and thematically inspirational material, as well as getting to know the objectives of the collection, potential markets, end-use and customer. (Russel, 2011: 138; Clarke, 2011: 177-180; Pattern Lab process, 2016; Salolainen, 2017.) An artistic research can include inspiration across all mediums. Designers gather visual material, physical objects or e.g. music. The essence of the research is then percolated into a moodboard that displays a composition of paramount images, texts and objects. A clear concept, visualized as a moodboard and a color chart, sets the basis and guidelines for designing a collection. Themes and moodboards are used broadly, from inspiration to marketing the final designs or products. (Clarke, 2011, 178; Pattern Lab process, 2016.)

Moodboard is an essential tool for a collection designer. It inspires and most importantly sets design guidelines for individual prints as well as managing the collection as a whole. What should be included is as important as what should not be. A moodboard is not "literal" (e.g. a moodboard of a print designer does not include pictures of actual prints), nor does the designer create a group of designs somewhat loosely inspired by the mood of a moodboard. The moodboard is the story, with all its inspiration as well as limitations. It sets the designer to the right path and keeps him/her there. Interpreting a moodboard is easier than working without it, i.e. without any base story or limitations. In David Ogilvy’s words: “Give me the freedom of a tight brief”.

The designer may get inspired by a certain spot, feature, detail, color, feeling, or a combination of them on the moodboard, that s/he then interprets into a print design. By continuing this way of working the designer will end up with several different designs that still cohesively belong to the same story, i.e. the moodboard. If the moodboard is a cohesive and attractive entity of different parts it will result in a cohesive and attractive entity of individual designs (Pattern Lab Process, 2016; Salolainen, 2017). On the next spread I present an example of a moodboard and a collection based on it (see pictures 3 and 4).

Designing a collection is an iterative and multifaceted process, where the designer switches between two different roles: an artist-designer and an editor-designer. By switching between these roles, the designer switches between perspectives. The artist-designer is the maker and explores expression at the level of individual prints, while the editor-designer takes a few steps back and examines the whole from a larger perspective: the relations between prints, how they suit the concept and how they meet the objectives of the brief. As an editor-designer one, for example, tends to the fine line between overlapping designs (too similar) or designs that don’t belong (too different). (Pattern Lab process, 2016, Clarke; 2011: 168-176.)

Russel (2011: 138) defines print collections as “groups of prints that are linked by colour, style, content, presentation and end-use.” A print collection usually consists of distinctive main prints, which clearly communicate the story and of coordinate prints that support the main prints. Coordinate prints are more subtle and “basic” than the main prints, they often are simple geometric patterns or abstract surfaces. In individual prints the designer considers e.g. colors, motifs, scales, rhythm and composition of the pattern. Coordinating a collection means to consider the relationships between these elements. A successful collection precisely represents the set color and mood and offers a smart and balanced variety of suitable print types, scales rhythm and composition styles. (Clarke, 2011: 180; Pattern Lab Process, 2016; Salolainen, 2017.)

A print collection can be presented on paper, on fabric or digitally. In addition to (1) the actual individual prints in full scale, the final presentation package of a collection usually includes: (2) a collection map that shows a piece of all prints at a single glance, (3) technical information on repeat size and color amounts, (4) small scale illustrations of the pattern repeating (5) chips of individual prints for quick referencing, and (6) illustrations of end-use, e.g on a product. (Russel, 2011, 139-145; Pattern Lab process, 2016).
Collection map of my own Arctic Noir collection, showing prints as well as woven and laser cut designs. All students in the Pattern Lab course interpreted the co-created moodboards into a collection of their own.

Picture 3 Moodboard for Arctic Noir. Arctic Noir was one of three collections created during the course Pattern Lab, in 2016. Moodboards are co-created by the whole body of students who took part in Pattern Lab 16 course.
3 Digital

3.1 Digital Production

Advancements in manufacturing technology lead to new business approaches and strategies (Chen, Heyer, Ibbotson, Salonitis, Steingrímsson & Thiede, 2015) as well as novel design aesthetics and styles (Ujiie). Mass production in the beginning of the 20th century was fuelled by advancements in lean manufacturing technology that enabled the production of standardized, good quality products in large volumes. In the late 20th century a growing variety in customer demand and technological developments led towards more flexible manufacturing and a strategy of mass customization emerged. (Chen et al., 2015.) Mass customization enables the production of customized goods, with nearly the same efficacy as mass production (Pine, 1993). Recent technological advancements continue bringing increasingly more flexibility to production (Chen et al., 2015).

Digital Textile Printing, DTP

The first digital textile printer was developed by the carpet manufacturer Milliken in the 1970's, but it wasn’t until the new millennium when major technological advancements (especially the large format color ink-jet printer) started to bear fruit and Digital Textile Printing (DTP) begun to seriously attract producers. (Carden, 2016: ch2 : Digital Printing1.) Digital printing works similar to an ink-jet printer: it delivers small dots of color from which the image is composed on to a base material. DTP can refer to either direct printing on textile or transfer printing, where the image is first printed to a transfer paper and then applied to fabric or other base material with the help of heat and pressure. (Doe, 2013: 10.) DTP has been a revolutionary technology. It makes possible completely new ways to design, manufacture, sell, buy, and use textile products. And surely all of its implications have not yet been seen or even invented.

Even though DTP is continuously growing, from the whole textile printing market it still claims a share of only 3.5%. The sector is dominated by rotary screen printing (65%) and automatic flat screen printing (25%). Hand screen printing, dye sublimation transfer printing, and copper roller printing hold the remaining 7.5% of the markets. DTP is mostly used in signage and banners, as well as in fashion apparel. 8% of all digitally printed textiles are produced for the home textile sector. (Textile Outlook International, 2016: 9.)

DTP liberates the designer from restrictions characteristic to traditional printing methods such as a limited color amount or repeats. It enables advanced aesthetics, such as fine line details, gradients and a vast amount of colors. From the producer’s perspective, DTP facilitates quick try-outs, shorter lead times and smaller production lots. Digital printing allows companies to offer a cohesive, coordinated look in a wide range of different products, from floor tiles, bedding and tableware to packaging (Chapman, 2017: 17-18). In a broader context DTP makes possible a new kind of value creation. Textile Outlook International highlights digital printing as the major factor in satisfying customer needs in the future textile markets. This is greatly due to the coming of age of millennials, who have been found to be especially attracted to customizable products (Textile Outlook International, 2016).

In addition to enabling a completely new kind of aesthetics and approaches to production, DTP redefines the concept of printed textile design. Printed textiles and print design are now more broadly applicable across product and material categories, and designing printed textiles is more accessible to non-textile designers. (Ujiie.)

3.2 Digital Content

Digitality is changing everything. It is reshaping the way we experience the very fundamental dimensions of life - time and space. What seems to be the biggest limitation in digital is, that the pace that people are adapting to new things is slower than the pace that innovations are made. But eventually we will all get used to e.g. interpreting the
world through screens, constantly flowing real time content and virtual spaces (see e.g. Kelly, 2016). Digital does not have the same limitations that apply to physical matter. Paper or books are “fixed” products, but digital content is “liquid” and does not obey the same laws than “fixed” matter and objects. Digital has no “fixed” permanency, it is forever intangible and changeable. It has endless possibilities and practically no restrictions of size or form. (Kelly, 2016: 64-67.)

In the case of digitally printed textiles, defining what the product is becomes challenging. In other words, is the product the printed fabric or the digital file that holds the DNA of the printed image? Carden (2015) argues that the digital file (that encloses the image to be printed) can be regarded as the primary product, whereas the digitally printed textile can be seen as a physical interpretation of the originally digitally visualized product. A digital print design, by itself, is not a physical product yet. Only after it is produced into physical form (i.e. printed on fabric) it gains its material properties. These material properties are then strongly linked to the chosen printing techniques and base materials. In essence, a digital print design, by itself, is visual content that only after execution is tied to a physical form. Carden (2015: Ch.6: Components and conditions…) discusses the nature of a digitally printed textile in depth. She argues that the authenticity of a digital print ends the second it is produced, after which it becomes merely a reproduction of the authentic. She explains: “The means of reproducing does not include the final printed artefact, so it would appear that the term digital textile print encompasses a number of processes, including everything that is necessary to print a digital image digitally, but does not include the dye-formed image once it is in a physical state. The final printed textile, similar to a traditional printed photograph on photographic paper, is a post-condition of the process.” (Carden, 2015: Ch. 6: Original condition). Carden encapsulates her thoughts brilliantly: “Digitally printed textiles are a crossing over of materials, from physical to non-physical [ … ] one foot in the physical world and one in the digital world.” (Carden, 2015: Ch6: Knowledge in Digital Textile Printing.)

“Digitally printed textiles are a crossing over of materials, from physical to non-physical [ … ] one foot in the physical world and one in the digital world.”

- Susan Carden (2015: Ch6: Knowledge in Digital Textile Printing)
4 Mass Customization

Mass customization (MC) is already a largely applied and researched approach. Customization is steadily gaining popularity, especially among millennials, among who MC is often already considered more as self-evident than an alternative (Flynn & Vencat, 2012: Ch:3). MC creates added customer-perceived value through active customer engagement that results in more personalized products and services, as well as many experience-based benefits. Digital communication and production technologies have made offering MC increasingly more possible and accessible. While some MC programs have had great success (e.g. NIKEiD), some have failed (e.g. Levi’s Original Spin) and shown that the success of mass customization is not self-evident. (Franke & Schreier, 2010: 1020.)

The concept of mass customization (MC) was initially introduced by Stan Davis in 1987 and later refined by Joseph Pine. MC is a combination of two seemingly opposite approaches: mass production and customization. Pine defined MC as producing personalized products and services with nearly the efficacy as, and with the means of, mass production (Pine, 1993). Pure customization can be defined as a product or a service especially designed and constructed to fit the needs of an individual customer. Mass production refers to the opposite: large batches of the same standardized product are produced and sold, in great volumes. Customization can complicate scaling the production, whereas mass production usually limits the product variety. In MC, flexible product or service features enable moulding them to match an individual customer’s needs, while production and distribution are premised to cost-efficient methods as in mass production. (Pine, 1993: 14-18, 44-48; Blecker & Abdelkafi, 2006: 1-2.) MC always requires some amount of customer participation, but the degree of customer engagement can differ quite drastically between different MC approaches. Terms such as co-creation, co-design and prosumption (producer + consumer) are used when the customer is involved in the design process. Meanwhile almost completely mass produced products can be called mass customized if they include some adjustable element (e.g. car seats that are completely standardized and mass manufactured but can still be adjusted by the driver). (Blecker & Abdelkafi, 2006:3-4.)

A toolkit is the medium of mass customization: it’s where the service provider and the user meet and the mass customization happens. A MC toolkit is a (usually digital and internet based) tool or platform that allows the consumer to make modifications to the design or the product. There are different approaches to MC toolkits, from which the most common ones are: alternative-based and attribute-based. The slightly simpler version, the alternative-based approach is a selection of ready options that a customer can choose from. A more complicated set up, the attribute-based approach allows the customer to build the product out of different feature components. The simpler, alternative-based approach is suggested to be more suitable for novice users as well as for early and late majority product adopters (see figure 3). The attribute-based approach in turn is proposed to better fit more experienced users as well as innovators and early product adapters (Hunt, Radford & Evans, 2013: 334). The most valued feature in a MC toolkit is instant visual feedback that helps to anticipate the outcome (Chang et al., 2009: 148).

MC creates added customer-perceived value through active customer engagement that results in more personalized products and services as well as many experience-based benefits. Major positive returns of MC in practice include increased customer satisfaction, willingness to pay the premium price, and customer loyalty. (Spaulding & Perry, 2013; Hunt et al, 2013: 329.) These benefits are all due to the added customer-perceived value of MC that arises from both the customized end product as well as the whole MC process experience.

The biggest challenges of MC are its complexity and slow pace. From a company’s perspective it can become laborious to predict demand or manage production processes. From the customer’s point of view (POV), for example the spectrum of available choices can be puzzling and longer lead times irritating. (Blecker & Abdelkafi, 2006.)
4.1 Customer-Perceived Value in Mass Customization

Customer-perceived value is positively influenced by perceived benefits, whereas perceived risks affect it negatively. In other words, value is what is left when risks are subtracted from benefits. Perceived benefits and risks can be quantitative or qualitative. Perceived risks are e.g. related to the cost of all different customer resources (economical, time, effort, etc.). (Hunt et al., 2013.) From the customer’s POV the value of MC lies both in the outcome and the process. Various drivers affecting customer-perceived value in MC have been identified by scholars: (1) perceived preference fit (functional or aesthetic) (Franke & Schreier, 2008), (2) perceived product individuality and uniqueness (Tian, Bearden & Hunter, 2001; Franke & Schreier, 2008), (3) perceived process complexity (Blecker & Abdelkafi, 2006), (4) perceived control (Chang, Chen & Huang, 2009), (5) psychological ownership (Franke, Schreier & Kaiser, 2010), and (6) process enjoyment (Chang et al., 2009; Franke & Schreier, 2010).

Positive Value Drivers

Some customers may find value in the optimal fit or aesthetics of a MC product, while some appreciate the engaging process of the MC. As in a broader context of consumer behaviour, the consumer first and foremost needs to want the product. More precisely, there needs to be a match between the customer’s functional, aesthetic and/or symbolic needs, (such as the need for uniqueness) and the product. A customer taking part into a MC process can influence the outcome and gets a product with optimal functional and/or aesthetical preference fit or level of uniqueness. Optimal fit or level of uniqueness delivers added value, compared to an off-the-shelf product. (Franke & Schreier, 2008; Hunt et al., 2013.) The uniqueness of mass customized products is valued by consumers who build, boost, or express their personal and social identities through them. (Tian et al., 2001.)

The belief that customer participation directly increments customer value is deeply embedded in the concept of MC. (Chang et al., 2009: 147-148; Franke & Schreier, 2010: 1020; Fiore et al. 2004: 845). While the customer is always greatly involved in value creation (Vargo & Lusch, 2004: 11), his/her contribution becomes ever more significant in a mass customization process. (Hunt et al., 2013: 329; Blecker & Abdelkafi, 2006: 9-10.) MC can be seen as customer co-design or co-production as it, in all of various forms, always requires an active input from the customer’s part. Although customer participation increases perceived value of a product, it does so only up to a certain limit: there is a point after which more input of resources (time, abilities, money) will be perceived as effort, which again diminishes perceived value. (Franke et al., 2010: 137.)

The customer evaluates the MC experience as a whole. Franke & Schreier (2010) show that the outcome is evaluated through the whole experience, not only through actual end product features. The same goes the other way around: the whole process will be assessed according to how satisfied the customer is towards the outcome. Perceived process enjoyment creates added value, even over the obtained preference fit of the product. In other words, merely a good experience can increase perceived value of the end product, regardless of the product features. However, a bad experience may not alone diminish the value of an end product. (Franke & Schreier, 2010: 1029-1030.)

Co-designing can be seen as creative expression (Fiore et al., 2004: 838) or having control (Hunt et al., 2013: 12) over the process of designing, both of which increase the customer’s psychological ownership of the product and experiences of pride and achievement. (Chang et al. 2009: 152; Franke et al., 2010: 127.) The customer’s own contribution gets embedded into the product and the experience may stay present (e.g. as memories and associations) within the product for the rest of its life cycle (Hunt et al., 2013: 12).

Negative Value Drivers

Some consumers, while interested in using customized and unique products, are still not willing to invest the resources (effort of engagement or money) that it requires. (Hunt et al., 2013: 328.) According to Deloitte Consumer Review, 42% of the people that report...
an interest in customized products are still rather "led by brands and choose from a selection" (Deloitte, 2015: 3).

A mass customized product requires more resources and effort from the customer than an off-the-shelf product (Blecker & Abdelkafi, 2006; Hunt et al., 2013). Co-creating is also referred to as prosumption (producer + consumer). The concept of prosumption, originally created by Alvin Toffler (1980), emphasizes the nature of co-creation as an iterative process of trying and learning. While inspiring positive feelings of achievement and pride, prosumption, or co-creation, also requires motivation as well as tolerance for frustration and mistakes. (Xie, Bagozzi & Troye, 2008: 112.)

Perceived complexity may cause uncertainty and frustration, and thus decrease perceived value. Perceived complexity originates from cognitive effort, customer’s lack of required knowledge and dubiety of own preferences. Cognitive effort is required when one is processing information and considering options. Lack of required knowledge (e.g. about the product) may complicate rational comparison between different options. And lastly, dubiety of own preferences refers to those customers that do not have (or don’t realise they have) specific preferences prior they need to make a decision. In other words, the preference is born within the situation of deciding. This may cause unsure decisions and "wrong" purchases that will be regretted later. (Simonson, 2005: 33; Blecker & Abdelkafi, 2006: 14-16; Niinimäki et al., 2017: 36.) Perceived complexity is suggested to affect the consumer’s overall motivation towards MC (Dellaert & Dabholkar, 2009: 60-61). However also the contrary has been argued: for example Franke & Schreier (2010) propose that perceived complexity depends greatly on the customer satisfaction towards the outcome, i.e., a satisfactory product makes the process seem like an accomplishment rather than an effort.

MC's unpredictability is caused by difficulties of anticipating the outcome in advance and perceived risk of not being able to call off the process. These factors also have a value decreasing effect. MC usually requires trusting in some kind of digital visualization and one's imagination in order to anticipate the end product, as the actual product is not present (e.g. in web environment) or simply because it is not produced yet. Additionally, going back, i.e. cancelling the order or returning the purchase, is clearly a more complicated matter with MC products than mass produced products. (Hunt et al., 2013: 329.)

**4.2 Brand Related Value of Mass Customization**

As mentioned already, over 40% of those people that initially report an interest in customized products are still rather "led by brands and choose from a selection" (Deloitte, 2015: 3).

No research could be found that would address MC directly from the perspective of a collection or a cohesive group of products. All experimental studies explored that address the mass customization and co-design of the aesthetics (e.g. color, surface design, or style) of a product (instead of e.g. it's functional properties) are based on single, quite simple products (e.g. T-shirt or cell phone case). However, if collection coordination is understood as a tool to manage and communicate the brand (as it is in this thesis, see chapter 2) it is beneficial to examine the relation between MC and brand value.

As already discussed, co-designing increases the customer's psychological ownership of the product through experiences of pride and achievement (Chang et al. 2009: 152; Franke et al., 2010: 127). This perceived ownership may extend from product to the whole company or brand as the customer feels as a partial employee (Teichmann, Scholl-Grissemann & Stockburger-Sauer, 2016: 26). Teichmann et al. (2016) show that co-design increases the customer-product attachment as well as the customer’s emotional bond with the MC offering company. Moreover, they argue that the willingness to pay a higher price for a co-designed product, compared to a corresponding off-the-shelf product is in fact due to the perceived emotional bond with the company, not with the product. (Ibid.: 24 -25.)

Teichmann et al. (2016) focus on customer-company identification, which refers to the perceived "shared similarities between the..."
customer's identity and the company's values" (ibid.: 17). They show that although co-design creates more perceived value towards the product than towards the company, the willingness to pay extra for a customized product is due to the brand. (Teichmann et al. 2016.) An even more interesting question would be how MC and co-design affect the perceived brand consistency (the similarity across a brand’s range of supply), especially in aesthetics and style, i.e. can a co-designed product reflect aesthetical brand consistency (which is here presumed to be a significant value driver in fashion sensitive consumer behaviour)? Also Fiore et al. (2004) recommend the relation of brand and co-design in MC as an interesting topic for further research, for example “how to ensure the aesthetic of the co-designed product fits with carefully crafted brand image” (ibid.: 845-846). This is an extremely interesting question, but one that I could not find an answer to from literature. Therefore this question will be explored further in the form of a practical example in the next chapter.
5 Benchmarking

This chapter will examine more closely the already mentioned NIKEiD service. After that, benchmarked examples concentrate on companies offering mass customized, printed, home décor products.

5.1 NIKEiD

The previous chapter concluded with a question about ensuring aesthetical brand consistency in a co-designed, mass customized product. This question led me to take a closer look at the already mentioned NIKEiD. Nike Inc. is an American, globally renowned company and brand offering e.g. footwear and apparel. NIKEiD is Nike’s established and successful mass customization (MC) program and it is a clear example of a service that offers both MC and brand consistency.

In the NIKEiD service the customer can customize the shoes of his/her choice, section by section (see picture 5). S/he can make a combination of his/her choice, from a selection of colors, patterns and materials (see picture 7). The possibilities per section are not very wide, there are usually about 3-10 possibilities for each section, from which most are plain colors.

Combining all alteration possibilities of each separate section there is still a large amount of possibilities in how the end product could look like. The offered selections are carefully coordinated. All shoe models have different selections of colors and patterns to choose from: to some shoe models it is only possible to adjust the colors, while to another model it is possible to choose between colors and patterns. All possible versions of each model are planned by coordinating the selection of possibilities. Therefore no matter how the customer compiles his/her shoes, they will look good, as the designer wanted, and reflect the Nike brand.

The brand consistency in NIKEiD may lie mostly in the structural and the material design of the Nike shoe. The prints or colors Nike offers are not that distinctive that they could reflect the Nike brand alone¹. They do so only when combined with the shoe design. Compared to a shoe, in the sector of printed home décor products the structural design or the shape of the product (e.g. printed bedding or kitchen textiles) is often quite generic and does not easily reflect the brand alone. There is no Air Force ¹ of bedding, i.e. a sheet model that would be recognized merely from its shape and structure without any color or print. In other words, in printed home décor products the print plays a major role in reflecting the brand. When it comes to textiles, chosen materials and textile structures always play an important part too. But if the product has a print, that print needs to reflect the brand, it is not enough that e.g. the material choices do so alone. To ensure brand consistency related to the print, the print needs to be designer-led and the range of choices given to the customer should be coordinated, i.e. designed so that it is impossible to make a “wrong” choice.

¹ This could be debated, considering for example Nike’s classical speckle print (see picture 6) that they utilize in slight variations across product ranges and collections. But the speckle print is quite basic by nature and is “classic Nike” only combined to a Nike product (i.e. a mere fabric with the speckle print would probably not be commonly recognized as the Nike brand).

² Air Force 1 is an iconic Nike shoe model, also featured in the example pictures on this page.
5.2 Mass Customized, Printed Home Décor

In order to gain a clear picture of the current state of mass customization in the context of printed home textiles, I took a closer look at several companies offering customized products in this specific context. I examined these companies from the perspective of collection and collection coordination in particular: I studied the level of coordination in the supply of surface design choices (not products) that they offer and whether the companies encourage the customer to buy a set of products or a single product. I also observed how the final products reflect brand consistency, in particular the aesthetics (e.g. the print). I found that most services offer customized home décor products as a way to accent one’s home (instead of decorating it fully) with one product or a set of several products displaying the same pattern (e.g. duvet cover and a pillow case). I will here briefly present the findings.

Within the benchmarked companies, most offer the customer blank products and the possibility to apply his/her own photograph or text to them. These type of companies commonly have a large variety of base products from several product categories. Some of these companies offer ready texts or slogans to be combined with the photograph and ready layouts for making easy picture collages. In addition, some offer an art library of patterns. Notably, these art libraries are not curated or coordinated, they are groups of single patterns. Buying a set of matching products is encouraged, e.g. by displaying a duvet cover and a pillow case with the same pattern, next to each other. The customer-perceived value of this type of service lies in the product, made unique and personal through a unique and personal photograph or message. As there are ready components offered for the print (i.e. layouts and slogans), some aesthetic brand consistancy can be seen in the final products: the designer’s (e.g. of the slogan) input stays present in the final products print.

Some companies enable the customer to apply his/her own design to fabric or a blank base product. Many of these companies also offer a platform for making the design. Spoonflower, founded in 2008, was the first B2C (business-to-customer) DTP (digital textile printing) company (Wisbrun, 2012:150) where the consumer can order digitally printed products with his/her own design. Spoonflower offers fabric, wallpaper, apparel, and a small range of accessories and home décor products, such as cushions. The consumer is able to sell his/her own designs through the Spoonflower website. S/he can also buy designs done by other users. From Spoonflower’s sister brand Roostery it is possible to order a wider range of home décor products with Spoonflower designs. Roostery offers quite a variety of different home décor products (see picture 11). In addition to patterns designed by users, both companies offer collections by visiting professional designers.

In both Spoonflower and Roostery the patterns (made by users) are categorized and they can be browsed according to print type and color. In addition, Roostery curates patterns according to themes (see picture 12). When selecting a pattern for a closer look, the website enables the customer to explore other patterns designed by the same user. This could encourage to buy several matching (but not displaying the same pattern) products, since the designer’s handwriting and style can be an element that makes the patterns “go together”.

The customer value of these companies lies in the service itself as well as in product uniqueness. The service offers a possibility for DIY (do-it-yourself)-designers to produce their own designs and for all customers to buy from a large variety of unique prints. Both companies have strong brands, but as the prints are completely done by users (and the products are quite generic), the brand manifests more on the website and in the service itself, not in the aesthetics of the final products. However having a strong brand may guide similar kinds of users to choose a certain service, which again could lead to a cohesive look amongst the prints, even designed by separate users. Even in this case, the aesthetics are not designer-led and can not be managed, designed or coordinated by the company.
Loom Decor is slightly different from the companies presented so far. It offers customized products, but does not enable the customer’s own content (e.g. photographs) or user created print designs. In practice, the customer can compile the aesthetics of a product from a variety of patterns and colors. The pattern selection is quite large, but easily manageable. Patterns are categorized according to color (see picture 13), but they are not coordinated, e.g. they don’t have a unified color chart.

Since all patterns and colors are offered by the brand, the supply could be managed, designed and coordinated, much like in NIKEiD. Coordination would lead to co-designed but designer-led end products. Loom Decor does not take advantage of this potential. They offer a large variety of different base products, from where the customer could easily pick most home textile products at the same time. But since the patterns are not coordinated (e.g. all blue patterns are of a different shade of blue) it would not be an easy task.

Picture 12 Roostery curates patterns made by users according to themes. This screen capture shows some products curated under the theme Floral Botanicals.

Picture 13 (left) Loom Decor’s blue patterns.

Picture 14 (right) Versions of a duvet cover customized by compiling different blue patterns at Loom Decor.
Part II

DESIGN PROCESS
6 Concept

Based on the background research, I created design guidelines for the concept (see figure 4). (1) The first objective was to make something that can be used as a coordinated print collection, i.e. something that tells a strong story and inspires and enables a variety of different but cohesive products. (2) The second objective was to ensure both brand consistency and the quality of the product, as well as decrease the customer-perceived risks of mass customization through designer-led products. (3) Third objective was to engage the customer. Mass customization creates added customer-perceived value through unique products and the process of customer engagement. (4) For all of these objectives to work together, one more objective is needed, and that is coordinating the customer’s possibilities, i.e. making it impossible for the customer to make “wrong” choices. As the latter is possible only through coordination, the concept comes a full circle back to the first objective. Other ways to eliminate the possibility for “wrong” choices would be limiting either the options or the customer engagement to its minimum. However both of these would make it impossible to reach the other objectives and would hence spoil the concept as a whole.

In conclusion, the concept needs to resolve the following problem: “how to engage the customer in co-design of a print, while ensuring designer-led end products?” Collection coordination is a strongly designer-led and/or company-led process by nature. A printed textile, inherently highly aesthetical, is a challenging product for combining customer co-design and designer/company-led coordination.

EXTRACT, visually presented in figure 5 (next page), is a digital “print collection composition” for digitally printed home décor products. It looks like a big canvas, with a coordinated composition of motifs. Due to its digital nature, EXTRACT is free from all limitations set by production methods, e.g. there are no limitations of size, shape or form. The customer is engaged, as a co-designer, in extracting his/her physical end products from the digital composition. Extracting a product means: (1) first using the product dimensions (or patterns) as a navigational tool when exploring the composition and its possibilities, and (2) cropping the product out from a chosen area of the composition. EXTRACT is a coordinated composition of motifs and it inspires extracting several different but cohesive products. The composition is designed in such a manner that the customer cannot make unwanted choices. This leads to co-created but designer-led and brand consistent products.

Figure 4 Concept guidelines.
EXTRACT is a coordinated composition of motifs and it works as a digital one-piece print collection for home décor products.

(a) First the customer explores the composition as a whole and chooses a base product.

(b) Extracting a product commences when the customer uses the product dimensions/patterns as a navigational tool to explore the collection.

(c) Extracting continues as the customer crops the product out from a chosen area of the composition.

(d) Finally, the extracted area can be produced (digitally printed and assembled) into a physical form.

Figure 5 EXTRACT, concept visualisation, see explanation on the next page.
7 Prototypes

I created three prototypes based on the EXTRACT concept. Each of the three prototypes is a slightly different interpretation of the concept. Each can be described as a digital, composed canvas that can be used for similar purposes as a collection. Some parts of the design process were the same as they are in traditional print collection design, e.g. all prototypes are based on a moodboard, include highlights and coordinate areas, as well as different scales. They include elements that repeat, don’t repeat, and some that seem to repeat. In this chapter I will present the prototype design process, first more generally and later the design processes of each of the three prototypes.

Despite the complete freedom of form, granted by digitality, I chose a rectangle to be the overall shape of all collections. The aim in mind, to make something digital but still applicable for being printed, the shape did not feel like a feature worth “playing with”. I see the rectangle as an appropriate choice, since many home décor products are - and efficient use of the printer and fabric require - a rectangle shape. I also used straight horizontal and vertical guidelines (see picture 15) as support in the composing.

I chose a basic duvet cover (150cm x 200cm) and a pillowcase (50cm x 70cm) as the main exemplary products. Firstly because of their different scales, and secondly because they naturally form a pair and are often bought as a cohesive set. I decided not to include both sides of the product, i.e. not to have two patterns (back and front) per product, but only one, the front pattern. This keeps the prototypes simple to understand and use. Considering both sides (or all patterns in a more complex product) seemed like a technical detail that could be refined later, during future stages of the concept development. I used the measurements of a duvet cover and a pillowcase to create guidelines for the composition in two of the concepts (see picture 15).

I set the size of each collection to 450cm x 300cm (see picture 15), although this is not a fixed size in all of the concepts. I considered other, mainly bigger, size options. The selected size is based loosely on the idea that the canvas could be divided evenly by the most common printer width, which is 150cm. Mostly the final size was the result of an iterative process of trying. I found the first try-outs to be “too full” and potentially confusing for the viewer. Also, as a digital product, it will most certainly be observed through a screen, and a bigger scale could complicate understanding the scale of the product e.g. on a computer screen. On the other hand the canvas could not be too small in order to offer variety in aesthetics, as well as enable different options to extract also a bigger product, e.g. the duvet cover.

Mostly by discussing the project with others, I realized that I should keep the visual look of the prototypes quite familiar and easy to relate. I explored some designs with a quite “digital look” (see pictures 16, 17 and 18) during the sketching phase. Nevertheless, I decided to keep the final motifs quite traditional so that they would remind the viewer of existing textiles. I considered try-outs with a too “digital look” to potentially confuse the participants in user test sessions.

Some phases of the design process were as in any collection design process. I gathered inspirational material and created three moodboards and color charts. All the color charts are built and the colors used in quite a traditional manner.
MC Toolkit

As discussed in chapter 4, the toolkit is the medium of mass customization: it’s the where the MC service provider and the user meet, and the mass customization happens. Each of the three prototypes studies a different approach to how this type of mass customization through extraction could work, i.e. what kind should the toolkit be. The first prototype is the simplest, it (1) makes possible to crop products with repeating (or seemingly repeating) motif areas, as well as products with different motifs. It is a one-layer, fixed size, quite rigid composition, closest of all the concepts to a traditional collection with separate prints, only with a fixed composition. The second prototype (2) enables the user to scale the motifs by zooming in or out on the canvas. Third prototype (3) works as a navigational narrative that enables the user to explore a two-layer collection. It was strongly inspired by how designers create and use moodboards.

![Picture 19 One of the first sketches for the structure of prototype 3.](image)
7.1 First Prototype, Flowerfall

Flowerfall (see pictures 21 and 24) is a quite classical landscape with floral motifs. It is inspired by Chinese folk art and farm paintings (mainly composition), Paul Klee’s art (mainly colors) and embroidery (mainly motifs) (see picture 20). The composition is divided roughly in areas of seemingly repeating patterns, but I also studied a more subtle kind of transition between motif areas (the tree, on the left side). I created the structure of the composition quite literally based on the exemplary product dimensions (see picture 15). Nothing is hidden or to be explored, everything is on display. The motifs are rather traditional flora and natural surfaces.

The composition is designed according to sizes of the exemplary products: duvet cover 150cmx200cm and pillowcase 50cmx70cm. All possibilities of cropping these exact products from the composition have been considered. This leads to end products, while co-designed by a customer, that are as the designer planned.

Flowerfall’s MC Toolkit

The user can observe the collection first as a whole. Then s/he chooses a product. The prototype includes two given exemplary products: a duvet cover and a pillowcase. The user then explores the collection through the fixed product pattern and considers his/her options. When s/he makes her choice s/he crops the pattern sized area from the composition. Now the extracted digital product can be produced (digitally printed on fabric and assembled) into physical form. The end product is co-designed but designer-led. The toolkit for Flowerfall is presented visually in picture 22, on the next page.
Picture 22. Flowerfall toolkit. First the user (a) observes the collection as a whole and chooses a product, then s/he (b) explores the collection and makes his/her choice. Now (c) the extracted digital product can be produced into physical form.
Picture 24, Flowerfall, the collection composition.
7.2 Second Prototype, **Curiosity**

Curiosity (see pictures 26 and 29) is a meditative scenery of rural geometrics. It is inspired by pictures of Mars and Nasa’s robotic rover Curiosity exploring Mars’s surface. It has geometric and abstract motifs but a soft, almost pastel color chart (see picture 25). The composition “follows” straight angles and horizontal and vertical guidelines. It was designed to yield an interesting result when cropping a rectangle shape, no matter the size. The user can scale the print by zooming in or out on the canvas.

In order for the scaling by zooming to work properly all motifs should be in vector format, so that the image does not pixelate when zooming in. Although this prototype was not actually executed in vector format in order to speed up the design process, I designed all elements so that they would easily work as vectors. It was also important to avoid large areas of a single color, so that even by zooming deeply in to the collection, one would end up with interesting surfaces, not merely a product of one color. For this reason I incorporated different scales of quite simple textures into the collection.

**Curiosity’s MC Toolkit**

The user can observe the collection first as a whole. Then s/he chooses a product. The prototype includes two given exemplary products: a duvet cover and a pillow case. The user then explores the collection “through” the product dimensions and considers his/her options. S/he can scale the print by zooming in and out on the composition. When s/he makes his/her choice s/he crops the area from the composition. Now the extracted digital product can be produced (digitally printed on fabric and assembled) into physical form. The end product is co-designed but designer-led. The toolkit for Curiosity is presented visually in picture 27, on the next spread.
Curiosity toolkit. First the user (a) observes the collection as a whole and chooses a product. Then s/he (b) explores the collection and makes his/her choice. S/he can scale the composition by zooming. Now the (c) extracted digital product can be produced into physical form.
7.3 Third Prototype, Daydreamescapade

Daydreamescapade (see pictures 31-33 and 37) is a layered narrative. This prototype has two layers of prints to explore: (1) a composition with the fixed size of 450cm x 300cm that the user can explore and extract products from according to the size of the chosen product (similar to the first introduced prototype Flowerfall). In addition, (2) the user can also “dive” into the composition by selecting an interesting area or motif on it. Selecting an area will lead the user to a new print. All prints and the whole structure are visually presented on the next pages.

Daydreamescapade is an eclectic and colorful collection, all about travelling the world - real and imagined - without actually leaving home. It’s a hypnotic and seemingly static but narrative world of floral, animal and abstract motifs, with a “free” composition. I had no guidelines and considered no product sizes or dimensions when composing it. Rather the opposite, I wanted to stretch the rules with Daydreamescapade and intentionally made the first layer composition very full-detailed. Daydreamescapade holds the color chart size record amongst the three concepts with the largest and quite wild color chart (see picture 30).
Daydreamescapade, layer 1.

Daydreamescapade, areas that lead to a 2-layer pair print.

Picture 31 Daydreamescapade, layer 1.

Picture 32 Daydreamescapade, areas that lead to a 2-layer pair print.
Daydreamescapade’s Two-Layer Structure

Daydreamescapade is a layered narrative. This prototype has two layers to explore, but it could have many more. A visual presentation of Daydreamescapade’s MC toolkit can be found on the next page. By selecting different areas of the canvas the user transitions to another layer that reveals a new print. The second layer pattern depends on the selected area, i.e. by selecting a cat one is directed to a print of that cat - or actually inspired by that cat, as I will explain. All second layer patterns are repeating. They could also be non-repeating, in fact, there could be several layers of non-repeating compositions, similar to the first layer. I considered making more than two layers, but I discarded the idea in order to keep the focus clear.

A composition with merely prints of a collection incorporated as surfaces feels more like a marketing tool or a visualization of how those prints could be applied in products. In order not to merely produce this kind of promotional image, I chose another approach, one closer to how a moodboard works. By selecting a certain area the user gets to explore one or several prints that are inspired by that particular area. I designed the second layer patterns to showcase a relation to their pair motif on the first layer, but not to be exactly the same. In other words, a second layer pattern may be similar to the first layer motif/pattern, but e.g. has a different colorway (see picture 34) - or the second layer pattern has a motif from the first layer composition combined with other elements, not appearing on the first layer (see picture 35). In this prototype, the second layer patterns are not observed all at the same time, but individually or in fixed groups. I followed this logic also in the user tests: when a user selected an area, I showed only the one corresponding pattern or group of patterns at a time.

As a designer, I interpret my moodboard in quite abstract ways. However, here I tried to keep the inspiration source quite clearly visible. I wanted the relation between the second layer print and its first layer inspiration to be apparent for a non-designer. I wanted the user to understand why a certain area leads to a certain kind of pattern. I tried out different approaches on how abstract or concrete the relation should be. I also made versions where a certain area of the first layer leads to more than one second layer patterns, e.g. a main print and a coordinate print (see picture 36).

On a conceptual level all areas of the composition lead to a second layer pattern. However for this prototype I merely created some examples that represent parts of a collection. I started sketching different approaches of the way the pair prints could be done. Initially it was not the plan, but during the design process I decided that I wouldn’t choose between the different approaches but instead I would test them all.

Daydreamescapade’s MC Toolkit

First the user can observe the first layer composition as a whole and choose a product. The prototype includes two given exemplary products: a duvet cover and a pillow case. The user then explores the first layer composition and make his/her choice to extract a product according to fixed product patterns. Furthermore, s/he can also “dive” into the composition by selecting an area that s/he finds intriguing. Selecting an area will transition him/her to a corresponding second layer print(s) that s/he can apply to his/her product. Finally, the extracted digital product can be produced (digitally printed on fabric and assembled) into physical form. The end product is co-designed but designer-led. The toolkit for Daydreamescapade is presented visually in picture 37, on the next page.

Picture 34 When selecting the black and white zebra surface on the first layer composition (small square), the user will discover a repeating version of the Zebra print, but in a different colorway.

Picture 35 The bird and the tree area on the first layer composition (small square), inspired the pattern Birdie, in which some of the first layer motifs (the bird and the flower) are combined with a background motif that does not appear on the first layer.

Picture 36 Shimmer (speckles) can easily be combined with Night Vision (cats), which is the main print in this pair.
Picture 37
Daydreamescapade toolkit. First the user (a) observes the first layer composition as a whole and chooses a product. S/he can then (b) explore the first layer composition and make his/her choice. S/he can also (c) “dive” into the composition by selecting an area that s/he finds intriguing. (d1, d2) Selecting an area will transition him/her to a corresponding second layer print(s) that s/he can apply to his/her product. Finally, the extracted digital product can be produced into physical form.
8 User Tests and Extracted Products

This chapter showcase visually some extracted products from each of the prototypes. All products have been extracted, i.e. co-designed by a third-party. Feedback will be discussed in the next chapter.

I asked four people to try out the concept prototypes in action. All participants are female and 20, 36, 44 and 67 years of age. One of the participants is an artist and an art educator, but the others do not have any background in the fields of visual arts or design. In one session two other people took part in the discussion, although they did not extract products of their own. This brings the total of people from whom I gathered feedback up to six.

In practice, I conducted testing the prototypes in Adobe Photoshop. I shortly explained what the prototypes are, and showed the possibilities of each collection through one exemplary product extraction. I had prepared a cropping tool for a duvet cover and a pillowcase. The user could use the cropping tool independently or guide me to move the tool. I also gave the users an option to request other products. I set no limitations for the amount of products. I asked the users to extract products for themselves or as a gift for someone else. I also requested the users to "think out loud". The next three spreads showcase an overview, not all, of the co-designed products.

![An overview of extracted Flowerfall products. In addition to duvet covers and pillowcases participants requested sofa cushions.](image)
An overview of extracted Curiosity products. In addition to duvet covers and pillowcases one participant requested sofa cushions.
An overview of extracted Daydreamescapade products. In addition to duvet covers and pillowcases participants requested sofa cushions and sheets.
Feedback

In this chapter I discuss the most interesting user feedback and observations I made during user tests. As described previously, user test sessions consisted of four participants extracting products, but altogether six people participating in the sessions.

The first concept prototype that I presented to the users was Flowerfall. All users easily understood what they were expected to do and how the concept works. “You have gamified prints!” said one participant. At first the users considered there to be many possibilities. Most understood immediately that they could pick several different but matching (i.e. cohesive) products from the composition. However one user had to “settle for” only one product set (a duvet cover and two pillowcases) after she had “used up” all options she liked. She did not consider the possibility of e.g. taking two sets of the exact same, but instead she wanted the sets to be different but matching. Nearly all product sets were selected from the same area and so that they show the same motifs. From now on, a product set refers to a set of a duvet cover and one or two pillowcases. Although as presented in previous chapter, other kinds of product sets (e.g. duvet cover, pillowcases and a sheet) were compiled.

In Flowerfall, several participants appreciated that some motif areas are more “basic” than others. Two users extracted duvet covers and pillowcases from areas they considered more basic, and sofa cushion covers from the areas that they considered to have a more eclectic look. One participant wanted to flip the cropping tool on its side, but it soon became clear to her that the composition does not really work the same way from all angles. Nevertheless, she managed to find an area that felt interesting to her and extracted a product. All participants expressed that it’s apparent that the composition is designed for its purpose and not, for example, as art. Compared to the other two concepts, Flowerfall was explored quickly.

All participants liked Curiosity, spent most time with it, and extracted more products from it than from the other two collections. I got two actual product orders! Scaling opened up possibilities to explore, while the concept still remained easy to understand. Again, some areas came across more basic than others, for example the dark area on the left was considered basic, and in fact all participants extracted a product set from it. What was considered as highlight (although not calling it that) areas varied amongst participants. In Curiosity, product sets were picked from the same area, showing the same motif elements, as in Flowerfall. But in addition, in Curiosity many product sets were also picked from different parts of the collection showing completely different motifs.

There was a “wow moment” for all the participants when first encountering Daydreamescape. This mood was liked best out of all three concepts. The composition was said to be the most interesting, to look most lively and intriguing. Nevertheless, this concept was the most problematic. Despite the apparent enthusiasm to explore details and layers, extracting products from the first layer composition was difficult and not all participants understood the second layer patterns’ point and their relation with the first layer.

Feedback related to both the layered structure and the fact that the second layer patterns are repeating, varied from one extreme to the other. Two participants liked the logic as it is and selected products from both layers. Two participants found the repeating patterns completely unnecessary. “Why would I choose a standard and mass produced fabric that I can get from the store, if I can make an original and unique choice?” One user chose only second layer patterns. She felt that she wouldn’t know where to crop from the first layer; to her the repeating patterns seemed “more ready and more designed”. Daydreamescape was the only collection from which participants expressed willingness to crop individual motifs as placement prints.
In *Daydreamescapade*, all participants found it a good thing and a nice surprise that the colorways between layers are not the same. Two participants appreciated the fact that they were directed to both, a highlight and a supporting print “with one click”. Some took advantage of this and extracted duvet covers and pillowcases from the main print and applied the coordinate print to sheets. Some first layer - second layer pairs aroused confusion amongst two participants: the relation between the motif and the pattern remained unclear for the participants. For example, the pattern Fruit (see picture 41), which indeed is quite an abstract interpretation of the fruit tree in layer one seemed puzzling to one participant. However it was another participant’s favourite.

In *Daydreamescapade* a phenomenon occurred that was nicknamed by a participant as “the bird leg effect”. The participant wanted to crop a duvet cover from an area that she liked, but no matter how she tried to place the cropping tool, she always ended up with an odd, small corner of a neighbouring motif in the cropping area, for example not the whole bird, but only the bird’s legs. In other words, the bird leg effect refers to unwanted split parts of motifs “invading” the selected area.

![Picture 41 Selecting the fruit tree area on the first layer (above) leads to four patterns, among which is the pattern Fruit (below).](image)
Part III

AFTERTHOUGHTS
10 Discussion

In this chapter I go back to my research question “how can mass customization benefit from collection coordination, in the context of digitally printed home textile products?” I have proposed an answer to this question in the form of a concept: EXTRACT guidelines describe the ingredients of a successful combination of co-designing and coordination. The EXTRACT concept is an interpretation of these guidelines. Prototypes concretize the concept and enable user tests, which again, facilitate analyzing the concept. Observing the prototypes in action enables to identify the concept’s benefits and challenges. I will firstly take a close look at the prototypes and how they performed in the user tests. I will analyze their success by reflecting feedback with the created concept guidelines. Lastly, I reflect on the design process as a whole.

10.1 Reflecting the Thesis Outcomes

The concept EXTRACT gives one potential answer to my research question in theory, and the prototypes suggest what that answer could look like in practice. In order to examine how successfully the concept manifests through each of the prototypes I return to the guidelines I created for the concept.

(1) My first objective for the concept was to make something that can be used as a coordinated print collection, which means that it would tell an engaging story, and that it would inspire and enable extracting several different but cohesive products. Daydreamescapade is the clear winner in storytelling: its fullness and details, the story and the mood, were liked best by all the participants. The first layer composition did inspire to explore, but not to extract matching product sets. If the amount of time the users explored a single composition is any indicator of success in storytelling, Curiosity did very well too. Participants spent most time with it and extracted more products from it than from the other prototypes. Compared to the other two concepts, Flowerfall was explored quickly. The user could see at one glance what she is offered, easily evaluate which areas are most attractive, pick her products, and be on her way. The story was not engaging enough, or there was not enough variation, or both.

Out of all three prototypes, Curiosity was “used” like a collection more than the others. Flowerfall seemed to offer too little, and Daydreamescapade too much variety. Although Flowerfall includes several different motif areas, users did not combine different motifs into one product set. Nearly all product sets were selected so that all products show the same motif area, e.g. a duvet cover and pillowcases that all show parts of the floral area. This indeed matches the products well together, but it could mean that the composition enables merely different variations of the same. This is similar to when smaller products are made from a textile with a quite large repeat, so that different products show different parts of the repeat. Variations of the same is not what a coordinated collection should offer. A collection should offer many cohesive but different options. Many felt they had quickly “used up” all Flowerfall’s possibilities.

From Daydreamescapade users extracted more product sets amongst the second layer patterns. The first layer composition offers, again, only variations of the same. This can be seen clearly amongst the extracted products: all products extracted from the first layer, although cropped in a unique way and with unique arrangement of details, are simply variations of the same. In Daydreamescapade’s case similarity between products is due to the fact that there is nearly no variation in contrast color or the use of space: it is fully detailed and rich in color. Where ever one crops, the end products are unique, but somewhat equal amongst each other. In Daydreamescapade, making the first layer “one big highlight” was intentional. It offers product uniqueness, but does not alone work as a collection. I designed the second layer patterns to bring variety to the collection.

In Curiosity, product sets were also done by combining products extracted from one area, showing the same motif elements. But
unlike in *Flowerfall*, many matching products were also extracted from different parts of the collection showing completely different motifs. Users felt *Curiosity* offered a lot of possibilities, but did not seem to be overwhelmed by them. Several participants appreciated that in *Flowerfall* and *Curiosity* some motifs are more “basic” than others, which means that the coordinate areas were recognized. Two users chose duvet covers and pillowcases from *Flowerfall* areas they considered more basic, and sofa cushion covers from the areas that they considered to have a more eclectic look.

Based on the user feedback and the extracted products, I argue that out of all the prototypes, the first objective was most successfully met in *Curiosity*, since it inspired each user to extract several different product sets and “compile” them freely amongst all parts of the composition.

(2) My second objective for the concept was to ensure both brand consistency and the quality of the product through designer-led products. From this perspective *Daydreamescapade*’s first layer was quite a catastrophe. The freely constructed composition, although seen as more lively by many, resulted in the bird leg effect, meaning unwanted split parts of motifs invading the selected area. I did not compose *Daydreamescapade* based on rectangle shapes as I did the other two prototypes. And it resulted in a bundle composition where one very easily ends up being forced to crop so that it splits motifs in an unwanted way. It felt disappointing to some of the participants that they are offered an interesting motif or motif area that they can’t “manage” the way they like because of the bird leg effect. As the designer, I found the bird leg effect to be very irritating. I would not wish my name on a product with accidental, split motifs. *Daydreamescapade* is thus a clear example of how it should not be done.

In order to ensure product quality and brand consistency, the customer should not have a possibility to make a “wrong” choice, e.g. a choice that is not intended by the designer and does not reflect the brand. The product, and the range of choices related to it, should be coordinated so that it is impossible to choose “wrongly”. *Curiosity* and *Flowerfall* both met this aim, and all products extracted from these two get the designer’s “approval”.

(3) The third objective for the concept was to engage the customer. This objective was met in all three prototypes. Participants thought the concepts to be fun and easy to use. Even the most complex prototype, *Daydreamescapade* was fully understood. However I think that it would have been beneficial to test this collection as a working digital application that would have transferred the user easily to the second layer. This would have made exploration of the second layer quicker.

Not according to what was said per se, but based on observing the users, I argue that even more than the strong visual story, scaling engages the customer to explore and extract products. *Curiosity* seemed to be an optimal match of possibilities and manageability. Scaling opened up possibilities to explore while the concept still remained easy to understand.

Academic research demonstrates that mass customization creates added customer-perceived value through unique products as well as several experience-based features, as discussed in chapter 4. These values were visible even in my small feedback sessions: product uniqueness was highlighted several times, as was the value of co-designing (being the one to make the product unique). It became clear through discussions over the *Daydreamescapade*’s repeating patterns that to some participants it was highly valuable to get to co-design in this way, as can be understood from this comment: “Why would I choose a standard and mass produced fabric that I can get from the store, if I can make an original and unique choice?” Process enjoyment was apparent, especially when the process was easily manageable by the user herself, i.e. in *Curiosity*. As described in chapter 4, co-designing creates e.g. feelings of pride and achievement and psychological ownership (Chang et al. 2009: 152; Franke et al., 2010: 127) towards the product. The co-designing customer perceives him/herself to be a co-worker in the company (Teichmann et al., 2016: 26). In this light, I assume that succeeding in both, in ensuring brand consistency and in engaging the customer, it is possible to create a feeling of having co-designed the print with the brand or designer.
As a part of the third objective I also assumed that a designer-led product would decrease some of the perceived risks related to mass customization. The presence of repeating patterns in Daydreamescapade arose some comments and opened one longer discussion related to this matter. To one participant, the first layer composition of Daydreamescapade felt “not designed” and thus risky. She thought that repeating patterns are a safer choice. She did not think that the other two prototypes were risky and she felt extracting from them was easy and fun. As already mentioned, as the designer I agree with her.

(4) The last objective I set for the concept was eliminating all possibilities for the customer to make an unwanted choice. The tool for making “wrong” choices impossible is collection coordination, including careful design of the composition. As discussed already, Daydreamescapade did not only fail to eliminate “wrong” choices but actually forced the customer to make them, as avoiding the bird-leg effect was quite impossible. Curiosity succeeded best in meeting the fourth objective. As the designer I “approve” all individual products extracted from Curiosity. They look much like I anticipated. Also Flowerfall yielded products that I do “approve”, but find the overview a little dull. There was no room for the user to play, to try out, and to explore.

To conclude, designing and testing prototypes translates from concept to practice and makes it easier to analyze it. The prototypes and gathered feedback show that the concept has potential. The prototypes confirm that (1) engaging the customer creates value. According to user feedback, co-designing by cropping was fun and created added value through the process, as well as towards the product. (2) Through coordination of the supply, the customer can be encouraged to extract several cohesive products. In addition, the prototypes show that (3) co-design and coordination can be combined in the context of printed textiles. Combining these two successfullly requires that (3.1) the user is offered an easily manageable variety of possibilities to explore (e.g. scaling by zooming) while (3.2) possibilities for “wrong” choices are eliminated (with a thoughtful composition structure).

### 10.2 Reflecting the Design Process

Working on this thesis was an intense and iterative process, going back and forth between the background research and the design process. The original inspiration stemmed nearly a year before commencing the project and I started reviewing literature and sketching some ideas quite early on. However, the deep dive, the actual execution of the project, was an intense period of about 50 days. This was, naturally, not the original plan.

This project had its fair share of technical problems. These problems eventually changed the course of the design process of the prototypes quite dramatically - and for the better. Not too far from the deadline, practically all files related to the thesis (sketches, artistic research for mood boards and notes) “got stuck” between my computer and the iCloud file storage. Customer service offered its official diagnostics: “pixel glitch”. Nobody actually knew why this happened, and it took a long while for anyone to come up with a solution. Finally some of the files were saved and some were lost. Most importantly, the whole process took such a long time that eventually I had to decide to either keep going, which meant in many ways starting over from zero, very close to the deadline, or to postpone the deadline. I decided to keep on going. In hindsight this “pixel glitch” debacle led to a more focused final outcome by forcing me to drastically reprioritize everything. For example, I took a completely different approach to sketching.

I found sketching separate motifs by hand problematic even before the files were lost. In practice, most of the lost files were originally sketched by hand but heavily edited in digital format, including quite complex implication of color (see picture 42). Sketching this way was intriguing and explorative and yielding interesting results. However it was highly time consuming and the sketches were still mostly separate motifs or motif areas, and I had no good plan how to combine them. Try-outs to combine the separate sketches resulted in disconnected compositions that did not work as a collection. While being an interesting exploration in digital expression, this approach was sidetracking the project.
from its focus. The point of the project is not refined, creative, visual expression but the concept. Leaving behind this sketching method started quickly to make sense in every way. In particular by discussing the project with others (mostly non-designers), it became clear that the visual look of the concept prototypes should be kept quite familiar and easy to relate to. By making the prototypes look like traditional printed textiles I hoped to facilitate understanding the concept and imagining the prototype image as fabric, especially during the user feedback sessions. The outcome, with quite traditional motifs that all appear to be color separated (similar to printed textiles produced with traditional methods), is thus a result of being forced to prioritize time, a need to refine the overall focus of the thesis, and wanting to make the concept prototypes as easy to understand as possible.

For a while I was lost in exploring new and interesting ways of visual expression when I should have been exploring the composition. These two are not easy to study simultaneously. Being forced to start from scratch, and the fact that sketching separate motifs did not work, led me to sketch “on-the-go” and directly on the canvas (on the composition) with a pen tablet. This way I could observe the composition as a whole and draw what was needed, when it was needed. In hindsight, it is clear that designing a composition of such complexity should be done digitally as a whole, not by hand on paper, nor by creating and combining separate elements. One should compose the whole collection as one, after which it is naturally possible to work on the motifs or motif areas separately.

I have some regrets about Daydreamescape’s second layer patterns. Designing a full collection is a time consuming process. And since I had very limited time, the patterns are executed extremely quickly. For the non-designer participants in the user tests this did not come across, but a professional eye surely notices that they could be of better quality. However, as representations of parts of a collection in a prototype context, I consider them all to be very suitable.

Initially I had planned to execute, to print out and assemble some of the extracted products as examples. As printing is quite expensive, I applied for a grant, but did not get it. Thus, I did not print. I could have tried to solve this, and would have, if I had thought that the actual physical products would have been essential for the work. But I find that the concept as well as the prototypes can be fully understood the way they are presented now. In this thesis I do not concentrate on practical details or technical issues, but keep the project on a very conceptual level until the end. Maybe executing actual products could even have steered the topic away from its focus.

I had originally planned to present the project to two or more print companies in order to get feedback from the industry. However I considered involving users in extracting the products even more essential at this stage of the concept development. And since I already gathered up people to participate, I thought it to be appropriate to concentrate on the user feedback. Another possibility would have been getting users to extract products and then visit companies, and leave out the user test observations and feedback. I would not have had time to do it all, and in any case it would have exceeded the size requirements of a Master’s thesis.

Hindsight is somewhat frustrating: I have an urge to start the whole process all over again. However, Master’s thesis is a learning process and hindsight simply means that I have learned. These new learnings will unquestionably be of value for me in the future. Despite the little bumps on the road, this has been a great project. This is mostly because I am deeply fascinated about the topic, feel like I have simply scratched its surface, and could gladly continue exploring it much deeper.
11 Conclusions

In this thesis I answer the question “how can mass customization benefit from collection coordination, in the context of digitally printed home textile products?” Background research, focusing on mass customization and collection coordination, lays the basis on which I create a concept. The concept EXTRACT is a vision of a one-piece digital “collection composition” that is designed and can be used like a coordinated print collection. Through this concept I show that mass customization, in the context of printed home textile products, can benefit from collection coordination in many ways. I argue that carefully combining the two concepts would optimally result in a combination of both the value of mass customization and of collection coordination. In addition, designer-led coordination can decrease some of the perceived risks related to mass customization. The concept prototypes and gathered feedback show that the concept has potential and that it can create added value through the process as well as towards the extracted products. The prototypes confirm that (1) engaging the customer creates value. (2) Through coordination of the supply, the customer can be encouraged to extract several cohesive products. In addition, the prototypes show that (3) combining co-design and coordination, in the context of printed textiles, requires that (3.1) the user is offered an easily manageable variety of possibilities to explore (e.g. scaling by zooming) while (3.2) possibilities for “wrong” choices are eliminated (with a thoughtful composition structure). The prototypes also imply practical features worth refining or exploring in the future.

EXTRACT can be refined and explored further. As the next step, I will gather feedback from the industry by presenting the project to companies. Another round of prototyping, based on learning from the first ones, should optimally be tested as working digital applications. It would be interesting to try the concept in other product categories, in smaller or hard products, for example tableware. Apparel can require complex patterns, which may affect the extraction process and require redefining the optimal composition style.

EXTRACT, digital by nature, should be “in the cloud”, i.e. it could be an internet-based service with locally distributed production. Enabling the act of extraction requires consideration of user interface and user experience. Indeed, user experience related to extraction is an unseparable part of the whole concept and would thus be an essential feature for further exploration. Extraction as such does not have to be complicated. But it could be developed further e.g. towards a game-like approach: extracting could mean “playing” the products out of a coordinated collection “world”. A web service user experience could be personalized, so that the service would guide the user by suggesting collections or colorways based on either the customer’s previous behaviour on that web page or likes and dislikes the customer has specified.

In addition to web environment, the concept suits well also a brick-and-mortar store. Contemporary consumers often get to know the supply through company website before making a purchase at the store (Ninimäki et al., 2017: 32). In this case they could explore the collections from their own screens and visit the store to examine the base products and material samples. The act of extraction is quite simple and does not require investing much time or effort. Thus the whole process can also be done at a store. Extracting products can be done independently by customers themselves or the process can be assisted by the store personnel. I can easily imagine EXTRACT in e.g. Ikea.

The consumer’s ability to anticipate the outcome of the mass customization process and the preconception’s perceived accuracy play a major role in value creation. In other words, from the consumer’s point of view, the product has to match what ever the consumer imagined it to be. In services where the customer can, for example, apply his/her own artwork, it requires test printing if one wants to be sure how the colors will appear on the product. Testing consumes time and other resources of both the company and the customer.
However, EXTRACT is already ready before the co-design, and testing and adjusting colors and materials in advance becomes possible. With exemplary products and samples, the customer can be shown what they will be getting and how the material will feel like, or how the product, print and colors will look.

Thinking of the digital file as the primary product and its limitlessness inspires me to envision a variety of scenarios about future applications related to printed textiles. As the digital format is not fixed, even the product could be an iterative, ever-changing process, for example updated for every season. The print itself could be designed to be mouldable, while still remaining designer-led. This could be achieved e.g. through a feature of transformation of motifs. For example by combining dots and stripes the customer could get stripes made out of dots or the other way around. All these transformation possibilities could easily be designed in advance and the designer could make sure that all possibilities work. The prototypes presented in this thesis are all in the vicinity of a wall, and their scale can be hard to understand through a screen. With the help of technology related to augmented reality, it should be possible to project the digital composition in real scale on a background or even on products. It should also be possible to explore the composition in real scale or even an immersive print collection environment in virtual reality. A layered structure could be an engaging feature as well a navigational tool.

### 11.1 Limitations

Taste is an essential and embedded element in the context of aesthetics. User tests of prototypes that display prints are naturally effected by each participant’s personal taste: whether they like or dislike the aesthetics in question will undoubtedly influence the outcome and can easily distort the results of a small test group. Trying to minimize this effect, I told all participants that they can either choose a product for themselves or think of it as a gift for someone else. Nevertheless, the effects of personal taste cannot completely be eliminated, and prototypes concentrating on aesthetics should optimally be tested on a bigger group of users.

It is often said that color is the first thing that attracts the eye. Whether it is a painting or products on a shelf, we are first attracted to color. I have not discussed colorways for the prototypes yet. As discussed earlier, the bird leg effect means unwanted motif parts "invading" the selected area. A fixed composition of motifs and colors may result in a bird leg effect of color as well. Moreover, I believe that an invading unwanted color is even a bigger problem than an invading unwanted motif. Not being able to move or erase an unwanted color may easily spoil the extraction experience. This issue should be examined closely. There are different approaches for making the colorway options flexible. Letting the customer decide the colors freely (as in a coloring book) diminishes the designer’s control over the product. But with a coordinated color palette this option should not be overly problematic. Another possibility would be e.g. to offer several different set colorways for one composition.

People do not necessarily want the same kind of print on all of their home textile products, i.e if one chooses one kind of pattern for his/her bedding, that doesn’t mean that s/he wants that same print for his/her curtain. Therefore the chosen exemplary products, the duvet cover and pillowcase define the exact context where the results should be observed: bedding. However I consider the concept to be at such an early stage and the results to be at such a surface level that they can be applied on a wider range of printed products than merely bedding.
Closing Words

As I described in the very beginning of this book, in a way this thesis has been a discussion (even an argument) between me now and a younger me, when I was in the beginning of my textile studies. The younger me was not completely sure about the potential of mass customized printed products. She has now been fully convinced and joins me in my current fascination towards the topic. A coordinated, mass customizable print collection is a concept that keeps on intriguing me. There is a lot still to explore.
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EXTRACT

Concept for a Coordinated Print Collection for Mass Customization

LOOKBOOK
INTRODUCTION

This lookbook is a part of my Master’s thesis and showcases its productional components: (1) the concept EXTRACT combines the benefits of mass customization (MC) and collection coordination (CC) in the context of digitally printed home textile products. (2) Three "prototype collection compositions" are derived from the EXTRACT concept: Flowerfall, Curiosity and Daydreamescape. Lastly, the lookbook displays visualizations of (3) co-designed end products from each of the prototypes.

Thesis Abstract

The topic of my Master’s thesis is positioned in the intersection of mass customization (MC) and collection coordination (CC), in the context of digitally printed home textiles. MC creates a variety of added customer value through active customer engagement that results in more personalized products and services, as well as many experience-based benefits. While MC always includes an active input from the customer, CC is by nature a strongly designer-led and/or company-led process. A printed textile, inherently highly aesthetical, is a challenging product for combining customer co-design and designer/company-led CC. Amongst services that offer customized printed textile products, this combination is not currently in use.

The aim of this thesis was to explore how the two strategies, MC and CC, can be combined, in the context of digitally printed home textile products. The work consists of a written component and a production part, which includes the creation of a concept and three prototypes. Prototypes were tested with four users.

The concept Extract combines the strategies of MC and CC into a digital product that can be used for similar purposes as a traditional coordinated print collection. Extract is a vision of a digital "print collection composition" that engages the customer in co-designing the physical end products. It creates added value characteristic to MC through customer engagement but ensures aesthetic brand consistency of the end product through designer-led coordination. The concept is strongly based on digitality: (1) Digital textile printing enables the production of unique made-to-order products. (2) Moreover, the concept’s essence lies in the nature of digital content (the image to be printed), which is not bound by any physical limitations, such as requirements set by production methods. The concept describes the digital image as the primary product and the produced final product is seen as an application of the originally digital product.

My thesis brings new insight into the field of digital textile printing and participates in the discourse of the potential of digitality in the field of print design. It studies what is needed for a joint approach of MC and CC, and proposes one way that this can be done. A variety of benefits can be created through coordinated customer engagement. Joining the two strategies will optimally result in a combination of both the value of MC and of collection coordination. The concept prototypes and gathered feedback show that the concept has potential and that it can create added value through the process as well as towards the end products. The prototypes also imply practical features worth refining or exploring in the future.

Keywords: mass customization, collection coordination, printed textiles, digital textile printing
Concept

The concept EXTRACT combines the benefits of mass customization (MC) collection coordination (CC) in the context of digitally printed home textile products. EXTRACT is presented visually in figures 1 and 2 on the next spread.

The basis of the EXTRACT concept is displayed in figure 1. (1) Firstly, EXTRACT works and can be used similar to a coordinated print collection, i.e. it tells a strong story and inspires and enables a variety of different, but cohesive products. (2) Secondly, it ensures both brand consistency and the quality of the product, as well as decreases the customer-perceived risks of mass customization through designer-led products. (3) Thirdly, it engages the customer. Mass customization creates added value by making it impossible for the customer to make “wrong” choices, i.e. choices that do not reflect the brand or are not what the designer meant.

In conclusion, the concept resolves the following problem: “how to engage the customer in co-design of a print, while ensuring designer-led end products?” Collection coordination is a strongly designer-led and/ or company-led process by nature. A printed textile, inherently highly aesthetical, is a challenging product for combining customer co-design and designer/company-led coordination.

EXTRACT, visually presented in figure 2, is a digital “print collection composition” for digitally printed home décor products. It looks like a big canvas, with a coordinated composition of motifs. Due to its digital nature, EXTRACT is free from all limitations set by production methods, e.g. there are no limitations of size, shape or form. Customer is engaged, as a co-designer, in extracting her products from the composition. Extracting a product means: (a.) first to use the product dimensions (or patterns) as a navigational tool when exploring the composition and its possibilities, and (b.) to crop the product out from a chosen area of the composition. EXTRACT is a coordinated composition of motifs and it inspires extracting several different but cohesive products. The composition is designed and coordinated in such a manner that the customer cannot make unwanted choices. This leads to co-created but designer-led and brand consistent products.

Prototypes

The first prototype, Flowerfall, is a quite classical landscape with floral motifs. It is inspired by Chinese folk art and farm paintings, Paul Klee’s art and embroidery. The composition is divided roughly in areas of seemingly repeating patterns. The structure of the composition is quite literally based on the exemplary product dimensions. Nothing is hidden or to be explored, as everything is on display. The motifs are rather traditional flora and natural surfaces.

The composition is designed according to sizes of the exemplary products: duvet cover 150cmx200cm and pillowcase 50cmx70cm. All possibilities of cropping these exact products from the composition have been considered. This leads to end products, while co-designed by a customer, that are as the designer planned.

The second prototype, Curiosity, is a meditative scenery of rural geometrics. It is inspired by pictures of Mars and NASA’s robotic rover Curiosity exploring Mars’s surface. Geometric and abstract motifs are accompanied by a soft color chart. The user can explore the composition in different scales by zooming in or out on the canvas. The composition is designed to yield an interesting result when extracting a rectangle shape, no matter the size.

The last prototype, DaydreameScapade, is an eclectic and colorful collection, all about travelling the world - real and imagined - without actually leaving home. It’s a hypnotic, seemingly static but narrative, and full-detailed world of floral, animal and abstract motifs.

DaydreameScapade is a layered narrative. It includes two layers for the user to explore. First layer composition is the starting point for the user’s journey. By diving into (selecting) any area or detail, the user transitions to a second layer, which shows one or more patterns. On a conceptual level all areas of the composition lead to a second layer pattern. However this prototype includes merely some examples. Every first layer area or detail leads to pattern that can be considered a “pair” of that particular area. The second layer patterns are derived from and inspired by the first layer. They have been created similar to the way a designer works with a moodboard.

Extracted Products

All products presented in this lookbook are extracted, i.e. co-designed by third-party test users. All user test participants are female and 20, 36, 44 and 67 years of age. One of the participants is an artist and an art educator, but the others do not have any background in the fields of visual arts or design.

In addition to the given exemplary products, a duvet cover and a pillowcase, some users asked for additional products, such as sofa cushion covers and sheets.
EXTRACT

CAN BE USED AS A COORDINATED PRINT COLLECTION
Tells a strong story.
Includes cohesive variation. Its different parts belong to the same story and can be combined.
Inspires and encourages to buy several cohesive products instead of one single product.

ELIMINATES “WRONG” CHOICES
Careful coordination makes it impossible for the customer to make unwanted choices, i.e. choices that do not reflect the brand.

RESULTS IN DESIGNER-LED END PRODUCTS
Enables aesthetical brand consistency.
Decreases customer-perceived risks of mass customization as the responsibility of the aesthetical product quality is on the designer.

ENGAGES THE CUSTOMER AS A CO-DESIGNER
Creates experience-based customer value through customer engagement, e.g. psychological ownership and feelings of achievement and pride.

EXTRACT is a coordinated composition of motifs and it works as a digital one-piece print collection for home décor products.

(a) First the customer explores the composition as a whole and chooses a base product.
(b) Extracting a product commences when the customer uses the product dimensions/patterns as a navigational tool to explore the collection.
(c) Extracting continues as the customer crops the product out from a chosen area of the composition.
(d) Finally, the extracted area can be produced (digitally printed and assembled) into a physical form.

Figure 1 EXTRACT concept guidelines.

Figure 2 EXTRACT concept visualisation
PROTOTYPES
Flowerfall
How It Works

First (a) the user observes the collection as a whole and chooses a product. The prototype includes two given exemplary products: a duvet cover and a pillowcase. The user then (b) explores the collection through the fixed product pattern and considers his/her options. When s/he makes his/her choice s/he crops the pattern sized area from the composition. (c) Now the extracted digital product can be produced (digitally printed on fabric and assembled) into physical form. The end product is co-designed but designer-led.
Extracted Products

An overview of co-designed products from Flowerfall.
Curiosity, the collection composition.
How It Works

Picture 6 Moodboard and colourchart for Curiosity.

Curiosity toolkit. First the user (a) observes the collection as a whole and chooses a product. Then s/he (b) explores the collection and makes his/her choice. S/he can scale the composition by zooming. Now the (c) extracted digital product can be produced into physical form.
Extracted Products

Picture 8 (whole spread): An overview of co-designed products from Curiosity.
How It Works

Daydreamescapade toolkit. First the user (a) observes the first layer composition as a whole and chooses a product. She can then (b) explore the first layer composition and make her choice. Furthermore, (c) she can also “dive” into the composition by selecting an area that she finds intriguing. (d, next page) Selecting an area will transition her to a corresponding second layer print(s) that she can apply to her product. Finally, the extracted digital product can be produced into physical form.
Pictures 12 and 13 Selecting an area on the first layer (above) will transition the user to a corresponding second layer print(s) that s/he can apply to his/her product (next page).
Picture 14 (whole spread)
An overview of co-designed products from Daydreams-capade.
"Extract"

**Extract** comes from the Latin word extrahō, *to draw out or forth*.¹

**verb**
- to draw forth⁴
- to remove or separate²
- to derive (pleasure, information, etc.) from some source or situation²
- to deduce (a principle or doctrine); construe (a meaning)¹
- to derive (pleasure or comfort) from an experience¹

**noun**
- a solid, viscid, or liquid substance extracted from a plant, drug, or the like, containing its essence in concentrated form³
- part taken from a longer work⁴

³ http://www.dictionary.com/browse/extract?s=t
⁴ https://www.merriam-webster.com/thesaurus/extract
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