What makes the flow

Understanding the immateriality of screen-based interactions

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Abstract

Building upon previous research done on interactivity attributes describing the aesthetic quality of interactions, this paper aims to explore the sense of flow in screen-based interactions, narrowing down to the finer details that make the personality of the interactive experience. The goal is to provide a deeper knowledge on the concrete, expressive qualities of screen based interaction, being “the immaterial material” moulded in the design process. The relevant information for practicing designers is the awareness of what emotions certain interactions elicit and how interactions can be used to convey brand personality.

The process conducted followed a research through design methodology, as the aim was to explore the defined design space rather than answer a specific problem. Two major user studies provided insights and refocus in the process along the way to the final result: a set of guidelines and a prototype embodying them. The guidelines provide some details on designing flow experiences on a mobile screen, and are to serve as inspiration and reference to future work and design practice. The prototype, called ‘The Embodiment’ serves as an illustration of the guidelines, as mere words are not able to fully describe the dynamic quality.
1. Introduction

Screen-based interaction is a field that is very much overlooked on the scope of the master’s programme in interaction design at Malmö University. It is a shame, as screens are a major part of modern life, and it is one of the major subjects practicing interaction designers work with in the industry. Interaction with digital screens is often seen as the opposite of embodied and tangible interaction, as it is immaterial. The quality of immateriality is what makes the topic a fruitful field for exploration.

Immateriality means that the design can be very dynamic, and thus the design space is opened up to complexity and a large variety of possibilities (Lim, Lee & Kim, 2011). It can, however, be argued, that screen-based interactions do no entirely lack tangible and embodied quality, as even a simply touching your finger on an interactive surface is a sensory experience, not to mention the tactile feedback of a keyboard or a mouse. Vito Campanelli (2010) frames that touch screens fall somewhere in between the two opposites, being “neither definitely tactile nor definitely optical” (p. 136).

This paper builds upon definitions of interactivity attributes (Lim, Stolterman, Jung, & Donaldson, 2007; Lim, Lee & Lee, 2009; Lim, Lee & Kim 2011; Lenz, Diefenbach, & Hassenzahl, 2013; Aagesen & Heyer, 2016) that have been developed to serve as a vocabulary for aspects, or aesthetics of interactivity. The attributes aim to describe different immaterial shapes of interactivity, many of which did not have well defined terminologies before. The attributes cover qualities like flow, proximity, feedback, consistency and concurrency. The immaterial part of an interaction that the attributes describe has been found to elicit human emotions (Lim et al., 2009), and open up the design space to be more expression-oriented. Aagesen & Heyer (2016) linked the attributes with brand perception to illustrate how interactions can be used to convey brand values.

From the set of interactivity attributes this paper focuses on one defined as flow, that has also been described as continuity, as opposed to discreteness. The questions that this paper aims to answer is What immaterial details embody a sense of flow in a discrete interaction? How are these details experienced by users? In previous research the attribute of flow was linked strongly with the emotion of joy and brand traits of sophistication and competence (Aagesen & Heyer, 2016). The aim is to explore the design space of the sense of flow in mobile touch screen interactions, narrowing down to the concrete details that make the flow, the immaterial quality of the interaction. Currently interaction designers are not familiar with conceptualising and manipulating this digital design material, as compared to product designers working with tangible materials and their qualities (Lim et al., 2011). In the big picture, this research aims to make path for interaction design to become more expression-oriented. The contribution to existing knowledge is a deeper understanding on the expressiveness of the immateriality and some concrete details that make the aesthetic of the interaction. This is relevant knowledge to designers working in the field with screen-based interaction design, especially with branded experiences.
The chosen method was research through design, as the nature of the project was more of an exploration of the defined design space rather than solving a specific design problem. The user studies conducted resulted into insights that adjusted the focus of the research along the way.

This document contains a brief literature review covering the main points that make the background of the project: interactivity attributes, the immaterial quality of screen-based design, user experience and the concept of flow. The following chapters go through the design process conducted in this project, that encompasses some ideation, two major user studies and an outcome building up from the results. The outcome is a set of guidelines for designing interactions with flow, and a prototype that embodies them. Finally, there is a chapter for discussion on the process and a chapter summarising the final conclusion.
2. Literature review

In this chapter I discuss four different points that are relevant as background: interactivity attributes, the immaterial quality of screen-based design, user experience and the concept of flow. These points define the design space explored in the project.

2.1. Interactivity attributes

Lim et al. (2007) developed the concept of interaction gestalt, arguing that an interaction is a composition of qualities that together become something bigger than the sum of its parts. Interaction gestalt contains a vocabulary of interaction attributes that help the designer consider different parts of the interaction to reach a specific interaction gestalt. The attributes are used to describe, shape and analyse the interaction. Each of the attributes are manipulated on a linear axis, for example slow to fast. These variables are used to design the desired experience, and they include things like pace, speed and resolution.

Lim et al. (2009) further developed the concept of interactivity attributes to have a language to describe the immaterial, dynamic shape of the interaction, as one might describe physical materials. The attributes were introduced as “a new way of thinking and describing interactivity”, and they are meant to help designers look at and shape the invisible quality of the interaction. The attributes used in this research were concurrency, continuity, expectedness, movement range, movement speed, proximity and response speed.

Building upon the initial research on the attributes, Lim et al. (2011) aimed to bring the interactivity attributes into practicing designers’ work. They conducted a study with interaction design students. The students were asked to design artefacts first without the use of interactivity attributes, and later introduce the attributes and have the students design artefacts applying the attributes. The goal was to see how the attributes affect the approach of designing an interactive artefact. There was also a control group of students who did not get introduced to the attributes. The results showed that the students who worked with the interactivity attributes were more conscious about the interactive qualities they wanted to achieve. They also were able to describe the interactivity in more detail.

Similar notions were reached by Lenz, Diefenbach & Hassenzahl (2013) in their research on what they call interaction vocabulary. They suggest an overall experience to be defined first in the process, and then use the attributes that are known to be connected to that experience to be used to reach the desired design. The paper suggests that a combination of attributes might evoke a certain experience in the user, but also points out that context plays a big role on the experience. The attributes help designers keep the process more focused.

Aagesen & Heyer (2016) brought the point of view of branding to the usage of the interactivity attributes. Practicing designers often work with products and experiences that
are branded in some way, but the branding hasn’t been a part of the interaction design process in itself. It was suggested, that interaction aesthetics would be included in the branding process and brand guidelines, much like visual designers define colours, typefaces and shapes that communicate the brand personality. In the research conducted the relation of the interactivity attributes to emotions and brand traits was explored.

The problem with the research done so far is that the prototypes made lack context. The perception of a certain interaction might change drastically in different use scenarios. Within the scope of this paper I will bring the attribute of flow into more concrete user scenarios and test the emotional response the experience elicits and the perceived brand expressions. In the final outcome the research narrows down to finer, concrete details that make the sense of flow. A deeper understanding of the interaction attributes and how to use them in practice in the field will create a palette of interaction aesthetics that open up interaction design to be more expressive. This will result into more informed and sophisticated design decisions by designers working with branded interactive experiences.

2.2. The immateriality of screen-based design

In design disciplines, materiality has traditionally been a key element explored in the design process. When designing screen-based experiences, the material exploration is very different from actual physical product design. The digital material lacks the functional qualities of a tangible object.

The materiality of electronic objects has been discussed even before touch screens were introduced to our everyday lives. Dunne (1999) framed that "the electronic object is an object on the threshold of materiality" (p. 11). Jung & Stolterman (2011) frame the problem of digital design as "a particular challenge regarding design material due to its complicate composite of physical and digital qualities." (p. 2). The reason materiality in electronic objects is a complex topic is the fact that there is a disconnect between the surface and the inner complexity. What is often seen as good design is design that communicates the desired use of that object. To reach that notion, designers tend to hide what is under the surface of the object (Redström, 2005).

Lim et al. (2007) relate screen-based design to designing physical objects. When designing with physical materials, one needs to understand the qualities that make the material, such as weight, size and hardness, to make good design decisions. The challenge of designing interactions is the material does not have such concrete properties, it is "flexible, ungraspable, and phenomenal" (p. 245). The problem is that interaction designers are not taught to conceptualise and manipulate the design material they work with, as compared to designers who work with tangible and material qualities (Lim et al., 2011).

In the field of interaction design, the conducted design work can be seen as separate from the actual object and its contents. It has been suggested that there has been a shift from traditionally addressing about ‘materials’ and ‘objects’ in design work to designing ‘services’ and ‘experiences’ instead. This shift requires designers to design products are not necessarily finished, but rather iterated in use (Redström, 2005). The iteration of
user experience is a key process in screen-based interaction design, as the immateriality allows for continuous re-shaping. Often even the devices used in the design process might vary, as the design itself is only information and can be shaped with different computers and other devices. The continuous re-shaping of the design is the reason a research through design process if often a good method for designing interactive experiences.

Screen-based interaction design if often seen as an experience that lacks richness of interaction, tactile sensation and bodily engagement, as opposed to tangible computing. This is based on the notion that humans are more familiar with using physical objects in their everyday life than interacting with digital interfaces (Dourish, 2001). The total lack of embodiment in screen-based interaction has been argued in the sense that even a subtle touch screen interaction is embodied, as bodily senses are used also with the screen. When a human uses a finger to touch a surface it is always a sensory experience. Vito Campanelli (2010) frames that touch screens fall somewhere in between the two opposites, being “neither definitely tactile nor definitely optical” (p. 136). What can be said is lacking, is the haptic feedback in a touch screen interaction.

To make the experience more familiar to users, screen interactions are sometimes designed to mimic physical interactions and materials. Skeuomorphism is a branch of user interface design that thrives to make digital products look like physical ones. Often the gestures you do with physical objects are also mimicked in these experiences, like swiping on the corner of page to “grab it” and turn to the next one. During the last years skeuomorphism has become less popular, while more minimalistic, flat aesthetics have taken over most digital products and experiences. This new trend embraces the immateriality of the digital design space, and opens up to more abstract representation. Flat design implies that humans in modern societies are already so familiar with screen interactions, that there’s no need to bring the physicality to a screen representation, but rather create clear affordances. During the last decade some touch screen interactions and iconography have emerged to be conventions, such as the “hamburger menu icon” or swiping left to delete or disregard something.

Lim et al. (2009) conducted research on whether the interactivity attributes used to describe the immaterial qualities of an interactive experience are perceived and have emotional effects like physical materials. The results support the notion that screen-based interactions can elicit varying emotions and the interactions can be experienced as being rich. Even though the participants were interacting with two dimensional Flash prototypes, a lot of their answers suggested feelings of interacting with physical materials. These results suggest that screen interactions might be perceived as rich interactions, like those with physical materials. More research needs to be done to learn about what is it about the interactions that makes users feel the materiality in a digital experience.

The immateriality of the screen interaction opens up the design space for complexity of expression, because the nature of the material is dynamic. (Lim et al., 2011). Jung & Stolterman (2012) even go as far as to say there is unlimited design potential that can be
expressed with digital technology. The different types of dynamic aesthetics that make the screen interaction pleasing are the expression this paper aims to look into.

The immaterial quality can be described as the feel or the personality of the interaction. In order to unpack what has been called ‘complexity’ and ‘unlimited design potential’, the properties of this dynamic material need to be defined. The previous work on interactivity attributes aims to do that, but does not go very deep on a concrete level - what makes the interaction to be perceived as discrete or continuous? It is the complexity of the dynamic material that can alter the perception, but what needs to be defined is what properties make this complexity.

2.3. User experience in relation to interaction aesthetics

Garrett (2011) wrote: “designing the user experience is really little more than a very large collection of very small problems to be solved”. What we are interested in as design students is often a well-rounded view of the experience a user has with certain product, and the grounding of an idea on a conceptual level. As a practicing designer, however, one might have to go into detail and solve this these small practical problems to make the product actually usable and feasible to be implemented. The fine details in specific interactions are the focus of this project.

To design good user experience in general, one has to be aware of the needs of the user and to have a well defined reason for every design decision made. Good user experience is often characterised by improving efficiency of reaching a goal in minimum time and effort and with little mistakes made (Garrett, 2011). The emerged concept of interaction aesthetics challenges the idea that the desired user experience should be only about efficiency. In their paper Lenz et al. (2013) propose that “designers need to develop a notion of what a "good" interactions constitutes beyond mere effectiveness and efficiency” (p. 126).

Cooper, Reimann & Cronin (2014) define human-oriented design activity in three points:
- Understanding the desires, needs, motivations, and contexts of people using product
- Understanding business, technical, and domain opportunities, requirements, and constraints
- Using this knowledge as a foundation for plans to create products whose form, content, and behaviour are useful, usable, and desirable, as well as economically viable and technically feasible” (p. 3-4).

The understanding of emotions that interactions trigger in people, will help designers make more informed design decisions, and that will result into more useful, usable and desirable products.

Often designing a good user experience means that one has to follow the conventions of modern day web. Different services might have different means of accomplishing tasks, but sticking to ones most users are familiar with makes for an easy learning curve. Garrett (2011) calls these conceptual models, and uses the shopping cart for online stores as an example. It is a convention people are used to, even though the idea of “putting
things into" and “taking things out of” a digital shopping cart is completely artificial. If one would design an online store that had a completely different conceptual model for shopping for items, one would need a good reason to do that and design an intuitive system for users to be able to complete tasks easily even without the familiarity of the feature. The most important thing about conceptual models is consistency. When a user has learned a way of accomplishing a task, the same service should provide the same model for accomplishing it again. Convention does not necessarily dictate all decisions, but it should be carefully considered. The element of surprise might be delightful to the user, but it also might mean there is a learning curve.

The underlying statement is that basic usability expectations can be seen as more essential to be fulfilled rather than aesthetic expression (Jung & Stolterman, 2012) even though they might not exclude one another. Udsen & Jørgensen (2005) look at aesthetics in HCI from different perspectives and conclude that in the functionalist approach “the aesthetic appearance of products increases usability” (p. 209).

Lim et al. (2007) state that “only thinking about the user experience cannot fully guide designers to explore a design space of possible aesthetic interactions in a concrete way” (p.240). User experience is mostly based on efficiency and solving problems, where as the design space of interaction aesthetics is about expression and emotion. Within the scope of this research I am not looking into solving user experience problems, but finding the expressive quality of the interaction and exploring it. The exploration might even expand outside of current usability expectations. However, basic usability principles are a good starting point for prototyping, as they are proven to be familiar to most smart phone users.

2.4. Flow

2.4.1. Flow as a concept

The concept of flow in psychology was created by Mihaly Csíkszentmihályi. He describes it as an optimal experience, or an autotelic experience, which means that the experience in itself is rewarding, not the outcome, a consequence or some future benefit of the action (Csíkszentmihályi, 2013). Usually the sense of flow is seen as full concentration and immersion in the task at hand, but it requires also some external conditions. A state of flow can be reached doing very different types activities: playing a game, painting, driving, having a conversation, dancing. The main component in reaching a flow state is the relation between skill and challenge levels (Figure 1). Flow is reached when there is enough challenge to keep the person interested in the action, but enough skill so that the person does not struggle in performing the action.

There are certain circumstances that facilitate reaching a flow state, including: sense of control of the action, rules, a goal and a way of obtaining feedback. This means that the person gets a sense of how well they are performing the action, and can adjust accordingly. (Csíkszentmihályi, 2013)
It has been argued, that the flow state is not purely a positive thing, but as an experience to be facilitated for using a service, it is a desired state. Games, for example are designed for reaching a flow state easily and getting the player hooked. However, looking into games is a field too wide to dive into within the scope of this paper. The focus is to facilitate a sense of flow in everyday interactions on a mobile screen and find the concrete expressions of flow. The concept of flow in psychology serves as a background understanding of what the user should be feeling when attempting to facilitate the sense of flow.

2.4.2. What I talk about when I talk about flow

In the start of the process, I asked a group of friends on to tell me what they think about when they hear the word “flow”. Figure 6 is a word cloud created from these answers, and it has been used as a source of inspiration. The words mentioned most often are fluidity, liquid, water, waves and continuity. As mentioned before, in psychology flow is an immersive state where sense of time and surroundings disappear. Immersiveness as a word obviously refers to immersing something in liquid as a whole. In this paper flow as a concept is discussed in relation to finding representation for the immaterial quality of interaction. Flow as a term is also immaterial and intangible, but in order to understand what it is we are talking about, we try to find material ideas that embody the feeling or some aspect of it. As was learned, water and liquid come up most often, and those materials representing immateriality are the background in the ideation process.
When discussing the flow of web, Campanelli (2010) frames that “we are persuaded that we are in control”, meaning that we have the feeling of control, but it’s not real. Web pages, as other interactive experiences, are always designed by people, who create scenarios and paths for the user to take when navigating through. There might be options, but true control is not in the hands of the user, but in the hands of the people who designed the experience. However, the feeling of control is still often an experience designers want the user to have, be it real or not.

The starting point for this project is the interactivity attribute of flow, or continuity. In previous research the attribute has been embodied as a continuous movement such as a slider or a dragged shape. The opposing interaction was discreteness, a stepwise action (Aagesen & Heyer, 2016; Lim et al., 2009). In order to explore this design space more representations were designed.

Within this paper what is meant by flow in the screen based interaction is conceptual. It means an immersive interaction, where the gesture is performed and the goal is reached with little effort and much pleasure, with the feeling of control. In the iterative process the goal was to prototype and test different embodiments of flow and not only see the emotions they elicit, but also test how well they express flow to validate the prototypes.

2.4.3. Case studies

One of the most known and discussed popular applications nowadays is Tinder, the dating application where one swipes peoples profiles left or right depending on whether the user is interested in that profile or not (Figure 2). The basic swipe interaction on Tinder is a good example of flow on a mobile screen. It is simple, engaging and the feeling of control is present - you decide which way to swipe and at what pace. The interaction is immersive - after you swipe one profile, the next one pops up right away and it affords for you to keep swiping through. The swipe is a more expressive gesture than simply tapping on a button.

Pause is an application that is designed for relaxation, for taking a pause. It is based on a meditative lava lamp style visual (Figure 3), and the simple interaction of slowly dragging a bubble around the screen, growing it gradually bigger until it fills the whole screen. The experience is very immersive, and that is why it is successful as a relaxation exercise. The immersiveness comes not only from the liquid style of the visual representation, but also from the pace of the interaction. The dragging gesture is very slow and the application tells the user to slow down if they are going too fast. As people are used to maximising efficiency with very fast interactions on their phones, one way of designing for immersiveness is reducing pace.

Haze is a very visual weather application (Figure 4). The information is represented as numbers in bubbles that pulsate in a colourful gradient visual. The interaction of toggling between different screens giving different information can be done either by swiping or turning the phone in different angles as like a bubble level. The feedback is pulsating animation and liquid-like movement. When the user wants ore information, the ellipse can be tapped on, and it bursts into smaller bubbles with bits of information. The visual
Figure 2. Tinder application.

Figure 3. Pause application.

Figure 4. Haze application.

Figure 5. Snapseed application.
representation creates a flow to the user, and especially when doing the interaction of turning the phone to find out more, there is a little challenge on levelling the phone to the desired position. The application has a sense of flow for checking the information you need, quickly, but it does not keep you engaged for long.

Snapseed is a photo editing application with very intuitive controls (Figure 5). Many of the adjustments are hidden, you control them by dragging your finger horizontally on top of the photo you are editing - the change appears in the photo and the numbers below. A vertical drag on top of the photo makes a see-through menu appear where you have more controls, and by releasing your finger the control is chosen and you can go back to horizontal drag to change it. The beauty of this interaction is that with one simple gesture, done in different directions can control so many things. The interaction is intuitive and pleasant, and with dragging a finger it is possible to be very precise or also quite rough.

These case studies were picked for reference and inspiration. Some of them are used further in the process to illustrate to users what I mean when I talk about a flow experience on a mobile screen. The main reasons for choosing these examples are the overall sense of immersion and the balance between challenge and ease of use that keeps the user engaged. Also, for variety examples with different gestures were chosen.
3. Process

In this chapter I go through the design process conducted in this project. There are two major user studies that informed the final outcome, that is a set of guidelines and a prototype embodying them.

The chosen methodology is that of research through design, because of the nature of the project. The goal is not to so much solve a specific problem, but explore the defined design space and design embodiments to be tested. The process is based on design activities, insights gained from them and iterations that follow in a loop. Within each loop the previous actions are evaluated and even the research goal might be adjusted accordingly. Great emphasis is on the process itself and the knowledge it creates. (Koskinen, Binder, & Redström, 2008; Koskinen, Zimmerman, Binder, Redström, & Wensveen, 2011; Gaver, 2012)

The process started out with the research focus being on the interactivity attribute of flow and the testing of it in different contexts. The existing research done on the attribute lacks context, because the prototypes used are very abstract, and this was to be challenged in this project. However, as often in research, the focus shifted during the process. The first user study provided some insights that were found interesting to be explored. One insight was chosen to move on with: defining some of the immaterial qualities that make the sense of flow and the personality of the interaction. This was seen as a more practical focus to be explored within the scope of this project, as it nar-
rows down to fine, but concrete details. Finally, the research questions that were to be answered were: What immaterial details embody a sense of flow in a discrete interaction? How are the details experienced by users?

The design activities carried out consist of a light round of interviews and two rounds of user testing in a lab environment (Koskinen et al., 2011). In the lab setting the participants take part in the design activities in a controlled set up where specific variables can be adjusted. The results inform the following steps in the process. Some basic user experience literature served as inspiration on setting up the so-called script of user testing. Traditionally usability testing is “a collection of techniques used to measure characteristics of a user’s interaction with a product” (Cooper et al., 2014, p. 57), and it is focused on validating a certain interface or user path and revealing errors. In this project the used parameters and outcome are different.

The design space explored in the project is that of the sense of flow on a mobile touch screen, narrowing down to the concrete details that embody the flow. The concrete details are the immaterial quality of the interaction, what makes the ‘feel’ of the interaction, or the interaction aesthetic, in practice.

3.1. First steps

Early on in the research the decision was made to focus on the mobile touch screen. This is based on personal interest that serves as a way to narrow down the research focus. As the smart phone has established its presence in modern life, more and more services are designed for mobile screens. The mobile touch screen is very different from desktop in terms of interactions. The swipe, the pinch, the drag - these are gestures that we were not used to doing on a screen 10 years ago. The technology is still novel, even if it has made its way into our daily lives. When the smart phone emerged into the market,

Figure 7. Word cloud for ideation.
quite often the interactive experience on a mobile was a stripped down version of the “real” website or product, which was experienced on a computer screen. Nowadays the mobile version of a page or a service is seen as important, or even more so than the desktop. The design possibilities of the mobile screen seemed very restricting to many designers - also to myself when I had to design my first responsive website. In the end the beauty of being a designer is to thrive on the challenges, and see the restrictions as problems to be solved to reach the desired outcome.

As mentioned before, I interviewed some friends to tell me what they think about and associate with the word ‘flow’ (Figure 7). These thoughts served as inspiration in the initial ideation phase, as well as the flow experiences also introduced in the previous chapter.

Ideation and sketching was done with varying materials. Figure 8 exhibits some physical sketches made to explore transitions and representations. The sketching done with watercolours, pens and markers on paper was for inspirational purposes. Because the research is about finding the immaterial qualities, stationary, physical sketches can only go so far. For this reason, I combined the digital with the physical sketches by turning them into videos. After that step I moved onto completely working with the computer. The first fully digital sketches were more conceptual (Figure 9), but soon turned into the contextualised prototypes used in the user studies.

3.2. User research

Cooper et al. (2014) state that “user research is the critical foundation on which your designs are built” (p. 59), from the perspective of making informed decisions when designing user experience. It has been critiqued how research sometimes is an activity that is separated from the actual design work and state that a strong knowledge of scientific practice has not been common among designers (Koskinen et al., 2008; Koskinen et al., 2011). Thus more designerly methods have been suggested.

The classic user experience testing is looking at the usability of a certain site or product. The point is usually to validate the design and reveal problems. Within this project, the user testing conducted was inspired by usability testing in terms of the set up and the rough script of the test situation. Because these studies are not usability testing per se, different parametres are focused on.

Aagesen & Heyer (2016) say that their prototypes were “deliberately designed to be more familiar, concrete and complex than those of earlier work” (p. 3128). The prototypes are still very simple, geometric shapes that the users manipulate by clicking and dragging with no context. The first test was to see if the contextualisation would produce more varying results. The focus of the project was later shifted from the insights gained.

3.3. User study 1

3.3.1 Set up

The first user study was conducted with three different prototypes embodying flow. There were 6 participants, who were asked to interact with the prototypes and were
Figure 8. Physical sketches for ideation.

Figure 9. Digital sketches for ideation.
then asked a series of questions about how well the prototype embodied flow, what emotions it triggered and how the user related it to the brand traits.

The prototypes embody three contexts (Figure 10, Figure 11, Figure 12). Prototype 1 is an image editing app (https://youtu.be/OrPiBd9vxyY), prototype 2 a travel app (https://youtu.be/pSlgSmVV-rk) and prototype 3 an online shopping site (https://youtu.be/aMm41Adv3Kw). These prototypes were created to be simple but concrete experiences in different contexts, keeping the visual representation of branding quite discreet in order to keep attention in the interaction, not the visual design. On top of different contexts, the three prototypes have a different gesture for expressing flow: swipe, tap and drag.

The goal was to see if the users experience a sense of flow in these prototypes and what emotions and brand expressions they relate them to, and which ones not. They were asked how much they relate each prototype with each emotion and brand trait. The emotions used for the study were the six primary emotions defined by Damasio as they have been used in previous research (Percy, Hansen & Randrup, 2004; Aagesen & Heyer, 2016). The model of brand traits used is the recognised brand personality framework by Aaker (1997), consisting of 5 different brand personality dimensions. The questions on emotions and brand traits were asked to see how the responses differ in the different contexts.

The prototypes were tested on relation to the emotions elicited and brand expressions experienced in a similar way that Aagesen & Heyer (2016) did in their research. The testing on emotions and brand expressions brings valuable information for designers working in the field with branded interactive experiences. When designers become more familiar with what kind of emotions are elicited and how, they can make more informed design decisions. The brand expressions could be used as guidelines for interaction design, much like visual designers do when they design brand books with specified colours and shapes that communicate the personality of the brand. Currently brands do not usually carefully consider interaction aesthetics as a part of the brand communication.

The study was conducted in a lab environment (Koskinen et al., 2011), casually talking while users interacted with the prototypes one by one. As the prototypes are very simple, the users were not so much completing tasks, but rather playing with the interaction how they wished. The order of the prototypes was randomised with each participant. The chosen users are friends, who are students and/or professionals within digital media and design, between the ages of 23 and 35. All the users are very familiar with using mobile touch screens, so there is no learning curve.

What affects the reliability of the results of this study is the context the interaction is situated in. The contextualised prototypes might elicit different results in users purely because they find the visual representation pleasing, or not in their taste at all, or the travel app especially exciting because they like to discover new destinations. Also the fact that all of the participants are either studying or working with digital media and design means that they are all quite familiar with interacting with digital applications and
Figure 10. Prototype 1. Screen capture from a video that can be seen here: https://youtu.be/OrPiBd9vxyY

Figure 11. Prototype 2. Screen capture from a video that can be seen here: https://youtu.be/pSlgSmVV-rk

Figure 12. Prototype 3. Screen capture from a video that can be seen here: https://youtu.be/aMm41Adv3Kw
assessing their aesthetics and usability. With a different user group the results might be different.

3.3.2. Results of the study

The study suggests that all prototypes expressed a sense of flow. Results on the emotions and brand traits were quite consistent. Many users thought that a very gradual change in image editing and the slider expressed a flow for them, but some people thought that immediate change suggests no flow.

The table in Figure 13 shows the overall results of whether each emotion and brand expression was seen to be expressed in each prototype. All the prototypes were said to express a sense of flow quite well, prototype 3 scoring the best. The emotions anger, anxiety, disgust and sadness were seen related to the prototypes very little, as well as the brand expression of ruggedness.

Prototype 1 (Figure 10, https://youtu.be/OrPiBd9vxyY) with the interaction of image editing by swiping was seen connected to the brand expression of sophistication by almost all participants. Most participants said this prototype embodies flow well, but two felt it does not because “the change is so gradual”. The quality of gradual change was felt as both an expression of flow and the opposite of it.

Prototype 2 (Figure 11, https://youtu.be/pSlgSmVV-rk) was found very related with the emotion of surprise and brand trait of excitement. What is interesting, is that this prototype was the most stepwise of the three, but the animation brings a spatial quality to the expression. Most participants found the prototype to embody flow well. In previous research discreteness has been the opposite of maximum flow, which was embodied by continuity (Aagesen & Heyer, 2016; Lim et al., 2009).

Prototype 3 (Figure 12, https://youtu.be/aMm41Adv3Kw) with the interaction of dragging a slider to change the color of shoes was most clearly connected to brand traits of sophistication, sincerity and competence. Some participants mentioned the word “trustworthy” and a feeling of control in the interaction. Also in previous research a fluent interaction had evoked the sense of control in users (Lenz et al., 2013). In terms of visual image, this prototype embodied a high-end online shopping experience. In this case it can be argued that the results of embodying sophistication and competence might be different with the same interaction but a different graphic.

The most interesting finding from this study is that some participants saw the gradual drag and swipe interactions as a better expression of flow, and some the discrete ones. Also, the delay and animation in feedback was seen as expressing more flow than an immediate reaction by some participants. One mentioned exactly the opposite, that there was more sense of flow when the user is in control. Aagesen & Heyer (2016) differentiated that flow is a continuous action, and an action with no flow is discrete. What this study showed, is that discreteness can also be expressed in a way that makes some people see it as a flow and an expression of fluidity. The results of this study suggest the key elements of expressing the fluidity is delay and animation.
<table>
<thead>
<tr>
<th></th>
<th>PROTOTYPE 1</th>
<th>PROTOTYPE 2</th>
<th>PROTOTYPE 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coloring an image by swiping</td>
<td>Browsing travel destinations with taps</td>
<td>Choosing shoe color with slider</td>
</tr>
<tr>
<td>FLOW</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SURPRISE</td>
<td>x</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td>ANGER</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>ANXIETY</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>DISGUST</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>SADNESS</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>JOY</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SINCERETY</td>
<td>x</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>EXCITEMENT</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>COMPETENCE</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SOPHISTICATION</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>RUGGEDNESS</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Figure 13. Table of the results of the first user study.
More testing needs to be done to find out more. In conclusion, the insights gained from this study were:

- *Even though it has been argued that flow is a continuous action, also discreteness can be expressed in a way that users see as flow*
- *The feeling of control is seen as a sense of flow by some - this needs to be investigated more. More iterations on flow and control might bring new insights.*

From the first user study some insights were gained. However, the study would have been more useful with more rigour on execution. The three prototypes would have given more information if each of them had another type of an interaction or feedback for control and comparison. Another issue is that when designing contextualised, branded prototypes the graphics play a big role on the experience. Even when participants are asked to evaluate the interaction, when talking about emotions and feelings elicited, it is impossible to not let the visual representation affect that.

The first insight was chosen to move forward with and more testing was needed to find out more. Digging deeper into how a discrete action can be expressed to elicit the sense of flow will bring concrete knowledge for design practice. That knowledge will contribute to an understanding of what are some of the variables within the immaterial, dynamic quality of the screen-based interaction. This required a rephrasing of the research question to be tackled, and some refocusing of the overall direction of the project. However, a second user study was to be set up to learn more.

### 3.4. User study 2

#### 3.4.1 Set up

The second user study is based on the insight gathered from the first one: how can discreteness be expressed in a way that facilitates flow. For this study prototypes were created that embody a discrete interaction and play with different values of delay and animation. The goal was to figure out how these variables can add flow to a discrete interaction. Also, the participants were asked if they relate the previous used emotions and brand expressions to the interactions. This is to see what kind of an effect changing the variables of delay and animation have on the elicited emotions and relation to brand expressions.

The delay and the animation are just a couple of variables that make the dynamic, expressive quality of the screen-based interaction. Lim et al. (2011) brought the interactivity attributes to practice as vocabulary of interactivity in the design process, but by closing down to specific variables to adjust in the design process bring the attributes to the concrete, detailed design decisions made.

There were 10 participants in the study. The participants were friends and acquaintances, between the ages of 23 and 35 with the same amount of females and males. All are either studying or working in the field of digital media and technology, and very familiar with mobile phones and touch screens. The study was conducted in a lab environment (Koskinen et al., 2011). The order of the prototypes was randomised with each partici-
Figure 14. Prototype 1. Screen captures from a video that can be seen here: https://youtu.be/hqzwiNqlNpl
Figure 15. Prototype 2. Screen captures from a video that can be seen here: https://youtu.be/qYHEODuSASQ
Figure 16. Prototype 3. Screen captures from a video that can be seen here: https://youtu.be/H12mX4IC03w
Figure 17. Prototype 4. Screen captures from a video that can be seen here: https://youtu.be/FS5E0lf0dwM
pant to reduce the impact that the order has on the results.

The prototypes have the interaction of typing, in this case tapping on the screen letter by letter to compose the text. The conceptual model (Garrett, 2013) of tapping the digital buttons to create text is something that was derived from physical keyboards to the touch screen. The interaction is familiar because it mimics its real-life counterpart, and that makes it easy to learn for users who are used to working with computers. This interaction was chosen because it is a mundane everyday task.

The prototype has 4 different versions, where one is the normal interaction of typing and others have different variations of delay and animation to them. The animations vary from dropping the letters from above to fading and bouncing actions.

3.4.2. Results of the study

Prototype 1 (Figure 14, https://youtu.be/hqzwiNqINpI) that has the letters dropping down from above with some delay was seen to embody flow moderately well. Some participants experienced it as frustrating, and especially mentioned it after the initial surprise had worn off. One participant said it “does not feel very professional or credible”, and that statement is supported by the unanimously low score on the brands trait of sophistication. This prototype was clearly connected with the emotion of surprise and the brand trait of excitement. This sort of interaction might work on contexts that do not aim to communicate professionalism, but playfulness and fun.

Prototype number 2 (Figure 15, https://youtu.be/qYHEODuSASQ) with letters appearing in a slow fade animation produced interesting results. Some participants thought it was frustrating at first because of the long delay, but after a while ended up immersed in the animation. Seems like because we are used to fast and efficient interactions, slow ones take little while to get familiar with and that can cause frustration in the beginning, but turn into a positive experience in the end. Most saw the experience as pleasant and something to concentrate on. This suggests the immersiveness of a sense of flow, an autotelic experience (Csíkszentmihályi, 2013. Two participants found it to inspire them to think of interesting designs, possibly adding sound or music to it. One participant wanted to keep typing and found the motion relaxing in comparison to regular typing. This prototype was most often said to represent the brand trait of sophistication.

In prototype 3 (Figure 16, https://youtu.be/H12mX4lC03w) the letters appear with a shorter delay and a bounce effect. It was seen to embody flow considerably well. This prototype was described as playful and fun, and it was most often connected to the emotion of surprise and the brand trait of excitement. One participant described the animation as an explosion, another as bubble popping. These could be interesting expressions for some products.

Prototype number 4 (Figure 17, https://youtu.be/FS5E0lf0dwM) was the control with regular typing feedback - the letter appears instantly. This prototype produced two kinds of results. Firstly, some participants felt very positive about it, because it works as expected. Secondly, other participants said it was neutral and didn’t elicit emotion.
One called it “boring” and another one said it’s “too expected”. The scores on emotions were low overall, but the one that felt most was sadness. No extremely strong negative feelings were related to the prototype, but several did imply the expectedness to be too familiar and not delightful.

Overall results suggest that the animation and the length of the delay have an effect on the emotional response and the feel of the interaction. Adjusting these variables can change the personality of the interactive experience. If the user finds the slow interaction is pleasant, it feels immersive. Slow and fading animation was experienced as sophisticated and relaxing. Faster animations tend to be seen as playful, no animation as neutral. In some cases, like prototype 2 (Figure 15), time seems to be a key element in the experience. Time meaning both the slowness of the feedback, and also the fact that users need some time to adjust to the interaction being slower than they are used to, to be able to feel the pleasant aspects of it.

The insights gained:
• Adjusting the variables of animation and delay even subtly have an effect on the emotional response to the interaction.
• Very slow interaction can be felt as immersive, even after there has been some frustration in the beginning. Taking time to actually experience, and to get over the initial frustration is the key to finding the interaction enjoyable.
• The experience with faster and more playful interactions was the opposite - they were found playful at first but some annoyance was elicited in longer experiences. The novelty wears off.

What was gained from this study is a more specific understanding of the details that have an affect on the sense of flow. More testing in various contexts will bring more reliability to these results. The information gained from each of the prototypes inform the final guidelines and the prototype that are the result of this project.
<table>
<thead>
<tr>
<th></th>
<th>Prototype 1</th>
<th>Prototype 2</th>
<th>Prototype 3</th>
<th>Prototype 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flow</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Surprise</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td><strong>Anger</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Anxiety</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Disgust</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Sadness</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td><strong>Joy</strong></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td><strong>Sincerity</strong></td>
<td>X</td>
<td>✓</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td><strong>Excitement</strong></td>
<td>✓</td>
<td>X</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td><strong>Competence</strong></td>
<td>X</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td><strong>Sophistication</strong></td>
<td>X</td>
<td>✓</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td><strong>Ruggedness</strong></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

**Figure 18. Figure X.** Table of the results of the second user study.
4. Results

This chapter covers the outcome of the project that was informed by the user studies conducted. A set of guidelines was developed to communicate the relations between some animations and the emotions and brand traits elicited by them. Finally, from these guidelines an interactive prototype was designed to illustrate them.

4.1. The guidelines

As a result of the studies done, a set of guidelines was constructed. These are rough guidelines for eliciting certain emotions and facilitating a desired flow experience. The guidelines are meant to inspire designs and serve as basis for future exploration in other contexts.

Guidelines (Figure 19):

- **Delay + dropping animation:** the animation is experienced as playful and fun. Does not communicate sophisticated or professional feeling. Not good for longer interaction, because in time it's found frustrating.
- **Long delay + fade:** a slow delay with a fade produces the immersive feeling that is key to reaching a flow state. Users tend to spend more time with the interaction and find it relaxing.
- **Short delay + bounce:** described as fun and surprising. Most felt emotion is joy and the brand expression excitement. Several participants mentioned it to be engaging.
- **Immediate reaction:** Mostly described as serious and credible. The most elicited emotion is sadness, but even that scored low. Compared to other there was not much emotion connected, but that can be the desired state.

4.2. The Embodiment

From these guidelines the final product, what I call 'The Embodiment' was designed (Figure 20 & Figure 21, [https://youtu.be/ad1eVS3So9w](https://youtu.be/ad1eVS3So9w)). This is a conceptual representation embodying the guidelines, and is thus more easily understood than a mere explanation. As Gaver (2012) states: "design examples are indispensable to design theory because artefacts embody the myriad choices made by their designers with a definiteness and level of details that would be difficult or impossible to attain in a written (or diagrammatic) account" (p. 944).

The Embodiment has the four points illustrated with abstract visuals. The interaction is tapping in each of them, and the user gets a dynamic, animated feedback as in the previous prototypes used for testing. On top there is a layer that can be dragged from the left. This layer shows a graph on how much of a flow experience each interaction should elicit, and key words describing the dynamic quality. The key words come from the final user study conducted. The top word is the emotion that was most related to this interaction, the second one is the brand trait and the third one is a word that most came up during conversations when participants described their experience and feelings with this interaction.
Even though the contextualisation of the prototypes used for testing was justified, the embodiment benefits for being abstract. The point of this prototype is merely to illustrate the interactions and it should not be seen as a final concept.

The goal of the project was to narrow down into finer details of the immaterial, dynamic quality of the interaction. As has been stated before, because the nature of digital design is dynamic, the design space is opened up to complexity and has limitless options (Lim et al., 2011; Jung & Stolterman, 2012). Within the scope of this project only a small part of the existing qualities are possible to explore and prototype.

Figure 19. A table of results used in 'the embodiment'.

<table>
<thead>
<tr>
<th></th>
<th>SHORT DELAY + FALLING ANIMATION</th>
<th>LONG DELAY + FADE</th>
<th>SHORT DELAY + BOUNCE ANIMATION</th>
<th>IMMEDIATE REACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLOW</strong></td>
<td><img src="image1" alt="" /></td>
<td><img src="image2" alt="" /></td>
<td><img src="image3" alt="" /></td>
<td><img src="image4" alt="" /></td>
</tr>
<tr>
<td><strong>EMOTION</strong></td>
<td>Surprise</td>
<td>Surprise</td>
<td>Joy</td>
<td>Sadness</td>
</tr>
<tr>
<td><strong>BRAND EXPRESSION</strong></td>
<td>Excitement</td>
<td>Sophistication</td>
<td>Excitement</td>
<td>Competence</td>
</tr>
<tr>
<td><strong>MOST MENTIONED WORD</strong></td>
<td>Playful</td>
<td>Pleasant</td>
<td>Fun</td>
<td>Expected</td>
</tr>
</tbody>
</table>
Figure 20. The embodiment. Screen captures from a video that can be seen here: https://youtu.be/ad1eVS3So9w
Figure 21. The layout of the embodiment. On the right the default layout, on the left the layer that can be dragged on top to show the guidelines.
5. Discussion

As stated before, the previous work on interactivity attributes lacks context and detail. If they are to be used as design tools more concreteness should be attained. Lim et al. (2011) state that they wish for interaction attributes to open up interaction design to be more expression-oriented. Research done after that has built onto bringing the attributes closer to use in practice (Aagesen & Heyer, 2016) and this project took a small step further. In order to have an impact of the whole field becoming more expression-oriented, the concrete qualities behind the attributes and their expressions need to be further unpacked.

This project aimed to dig into a more concrete level of the interaction aesthetics, and the final results gained provide some deeper knowledge of that. They reveal some practical information on small details of “the immaterial material” of the interaction. The contribution made to the field is minor but could serve as starting point for future work. The scope of this project unfortunately did not allow for more studies.

The contribution on top of the knowledge gained is the final outcome in the form of the guidelines and The Embodiment. They serve an invitation to fellow designers to test out these parameters in other contexts. These are exemplary ways of moulding “the immaterial material”, and seeing what emotions and brand expressions are elicited. In the end parallels can be drawn with physical materials and the immaterial materials: for example, the slow fade interaction was seen as immersive, sophisticated and relaxing. As a physical material this could be something like velvet, or mahogany. A designer working with textile or wood would be very aware of the feelings these materials elicit - and so should a designer working with digital material (Lim et al., 2011).

To relate back to user experience, as discussed earlier in this paper, these expressions of flow in interactions very likely have a very different take on what flow is and how it can be felt than user experience literature would provide. The prototypes designed in this process, on some parts, overlook basic usability expectations, even though some good usability examples served as initial inspirations. This is because when exploring the aesthetic nature of the interaction, one has to break away from current conventions, otherwise an exploration is not possible (Lim et al., 2007). The prototype, and even less The Embodiment, were not designed for efficiency. However, I do firmly believe that every single guideline could be contextualised in a situation where the balance between usability and aesthetic meet. The aesthetic is not meant to contradict the usability, but to support it.

The personal objectives for this project aimed at learning more about conducting lab testing and prototyping software, and those goals were definitely met. Behind the scenes of the report, several prototyping softwares were tested, with some success and some failures. Also, with basically no research experience, going into a full academic research project has been a scary, but an interesting journey to say the least. The studies conducted in this process would have benefited of more rigorous planning and execution.
A personal interest in future work that emerged from the findings of this project, is to explore how and if the immaterial quality of the screen-based interaction can elicit emotions and communicate feelings in the same way physical materials can - and if there are parallels that could be drawn between them. As tangible interactions are often seen to be more rich than screen based ones, more research could go into finding if a deeper knowledge of the immaterial material being moulded would result into something that could be seen as a rich screen based interaction.
6. Conclusion

The project started out with the aim of exploring the design space of flow for screen based interactions and finding out how the contextualisation affects the perception of the interaction attribute of flow. Along the way the focus shifted to finding and defining some of the dynamic qualities that make the perception of flow in an interaction. The new aim was chosen to narrow down to more specific details, and to bring more concrete information about what actually are the expressive qualities about the immaterial material and how they can alter the user’s experience. Previous work on interaction aesthetics does not go deep into these topics, and has only covered it on a more superficial level. The chosen methodology was research through design, as the purpose was to explore possibilities rather than tackle a specific design problem.

The rephrased research questions were: What immaterial details embody a sense of flow in a discrete interaction? How are these details experienced by users? The second user study revealed some answers to these questions. Adjusting the variables of delay and animation in discrete interactions have an effect on the sense of flow experienced. Different emotions are elicited with varying animations and delays, and the brand expressions connected to the experiences are diverse. For example, slow and fading animations can be experienced as relaxed and immersive, and are related to the brand trait of sophistication. Time is a key element in some cases - some participants experienced frustration in the initial interaction, but found the same prototype to be pleasant and made them focus after using it for a few minutes. The more specific details on emotions and brand expressions are embodied in the final prototype designed from the results. The Embodiment of the guidelines is to serve as an illustration of the dynamic qualities that can not be fully described with mere words.

The results are only a small part of the design space of flow in screen-based interactions, but within the scope of this project this is what was gained. The research is relevant because it tackles the specifics of what has been before vaguely described as the immaterial material of screen based design. A deeper knowledge of the details of what makes this material and what are the different expressions of it will result into better understanding of what can be designed, and what kind of experiences can be created. This information contribution is relevant for practicing designers. From the emotion found to be elicited through specific interactions, a certain experience can be facilitated. As many designers in the field work with commercial experiences, the relations to how desired brand expressions could be perceived is relevant. The final goal is to create an understanding of the material being designed, much like the one a product designer would have of the tangible qualities of the materials, and this will guide the field of screen based interaction design to be more expression-oriented.
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