Introducing Gestures
Exploring Feedforward in Touch-Gesture Interfaces

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Abstract

This interaction design thesis aimed to explore how users could be introduced to the different functionalities of a gesture-based touch screen interface. This was done through a user-centred design research process where the designer was taught different artefacts by experienced users. Insights from this process lay the foundation for an interactive, digital gesture-introduction prototype.

Testing said prototype with users yielded this study’s results. While containing several areas for improvement regarding implementation and behaviour, the prototype’s base methods and qualities were well received. Further development would be needed to fully assess its viability. The user-centred research methods used in this project proved valuable for later ideation and prototyping stages. Activities and results from this project indicate a potential for designers to further explore the possibilities for ensuring the discoverability of touch-gesture interactions. For future projects the author suggests more extensive research and testing using a greater sample size and wider demographic.

Keywords: Interaction design, Natural user interface, Gestural interaction, User-centered design research, Self-revealing gestures
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1 Introduction

Interaction design has been described as “the practice of designing interactive digital products, environments, systems and services” (Cooper, Reimann, Cronin, & Noessel, 2014, p. xix). As a practice it largely caters to the user of the artefact, their needs and wishes. Therefore, interaction design is largely concerned with how designs behave and how this affects user experience and actions (ibid. pp. xix-xx). Developments in the field have presented novel modes of interaction for users to experience and for designers to explore and possibly utilize when designing interactive artefacts.

Some services and designs in the touch screen domain have started to introduce interfaces that omit certain traditional visual representations of possible actions. The functionalities of components such as buttons, sliders and checkboxes are at times replaced with gestures such as swipes and long-presses. One of the most prominent uses of a gesture-driven touch screen interface is exemplified in Snapchat, a social media platform where users communicate primarily through temporarily available images and text messages known as “Snaps” (Snap Inc., 2019). Its user interface allows for using a wide array of swiping motions and touch gestures to move between screens and call certain actions (ibid.). Gesture interactions in touch-screen interfaces have since started to become more commonplace. We can see touch gestures being used for interaction in a variety of scenarios such as in apps where actions related to a list object can be called by swiping the item in a certain direction.

However, when looking closer at touch gesture interactions there seem to be certain challenges present in this type of design for interaction designers to address. Initial research seemed to indicate that communicating the interactions available has been a recurring challenge within interface design. This dissertation aims to investigate how gesture interactions could be made visible and communicated to users by means of creating an explorative prototype derived from cooperative research methods.

1.1 Purpose

The purpose of this study is to conduct a phenomenological, user-centred, design research process to better understand how a touch interface might introduce its own gesture interactions to the user. Insights generated from this phenomenological study will in turn be embodied into a digital prototype to test the viability of this method. Hopefully this may give some insight into how designers might ensure that gesture-based touch interfaces are learnable. Consequently, the long-term goal of this work is to expand the possibilities for providing users with interfaces that are free from visual
distractions and fully focused on the users’ goals, needs and intentions. To better communicate the intentions of this thesis a research question was formulated.

1.2 Research Question

_How might we introduce users to the different functionalities present in a gesture-based touch screen interface that lack visual representations of interaction through a user-centred research process?_

1.3 Delimitations

It is important to stress that this study does not suggest that gesture-driven touch interfaces are superior in every case or suitable for all purposes. According to Norman (as cited in Sharp, Rogers, & Preece, 2015, p. 220) the suitability for incorporating such interactions depends on the artefact’s complexity, the needs of the specific context and the required learning curve, amongst other things. This implies that touch gesture interaction is merely another mode of interaction that could potentially be valuable to incorporate into certain artefacts.

The goal of this project is not to arrive at a solution that could be considered “production-ready”. Instead this study seeks to be a design exploration on how we could create a user experience where touch-gesture interactions are learnable rather than discoverable by studying a practical teaching-learning scenario. The explorative approach was chosen due to the amount of research required for a production-ready solution being out of scope for the time and resource constraints in this project.

Due to the scope of this project the study will only address touch screen gestures on a mobile phone in a single application environment. Consequently, the results of this study might not be applicable to other contexts, modes of interaction or devices. Further investigation is needed to determine to which degree this study’s results might be applicable in other circumstances.

1.4 Ethics

It should be noted that gesture-driven interfaces hold certain ethical implications that would need to be addressed. Ann Light and Yoko Akama has discussed the ethical implications of doing design work with communities and within social systems (Light & Akama, 2019). It is suggested that ethics are present in the actions and roles through which they are constructed and manifested (ibid.). In relation to design work the authors state that the effects
of what is produced must be considered stressing that “shaping materials have consequences” (Light & Akama, 2019, p. 132), making reference to previous sections in their article’s anthology (ibid). Because of the nature of the designs deriving from this project there is a need to raise and discuss its ethical implications.

Since touch gestures require some kind of motion that would be more elaborate than the typical tap it could be excluding towards individuals with certain accessibility needs. As such, touch gestures may prove to be an unsuitable mode of interaction in regard to these aspects. The author would like to stress that this work do not intend to take a stance towards the suitability or unsuitability of touch gesture interactions. Rather, this should be seen as a mere experimental study in which limited aspects of gesture interactions are investigated for research purposes. As such, this text should not be interpreted as an ethical justification for incorporating gestural interactions that could exclude certain user groups.

1.5 Conduct

This study has strived to take the necessary steps towards maintaining the integrity of its participants. Consent forms were handed to each participant before conducting any research with them. Apart from stating how their information and contribution would be handled they would only opt-in to activities they felt comfortable with. They were also given the opportunity to freely ask questions about the study at any time and revoke their consent within a reasonable time frame. Coding of certain data has been applied as to not disclose any personally identifiable information.

The images incorporated into the prototype, as seen in the author’s own pictures and screenshots of the artefact, exist in the public domain.
2 Theory

In order to better understand how users comprehend and makes sense of digital artefacts a thorough investigation into design theory and the history of user interfaces was deemed necessary. This section introduces the seven stages of action and related interaction design concepts. A brief overview of the history of user interfaces will then be given to contextualize and provide a background to the issue presented in the research question of this thesis. Prior to this, a definition of interaction design will be offered and further defined in terms of touch screen interaction as well as gestural interaction for the purposes of this project.

2.1 Interaction design

Considering a visualisation and subsequent discussion provided by Preece, Sharp & Rogers, interaction design could, from the designers interpretation, be described as a cross-disciplinary field in which a number of design practices, academic fields and inter-disciplinary domains overlap (2015, p.9). One possible definition of interaction design is the practice of enhancing social, professional and/or communicative activities by means of creating a favourable user experience (Ibid, 2015, p. 8). As such the field is largely concerned with the design of interactive products and services (Cooper, Reimann, Cronin, & Noessel, 2014, p. xix), as stated in the introduction. This thesis work is grounded in interaction design and takes the above definitions of the field as its starting point.

2.2 Touch-screen interfaces

The touch screen is an important domain for endeavours within the interaction design field. They have the capacity to enable a wide variety of interactions such as taps, swipes, flicks and pinches (Sharp et al., 2015, p.197). The input flexibility of touch screens has resulted in new conceptual models being developed around the medium, such as stacks and cards (ibid, pp.197-198). In similarity with its input flexibility, touch screens can provide a wide array of content and feedback to users. Preece, Sharp & Rogers emphasizes the conjunction between the touch screen’s capabilities for providing rich interactions and experiences with the idea of multimedia content (2015, pp. 197-198).

Looking to the above discussion it could be argued that the touch screen’s interactive qualities offer a flexibility which makes it a suitable medium for interaction designers to investigate and evaluate novel interactions. This presumed relevancy is strengthened by the touch screen’s role as a frequently
used medium within interaction design work as well as its presence within contemporary society at large (within smartphones, computers etc.).

2.3 Touch-gesture interaction & natural user interfaces

To better set the scope for what this thesis aims to investigate there is a need to define gestural interaction within the touch-screen interface context.

Baudel and Beaudouin-Lafon presented an interaction model for gestures in a report outlining the development of a system known as Charade (1993). The Charade artefact would let users control presentation software through gestural commands by using a data-glove (ibid). The report describes gestural commands as going through three stages; a start position, a dynamic phase and an end position (ibid, p.4). The start position occurs when the user initiates a command within an artefacts gesture recognizing zone (ibid.). For the purposes of this thesis the start position was interpreted as occurring when the user places a finger within a gesture recognizing part of the touch-screen UI. The subsequent movement is what is known as the dynamic phase. Leaving the gesture recognizing zone or assuming an end position marks the third and final stage which concludes the gesture (ibid).

This thesis relies on the above interaction model for its definition of a gesture within the touch screen context.

The above interaction model has been expanded upon with a systematic framework aimed towards what is defined as “freehand gestural interaction with direct-touch computation surfaces” (Wu, Shen, Ryall, Forlines, & Balakrishnan, 2006, p. 183). The framework encompasses three design principles for gestures; registration, relaxation and reuse (ibid, p. 184). In the framework, the gesture registration phase corresponds to the start position as described by Baudel and Beaudouin-Lafon. However, Wu et al.’s framework lets the starting pose set the context for the subsequent dynamic phase and end posture of the gesture (ibid, p. 185). The authors argue that the interaction model presented by Baudel and Beaudouin-Lafon does not make a distinction between start position and dynamic phase for classifying a gesture. It is argued that an explicit gesture registration phase will let the same gesture be reused for multiple purposes (ibid.). The second principle, gesture relaxation, proposes that the user should be able to perform the gesture in a relaxed manner as soon as the command has been identified by the system (ibid.). A possible interpretation of this principle could be that the gesture and its system should allow for a certain amount of imprecision for when the user issues a gestural command. Gesture and tool reuse, the last principle, is concerned with the reuse of a single gesture for engaging different commands depending
on context. It is argued that this practice reduces the number of gestures, postures and dynamic phases that the user will have to learn and recall (ibid.).

Interfaces using gestures for engaging actions are sometimes categorized under a unifying concept called Natural User Interfaces (‘NUI’). Several ideas on what defines a NUI has been suggested; one definition looks at interaction - how our everyday skills and behaviour is accommodated for in interaction with the interface. This accommodation could refer to both how the interaction engages us physically through our bodies, hands or voice but also through skills that are readily available to us, such as writing, gesturing or talking (Sharp et.al. 2015, p. 219). A second definition looks towards the way we feel when using the interface. The naturalness in this case would seem to derive from to which degree users feel familiar, well-versed and confident in their interaction with the device (Wigdor & Wixon, 2011, p. 9). As such NUIs may hold a certain amount of potential for creating interactions that make for an intuitive and engaging experience.

2.4 Communicating interaction

Essential interaction design theory provides several notions that are valuable for understanding the interplay between user and artefact. Such theory could be helpful for understanding how an artefact can communicate its possible interactions to the user sufficiently through its design. The term Affordances will be used for describing such interactions. Affordances could be defined as the different ways an object could be used considering the relationship between its properties and the abilities of the individual interacting with it (Norman, 2013, p. 11).

In The design of everyday things Don Norman introduces the seven stages of action (Norman, 2013, p. 71), here incorporated into a visual model based on the original visualisation (see Figure 1). The model illustrates how an interactive artefact may respond to potential questions that arise during use through its design (ibid.). Considering these stages of action might be valuable for ensuring that a design can successfully do so.
These questions are in turn grouped into considerations regarding feedforward and feedback, represented in the model’s left and right column respectively. Whereas feedback is concerned with communicating the results of user action, feedforward addresses how a design may communicate which actions the user could take and how. From this discussion Norman proposes seven design principles deriving from the seven stages of action; Discoverability, Feedback, Conceptual Model, Affordances, Signifiers, Mappings and Constraints of which the last three is considered as related to feedforward (Norman, 2013, p. 72).

Looking further into these notions yields a definition of each. Mapping could be briefly summarised as the relationship between a target object and the input control available to the user (Norman, 2013, pp. 20–22). An example could be how moving the mouse to the left has the cursor move in the same direction on screen. A signifier denotes any type of indicator that communicates where an affordance is present and how the user can engage its functionality (ibid, p. 14). A button taking the shape of an icon in a menu bar could be said to be an example of a signifier for pressing at that specific
location to call a certain action. Lastly, a constraint constitutes a guiding restriction as to what the user is able to do (ibid, p. 73). Buttons in digital interfaces that indicates being deactivated by being semi-transparent is an example of a restriction.

2.5 Feedforward in user interfaces historically

The feedforward concept seems to hold the qualities needed to ensure that an artefact is understandable and, in turn, learnable. Since this thesis aims to explore how touch gesture interactions could be communicated through design a brief history of how feedforward has been embodied in different types of user interfaces in the past is offered below. Hopefully, such an overview could give a deeper understanding for feedforward-related challenges in interface design historically.

2.5.1 Command-line interfaces

User interfaces and the ways in which we interact with digital artefacts can be said to have evolved alongside the different input modalities that has been developed over time. The command line interface (‘CLI’) was mainly interacted with using a keyboard. An example of a command-line interface can be seen in Figure 2. CLIs had the user type predefined commands to which the computer would respond with the requested action (Sharp et al., 2015, p. 160) Consequently, CLIs generally required the user to have prior knowledge of the software’s commands (Soegaard, 2019, para. 4) or issue a ‘help’-command to receive a list of available actions. Apart from signifying that typing was possible through a text symbol cue when loaded up (Sharp et al., 2015, p. 160), it could be argued that these interfaces generally lacked the feedforward aspects of interface design.
2.5.2 Graphical User Interfaces

The development of input devices such as the mouse and the light pen paved the way for interfaces that could make use of their functionality (Grosz, 2005). Advances in the field resulted in the Graphical User Interface (‘GUI’) which incorporated actions into visual representations (see Figure 3). This allowed users to move away from interactions based on knowing and recalling text commands towards choosing between actions through recall (Wigdor & Wixon, 2011, p. 4). One of the most popular GUI implementations was the so-called WIMP-paradigm; an abbreviation for “windows, icons, menus, pointer” referring to the most common components of the interface (ibid. pp. 3-4). It would seem that embodying interactions into components rather than commands gave interaction designers the opportunity to work with feedforward in the digital domain.
2.6 Feedforward & Touch gesture interfaces

When looking at touch-gesture interactions from a feedforward-perspective it could be argued that some of the past challenges of designing interfaces seem to be arising once again. The element of feedforward, which the command line lacked and to which the GUI provided a solution, may in some cases be omitted in touch gesture interfaces. Some experts in the field has claimed that gestural interfaces have a negative impact on usability in their current form. Several reasons are suggested as to why. An absence of signifiers and a lack of discoverability has been suggested as well as a lack of established conventions (Norman & Nielsen, 2010). While the authors point out that gestural interfaces hold potential in how they feel to use and in providing a less heavy-handed visual language there is a need to develop design principles for such interfaces (ibid.).

Other sources have stated that one of the primary challenges of the NUI is ensuring its learnability (Wigdor & Wixon, 2011, p. 138). It has also been suggested that gestures are rarely guessable leading the authors to conclude that gestures must “Never rely on an action being “natural” (a.k.a. “guessable”)” (ibid. p. 154). An exception is however made for gestures related to direct manipulation (ibid.).

Building onto the discussions it could be argued that there is a need to explore and investigate the ways in which we might communicate the affordances of touch interfaces based on gesture interaction.
2.6.1 Self-revealing gestures

One design approach which seeks to better signify the affordances of a gesture-based touch interface is called self-revealing gestures. The author’s interpretation of this term, as described by Wigdor and Wixon (2011, p. 145), is that visual constituents are, in some manner, sparingly used for indicating actions within the gestural user interface. Wigdor & Wixon add that while a user interface is needed to make gestural interfaces feel intuitive, it should be as unobtrusive as possible (ibid, p.146). This thesis’ aim of exploring how feedforward could be provided in a touch-gesture interface could be said to be an investigation into designing self-revealing gestures.

2.7 Related work

A number of past studies has incorporated topics, methods and areas of focus which are similar to those found in this project. The following examples are raised in an effort to better position this work and its contribution within the field of interaction design.

2.7.1 Self-revealing gestures in Windows 8

In an article by Kay Hofmeester and Jennifer Wolfe it is described how the teaching method for novel touch gesture interactions in Windows 8 was developed (Hofmeester & Wolfe, 2012). In similarity with the aim of this thesis, said project investigated the ways in which the gestures present in a touch interface could be introduced to users. The authors give a detailed account on the design process behind the software’s method for gesture introduction, which was based around the self-revealing gestures concept (ibid.). When discussing the next steps for introducing gesture interactions the authors suggest “a wider investigation into other invocation methods for self-revealing gestures” (Hofmeester & Wolfe, 2012, p. 827). The following thesis work could be seen as an effort to contribute to such an investigation.

2.7.2 UTOPIA

The UTOPIA project led by Pelle Ehn and Morten Kyng, as described by Yngve Sundblad, was meant to expand on the methods for incorporating the target user throughout the entire design process (Sundblad, 2011, p.5). One of the activities within the project was that of mutual learning between its participants; end-users and researchers (ibid.). Results from the UTOPIA project contributed to cooperative design becoming a methodology within design research and development (ibid. p.7.). This project makes extensive use of cooperative methods for informing the design decisions made at the ideation and prototyping stages. As such, this thesis work may yield insight
into how, and to what degree, such research methods may prove useful for designing feedforward within touch-gesture interfaces.
3 Methods

The methods chapter outlines and explains the different methods used to conduct this thesis.

3.1 Applied Research

This project as a whole takes its base in applied research. Muratovski describes this type of research as a way of evaluating and reflecting on one’s own practices (2016, pp. 190-192). Due to this project’s aim to investigate ways for introducing novel touch gesture interactions a practice-based approach to applied research seemed to be the most suitable. Practice-based research could be briefly summarised as using practice as method to gain new knowledge, which in turn could be illustrated by describing the creative outcomes of said practice (Candy, 2006, pp. 1-3). A possible interpretation of this definition in regard to this project could be that there will be a close monitoring and subsequent evaluation of the practices and outcomes of this project throughout every step of the research and design phases.

3.2 Phenomenological Study

There was a need to investigate how it could be ensured that the prototypes that were to be constructed during this project would provide sufficient learnability. Therefore, a user-centred phenomenological study based on what is known as the master-apprentice model was the approach chosen for attempting to increase the relevance of subsequent prototypes. The main purpose of these studies would be to gain a deeper understanding for how we might teach and learn artefacts and activities based on perception and motor skills.

Phenomenological research has been described as a method which focuses on how individuals perceive happenings and things (Muratovski, 2016, pp. 79-80). Such studies could investigate many aspects of the participants’ daily lives and living conditions, including how artefacts are used. In depth interviews are mentioned as the primary method used in such research (ibid.). Phenomenological research methods seemed to correlate with this study’s aim of designing introductions for touch-gestures. It would allow the designer to study how expert users with proficiency in using a certain artefact would teach it to someone less experienced. Thereby a phenomenological research approach was chosen to inform later ideation and prototyping in this project. It was then further detailed through additional methods as described below.

Donald Schön has described what is known as reflection-in-action (Schön, 1991, p.49). In the everyday endeavours of a skilled tradesperson they can
continuously make informed assessments relating to their specific competences. Despite them being knowledgeable in their field it would often prove difficult for them to define or describe their procedures out of context (ibid. pp. 49-51). This is known as knowing-in-action; tacit knowledge that appears when a person is carrying out their common endeavours without prior or continuous reflection. Understandings that they may have been aware of previously are in some cases internalized and carried out intuitively (ibid. p.54). Reflection-in-action then could be briefly summarized as the ability to reflect on one’s actions while doing them (ibid. pp. 54-56).

In order to better understand the knowledge and reasoning of expert users from a design perspective, it would be valuable to gain insight into their knowing-in-action and reflection-in-action. A method that would be suitable for this task is the Master-Apprentice Model (Beyer & Holtzblatt, 1998, pp. 42-46). It has the researcher learn new skills directly from users by assuming the role of apprentice (ibid.). Researchers follow the interviewee’s actions as they perform tasks well known to them. During these sessions the interviewee [master] may talk about what they are doing and the researcher [apprentice] may ask questions about what the interviewee is doing (ibid. p. 42).

By applying this method in the project’s research phase, the goal was to facilitate a learning experience with the researcher assuming the role of apprentice and the interviewee demonstrating something that they felt comfortable and competent in. The notions present in the exchange between master and apprentice might prove valuable for designing the exchange between artefact and user when introducing the latter to a set of gesture interactions.

### 3.3 Qualitative Analysis

In *Interaction Design: Beyond Human-Computer Interaction* Preece, Sharp and Rogers suggest three types of qualitative data analysis methods; pattern and theme identification, data categorisation and analysis of critical incidents (2015, p. 291). The process of identifying patterns and themes could be briefly summarized as the researcher familiarising themselves with their collected data. Any data that may point towards a potential theme or recurring phenomenon is then strengthened or disproved by comparing it towards other collected data (ibid. pp. 291 - 292). In this project pattern and theme identification was carried out on the data collected during the master-apprentice studies by reviewing and comparing transcriptions of all workshops, which were documented on video in their entirety for this purpose.

Data categorisation is defined as the process of grouping similar data according to a categorization scheme, determined by the study’s aim (Sharp et al., 2015, p. 293). Such schemes could originate from external resources or
might, in the case of explorative studies, be defined from the data collected (ibid.). Phenomenon that arose from the pattern and theme analysis were subject to data categorisation. Categorised data would then serve as the basis for later ideation and prototyping activities. Because of this project’s explorative nature, the categorisation scheme used to analyse master-apprentice workshops were derived from the data itself. Categorisations were made in a manner akin to an affinity diagram; a method for hierarchically organising common phenomenon and patterns in a set of data (Beyer & Holtzblatt, 1998, pp. 154-155). This process is meant to uncover key issues while retaining the connexion between these and their corresponding data (ibid.).

3.4 Prototyping Framework

The main method for embodying notions of teaching and learning into an artefact will be by using prototypes as filters of design dimensions. As described in The Anatomy of Prototypes: Prototypes as Filters, Prototypes as Manifestations of Design Ideas the goal of this kind of prototyping work is to challenge and explore design ideas, not to prove the viability of a specific solution (Lim & Stolterman, 2008). Furthermore it is argued that the incompleteness of a prototype is what enables it to highlight the desired qualities that are to be investigated (ibid. p.7). Consequently, the prototype should take the simplest form in which the relevant aspects are revealed while distorting factors are avoided; also known as the fundamental prototyping principle (ibid. p.10). The authors provide a total of five filtering dimensions which could be described as the prototype’s areas of focus (ibid.) For the purposes of prototyping gesture introductions in a touch screen environment the filtering dimensions of interactivity, spatial structure and appearance would seem to be the most relevant. The filtering dimensions of data and functionality were omitted since they were not deemed vital for ensuring the learnability of gestures.

The Interactivity dimension include properties related to interaction such as operation, input and output (Lim & Stolterman, 2008. p.13). Since the artefact needs to present its affordances in a way that users can understand and react upon the prototype would need to sufficiently communicate its interactive aspects.

Spatial Structure relates to how components within the prototype are combined, structured and interconnected (Lim & Stolterman, 2008, p.13). For the purposes of this project it was seen as necessary for gesture introductions to be placed in a spatial structure that took a form most users would be familiar with. Putting introductions in a commonly recognized setting might give users a sense of the functionalities and purposes of the test environment so that focus during user tests may be kept primarily on the teaching/learning aspects of the artefact.
The **Appearance** dimension encompasses the physical properties of a design (Lim & Stolterman, 2008, p.12). For the purposes of a touch screen-based, digital prototype this dimension is interpreted as including user interface constituents. The appearance aspect was deemed an important asset to sufficiently communicate feedforward and feedback to the user in this project.

### 3.5 User Testing

User testing activities seek to ensure usability and evaluate whether a design can be used to achieve the intended purpose (Sharp et al., 2015, p. 475). A central component is to investigate how users perform a set of predefined tasks. Participants may be asked to think out loud so that the researcher gains insight into their thoughts and plans while performing the task (ibid.).

The purpose of user tests in this project would be to see how well the artefact can use a designed method to teach the user its own gestures. Consequently, it would be the artefact, not the researcher, that states which action the user is to carry out. Success or failure in doing so might provide insight into the viability of the design.

Since the artefact is the driving force in guiding user action the think-aloud method should be valuable for understanding how users perceive its instructions and behaviour. The way users reason when faced with the artefact could yield valuable insight into how they feel that the design accommodates for a pleasant learning experience.
4 Design Process

This chapter gives an overview over the design process that has been conducted for this thesis. The project emerged as a reaction to how certain mobile apps had started to incorporate gestural interactions that were effectively hidden from users. Initial instances of observing this phenomenon were derived from either discovering a hidden gesture by accident or someone else showcasing its existence. In turn, this raised the question of how users could be priorly made aware of these hidden interactions.

These initial observations later proved to coincide with an article by Donald Norman and Jakob Nielsen where similar observations are presented (2010). The article would also problematise certain usability aspects regarding gestural interfaces (ibid.).

What was first intended to be a primarily prototype-driven project evolved to use a phenomenological, research-centred approach for informing and subsequently designing gesture introductions. Several designs were ideated from the data gathered during several workshops with the final result being an interactive prototype which was then subject to user testing.

This chapter begins with a description of the activities carried out before a user-centred research approach was decided upon. A brief outline of the workshops resulting from this decision is then given. The analysis process applied to data from the workshops is explained along with the findings generated through this activity. Findings are then related to underlying background theory before the data categorisation process is accounted for. Later chapters in this section describe the ideation, prototyping and user testing stages of this project.

4.1 Initial work

Initially, this project set out to explore how touch gesture interactions could be introduced through means of sketching and prototyping only. As such, some early sketches were produced. Figure 4 shows an example of these.
In order to test these gesture introduction ideas an interactive, digital base prototype was created according to the filtering dimensions specified in the methods section of this thesis (see Figure 5). It was constructed in a digital prototyping environment which allowed for incorporating rich interactions into a visual design. The prototype took the shape of a mobile picture gallery app with basic editing functionality. The picture gallery domain was chosen since it would hopefully be familiar enough for testers to be aware of which functionalities to expect. Additionally, this domain seemed suitable due to its possibilities for including gestures that could be either simple (such as a single swipe) or more complex (such as pressing the screen for an extended amount of time).
A total of 5 gestural actions were incorporated into the album part of the prototype. This was an image carousel containing a collection of photos akin to what can be found in most smartphone models. *Swiping an image to either side* would show the next or previous image respectively. This artefact/UI state was defined as the view mode. *Swiping upwards* would bring up a grid overlay, representing an edit mode. *Swiping to the sides in edit mode* would overlay the current image with a coloured filter. *Pressing and holding* when editing would bring up an arc element which held several image editing parameters. *Swiping up/down or left/right* in this mode would let users edit the images brightness and contrast. Due to time constraints functioning brightness/contrast-controls were not implemented. *Swiping downwards* would exit out of the edit mode if this were active. Otherwise it would close out of the album view.

The base prototype’s gestures proved to be coherent with the interaction model provided by Baudel & Beaudouin-Lafon (1993, p. 4) with each gesture having a start position (putting a finger to the screen), a dynamic phase (movement or long-press) and an end position (reaching the swipe threshold
or long-pressing a specified amount of time). Considering Wu et. al.’s framework (2006), certain gestures within the artefact such as swiping downwards or to the sides would trigger different functionalities depending on if the user were currently in view mode, edit mode or adjusting brightness/contrast parameters. Thereby, the prototype could be said to incorporate gesture reusage, as defined in said framework (ibid. p.185). In summary, it would seem that the artefact’s interactions were built around what could be defined as gestures while repurposing these for several commands, reducing the number of gestures to be learnt by the user.

4.2 Master – Apprentice workshops

After having completed this testing environment for later gesture introduction prototypes it was realized that mere sketching and prototyping would not necessarily ensure that the designs produced during the project would hold sufficient relevance for users. This insight drew the attention to methods used in User-Centred Design (‘UCD’). According to Muratovski user-centred design is when users provide the information that informs the design process (2015, p. 135). Such design methods are primarily used to improve usability or develop new interactions (ibid.). Muratovski also states that UCD research enables the development of products and interfaces that are user-friendly (ibid.). Therefore, a user centred research process seemed to be suitable for this study’s purpose.

Since the initial process did not include any user involvement at an early stage it would potentially undermine the value of the projects prototyping efforts. In an effort to increase the relevance of gesture introductions the process was revised in favour of a more user centred approach. A master-apprentice study was the chosen approach for doing so since this type of study would allow the designer to be put in a learner’s position. Recording video and audio during workshops would allow the interplay between master and apprentice to be analysed by the designer at a later stage. The workshops were conducted in Swedish and any quotes from participants included in this study has been translated to English by the author.

4.2.1 Premise

Three Master – Apprentice workshops were conducted in total, each involving an experienced participant showcasing an artefact of their own choice. The workshop itself was divided into two exercises. These commenced after the participant had answered some initial questions about their chosen artefact/activity.

The aim of the first exercise was to gain insight into how a proficient user might share their knowledge with an inexperienced one. The researcher
would state: *I know nothing about* [the artefact], *can you show me how it’s done/used?* Participants were then free to use and teach their chosen artefact or activity in any way they deemed fit without any further prerequisites. While they did so the designer would, when appropriate, ask questions about what the participant was doing and how if this was unclear. Explanations, actions and scenarios would also be paraphrased to ensure that the designer understood these correctly.

After a while the designer would ask to try while thinking out loud, leading the workshop into its second phase/exercise. The experienced user was then free to guide, coach or help the designer as they saw fit without being explicitly told to do so. The purpose of this exercise was to study when the experienced user would assume a coaching role and how they might do so.

The following sections are meant to provide an outline for each workshop. Each section highlights who each participant is and what artefact they brought to the activity. How the activities during workshops unfolded is briefly described as well as selected insights that occurred during each workshop for illustrative purposes. Joint key findings are provided in the subsequent Analysis of Workshops-sections.

### 4.2.2 Pokémon Go

Vincent, the participant of the first study, lives in a city in southern Sweden and is a 25-year-old student. For the purpose of this study he chose to showcase Pokémon Go; a GPS-based mobile phone game in which players move around in the outdoor environment catching Pokémon, virtual monsters used in battles against other players (Niantic Inc., 2019). Vincent was first introduced to the game’s concept through previous video games in the series as well as the card game. When asked, he stated that the experience was very different from the games he grew up with and felt more centred around the player’s actions. He largely learnt the new game through exploration and felt that the playfulness of the UI allowed him to do so without being afraid of making mistakes. Vincent described the process of learning the game as “smooth sailing” and the artefact itself as feeling inviting and easy to approach.

In the first exercise, where Vincent was asked to introduce the artefact, he chose to do a complete walkthrough of the game’s interface while showing and explaining the basic premise and mechanics of the gameplay. He employed a variety of teaching methods as he found appropriate. It was also evident that he has had a vast amount of experience with the game since he could accurately define and explain intentions, relationships, goals and tactics present within the game’s inner workings. An example of this type of experience knowledge showed when Vincent was about to appraise a Pokémon. The app replies using a set list of response sentences rather than
numerical scores (Niantic Inc., 2019). Despite this Vincent could, through his knowledge, discern the meaning behind the app’s response.

“Then you can look in this menu here to see how powerful it is, because different Pokémon have different amounts of potential. Then you can tap on appraise, and this one [the Pokémon] is really great. Then you’ll also need to learn what these response sentences mean on a concrete, factual level. So, this one [the sentence] means that it is 82 percent, I think, of a 100 percent scale.” (Workshop Notes, 2019).

For the second phase of the workshop, where the designer would try the game, it was decided that this would be done outdoors, and on-foot as intended. The designer was given free reign as to where to go and what to do. During this part of the workshop Vincent assumed a guiding/coaching role. He would mainly encourage free exploration but could also suggest actions based on his own experiences if he saw that this would potentially benefit the designer’s experience. The designer had the ability to ask questions or seek guidance if needed.

4.2.3 Digital Drawing

The participant of the second workshop, Linnea, lives in a city in southern Sweden and is a 24-year-old student. She brought a drawing tablet and pen which was coupled with computer software to make drawings digitally. She started to draw using this digital setup at about 18 years of age but were already familiar with the concept since she was about 13-14 years old. That was when she first became interested in digital art watching videos on the subject online. She herself learnt it by practicing, freely exploring and watching videos of other people drawing.

The study started with Linnea briefly showing how the drawing tablet could be used for navigation after which she created a new document to show the basic drawing functionality of the device. She described and showcased the functionality of the digital pen; how it could be flipped over to act as an eraser and how its buttons could be used to switch brushes and move the canvas. When discussing the tablet’s possibilities and limitations Linnea accidentally found a hidden gesture present in the artefact. At the time of discovery, the discussion had moved into the differences between digital and physical drawing.

Interviewer: “But in the physical world there is always a trade-off between what it [the drawing] could become and not become so to speak?” (Workshop Notes, 2019)

Linnea: “Possibility versus risk is a thing in that case. Another thing I just thought about is that when I work with this tablet, I don’t have the – [Makes a swipe motion on the pad, the computer switches between windows] – well, I actually had it – oh! I learnt that just now, I haven’t seen that before! I
thought I had to move over here to switch windows [points to track pad], but I could have used this in the same way all along. That was kind of cool!” (Workshop Notes, 2019)

Having gone over the basics Linnea showcased an existing drawing of her own creation to demonstrate and explain some common techniques used at later stages in the drawing process. The finished painting acted as an example for how she could use zooming, masks, blending modes, colour overlays and other modification tools to tweak and enhance the drawing as part of the artistic process.

When switching sides Linnea immediately took on a coaching role, encouraging to try the drawing pad from the start.

Interviewer: “I recommend that we open a new document since I thought about trying this myself and I don’t dare to do it on... [the finished drawing]” (Workshop Notes, 2019).

Linnea: “Absolutely!” (Workshop Notes, 2019)

Interviewer: “So we’ll see how this goes...” (Workshop Notes, 2019)

Linnea: “Oh yeah you could create a new document yourself so that you get to try some navigation tool!” (Workshop Notes, 2019)

Linnea would largely let the designer explore and use the artefact freely during this phase. She intervened only on actions which would affect the entire process to the designer’s disadvantage or when she saw a learning that could be valuable to the situation. Such learnings took the form of mere suggestions. Akin to the first workshop the designer had the ability to ask questions at any time.

4.2.4 Goodreads

The third participant in the master-apprentice workshops was Alexandra, a 24-year old student living in southern Sweden. Alexandra had Goodreads as her artefact of choice. The site acts both as a database for books and a community for readers (Goodreads Inc., 2019). She first came in contact with the website by accident when she was searching the web for a particular book. She taught herself the site by exploring its functionalities. At first, she mainly used the database features, browsing and reading about books, authors and series. Alexandra felt that the process of learning the webpage was fairly straightforward but says she has developed her own “roundabout ways” (Workshop Notes, 2019) to better find what she is looking for. She thinks that the process of learning was easy due to the clarity of the website’s layout and descriptions.

Alexandra began the observation by going through the different functionalities of the website. Her own user profile gave her an overview of
books she had rated or reviewed, had read, was reading right now and wanted to read in the future. The website could also act as a personal database over her own book collection. Alexandra went on to show the different ways that Goodreads provide to find new books and authors. Recommendations, favourite genre filtering and searching user made book lists. She described how she herself uses these tools to find books she might like.

“There’s this thing I often do. What I usually tend do is to go into the lists here [goes to the ‘lists’-section] and then I can search for – because often it’s some sort of combination – I mean on recommendations there’s romance or fantasy or... it’s very divided like so [in genre]. But if I’d like to have both fantasy and romance for instance, I can search the lists for that [searches ‘fantasy romance’] and I get... We can go into this ‘Best paranormal and fantasy romance’-list here for example” (Workshop Notes, 2019)

Alexandra described her techniques for finding books that might interest her further when visiting an individual book page.

“I can click into the book first and then I see that – I usually look at how other users have rated it, and this one is over four [on a scale of five] so I’d assume that it’s probably pretty good, because there are like 65 000 reviews total. So that would be the first thing I do when sifting out books.” (Workshop Notes, 2019)

“Then I think that the user comments down here are pretty useful too – not all, but if you [other users] have left a comment with your review it makes for a good description. Let’s see... if I’m on the look-out for a very romantic book for example I can see here if they [other users] thought that the love felt believable or if there was some ‘instant love’ or the like.” (Workshop Notes, 2019).

Alexandra went on to explain how to navigate book series pages, author profile pages, genre pages and several community areas of the site. Asking to switch sides the designer would try to navigate the website. At an author’s page the designer wanted to find similar authors. Despite this functionality not being present at the time of this study Alexandra could draw on her experience to suggest alternative ways to achieve this:

“Hmm... similar authors... Well, you could look at what he [the author himself] has read”

“You could also look at lists with [the author] in them”

4.3 Analysis of Workshops

Each study was transcribed and analysed for patterns in regard to what was taught and how. When a potential finding was uncovered it was examined whether the same pattern or phenomenon were reflected in the other workshops or in other parts of the same workshops. All findings that proved
to be applicable across workshops or scenarios were documented in the margins as they appeared and in turn transferred to notes.

4.3.1 Findings

What follows are the key findings that were identified upon analysis of the master-apprentice studies. This section contains the findings that proved to be the most valuable for later sketching and prototyping activities. Although additional discoveries were made, they proved to be out of scope for the purposes of arriving at this study’s prototypes.

**Showing actions was a key tool for explaining them**

When teaching an action to the designer during workshops expert users most often chose to carry out the action while talking about it, rather than just describe it in speaking. In cases where an action, for one reason or another, could not be carried out at the moment it was common for participants to explain why the action in question could not be accessed. They would then go on to describe it in theory as best as they could.

**Participant’s explanations addressed fundamental questions**

When analysing how participants taught individual actions in workshops it would seem that they inadvertently answered a set of fundamental questions through their descriptions. Either by showing their actions, describing their actions or a combination of the two, they most often managed to convey the answers to questions of How, What, When and Why. An example of this occurred when Vincent, the interviewee of the first study, explained a certain throw technique in *Pokémon Go*. Vincent was about to catch a *Pokémon* (which implied *when* the action is applicable) and was slinging a *Pokéball* in circles (Which indicated *how* the action is done):

“Now this is a technique that you use so that the ball will get some spin (The answer to **what** the action means). Then you’ll get extra points which will make it easier to catch and you also get more experience points so that you can level up faster (Which explains **why** the action is carried out).”

(Workshop Notes, 2019)

As such, the expert user’s attention to this type of basic knowledge lay the foundation for successfully teaching the action to the designer in workshops. This finding was used to define the fundamental questions about gesture interactions that prototypes were to answer through their introduction.
Participants could explain things beyond the readily accessible

It would seem that the experience participants had gained using their artefacts allowed them to identify and explain connections, intentions and goals within their context. In turn this knowledge enabled them to explain and teach different tactics in use.

“Well, the fight works out in the way that there are different Pokémon types and certain types of Pokémon work well against other types of Pokémon. So, then you have to choose which type you want so that you can counterpunch the opponents.” (Workshop Notes, 2019)

As in the example above, Vincent could explain the inner workings of the battle section of game despite these not being explicitly stated.

Participants employed a variety of different teaching methods

The expert users would, as deemed appropriate, utilize an array of methods to enhance their teaching. One such technique, which were common for participants to use, was to relate phenomenon present in their artefact to other, often more commonly known artefacts. To better explain the motivating factors for painting digitally Linnea would outline its qualities in comparison with its physical counterpart:

“I can start over without wasting paper, without wasting colour. The materials are infinite when it comes to the digital world and that’s a big difference in contrast to the physical [...]” (Workshop Notes, 2019)

Likewise, the expert user could refer to their previous teachings to anchor and clarify information. An example of this was when Alexandra showcased a section of the book community site:

“If we go into the community section [opens community section] they also have “ask the author”. Here you’ve got some different authors that you can ask question to.” (Workshop Notes, 2019)

Later in the study, when the designer navigated to a specific author’s page Alexandra referenced back to ‘ask the author’, highlighting another way to navigate to the section:

[Referencing to a section on the authors profile page] “And you can see if he has participated in ‘ask the author’ further down.” (Workshop Notes, 2019)

Sometimes, to better illustrate the techniques, intentions, motives and goals behind their interactions the expert users employed a sort of storytelling where a past or potential scenario or need was described and addressed through actions and verbal explanations. While showcasing her drawing tablet, Linnea chose to open one of her previous paintings to describe her own drawing process:
“Here is one [digital painting] that I drew entirely with this tablet. Here I’ve used that zooming-in-and-out [technique] because those shapes in the background are pretty big, and what is so good about doing this is that you can split up the painting into so many different layers, so you’ve got a huge amount of freedom to alter tiny details in the background and so on. I use that a lot. Then I add masks like this so that I can erase a small part of something. Then I can choose to bring it back and test back and forth to see what I like the most.” (Workshop Notes, 2019)

In the workshops these type of storytelling methods mostly appeared when participants where to describe a more complex or intricate process within their context.

**Participants’ explanations seemed to follow a common structure**

Often times, a pattern for participants’ teachings could be identified. A common structure for explaining an action followed what could be seen as an intro, a description and a summary. In the following example quote Linnea is about to show a feature built into the digital pen that accompanies her drawing tablet. Describing an action would often start with some sort of identification of the action or where to engage its functionality:

[Showing the pen] “Here we’ve got two buttons...” (Workshop Notes, 2019)

A description of the interaction flow would then follow, clarifying how the participant would engage its functionality:

[Pushes one of the buttons] “…if you push it you do a right click...” (Workshop Notes, 2019)

Lastly, there might be some sort of summary were the value of carrying out the action was clarified by the expert user. In some cases, the feedback from the artefact would suffice:

[Brush selector becomes visible] “...and then you get like a shortcut to choose another brush.” (Workshop Notes, 2019)

4.3.2 Relation to theory

Looking back at the seven stages of action (Norman, 2013, p. 71) it would seem that some of the findings made during the master-apprentice workshops coincided with Norman’s model. One of the main findings from the workshops addressed the structure of how participants may explain their actions through an intro, description and summary. The intro and description stages of participants’ explanations seems to be reflected in the feedforward aspects of Norman’s model (ibid.). The introduction phase in participants’ descriptions would let them focus on a specific action. This would answer the questions of available sequences and possible actions
present in the feedforward column of Norman’s model (ibid.). Since the description phase detailed what they were doing the question of how to perform the action was explained. Feedback from the artefact acted as a vehicle for what was described as the summary part in participants’ teachings, showing or explaining the value of interaction if necessary.

4.3.3 Categorisation process

A categorization process was used to prepare findings for later prototyping work. As described in the methods section of this thesis categorisations and subsequent hierarchies were derived from the data itself. Each finding, represented on one note each, was grouped into four initial categories depending on what they addressed.

**Insights** were concerned with the data that uncovered entire processes, structures and relationships that commonly arose.

**Important phenomenon** included independent factors and events that were yet to be put in a larger context. This category included commonly addressed questions and recurring types of expert user knowledge, amongst other things.

**Master behaviour** comprised all type of data related to the expert users’ behaviour, role, competences and teaching methods.

**Master – Apprentice interaction** were all of the recurring types of interaction that occurred between master and apprentice. For example, how questions were asked and answered or how the designer would seek support and guidance when uncertainties occurred.

Notes relating to the first phase of the workshop, when the expert user would primarily teach their artefact by showcasing it, were transferred into a hierarchy based on what the findings addressed (shown below in Figure 6). For the purposes of this study this hierarchy is referred to as the *showcasing hierarchy*. Five level grouping were constructed from the characteristics of findings. The **basics** group represented the fundamental questions that were usually answered when expert users would showcase a single action within their artefact. The **experiences** group broadly related to abilities masters had gained through experience over time. The **insights** step built onto this by detailing the factors and information that the expert user had insight into through their experience. **Methods** were comprised of any methods masters might use to explain, clarify or enhance their teachings. Lastly, the **process** group was concerned with how the expert user might structure the individual teaching so that information was provided to the apprentice in an appropriate order.
Notes relating to the second phase of the workshop, where the designer would try the same activity, were transferred into a dialogue hierarchy (see Figure 7). The master section would outline different behaviour that expert users expressed during this phase. Likewise, the apprentice section represented the designer’s behaviour. The dialogue section in the middle represented any exchange or interplay that occurred between the two actors during this phase.
4.4 Ideation

To initiate an ideation process for later prototyping work and ensure that designs produced during this phase would correlate to workshop insights, smaller representations of the showcasing hierarchy and dialogue hierarchy were drawn on A3 papers. The idea was to pick out and combine concepts from within each hierarchy to outline the behaviours of a single prototype. As such, each prototype would be built from combining different workshop insights with one another, according to the same hierarchies for categorisation. Consequently, each prototype would have its own showcasing hierarchy – outlining its teaching behaviour - and its own dialogue hierarchy – outlining its response to user action. Concepts selected to be embodied in prototypes were to be adapted for the conditions, qualities and properties of the touch screen domain. The images below (see Figure 8 and Figure 9) represent the showcasing hierarchy and dialogue hierarchy of one of the prototypes, containing the concepts it was based on for introducing gestures to the user. A total of two potential prototypes emerged as a result of the ideation phase of this project. These are described in detail in the following sections.
Figure 8: Notes representing selected master-apprentice study findings in the ideation phase. Meant to highlight how one of the prototypes was to showcase a gesture to the user (Author’s Image).

Figure 9: Notes representing how the dialogue between user and artefact might look like in one of the prototypes (Author’s Image).
4.4.1 The Dramaturgical Prototype

Figure 10: Sketches summarising the intended interaction flow of the dramaturgical prototype. The macro sketch outlines how the prototype move users between the different gesture introductions. The micro sketch addresses how the teaching concepts of intro, description and summary would be handled for the individual gesture (Author’s Image).

The dramaturgical prototype (exemplified above in Figure 10) received its name because of how the way it teaches individual gestures resembles a small play. For the individual gesture it uses an icon as a representation for the action in question, hinting to the user when it is available and what function is represented. The icon is animated in a way that mimics the
gesture required to trigger the action. Besides communicating how an action is done, it is also meant to encourage the user to try the gesture themselves, indicating who is supposed to act. When the user makes the gesture themselves the value immediately becomes apparent when the artefact responds to the user’s gesture by bringing up the function in question, showcasing the why of the interaction. As such this prototype centres around the concepts of correlation and goal-oriented interaction.

Looking back to previous theory, the animated icons effectively become signifiers (Norman, 2013, p. 14). As such they aim to address the feedforward aspects of the gesture interaction.

An edit mode in a photo app which is engaged through an upwards swipe when a photo is opened would, for example, have an icon that represents the concept of editing the first time the user opens a photo in the app. The icon would immediately slide in an upwards motion, indicating the action required. When the user mimics the movement of the icon, edit mode would be brought up. Therefore, it is meant to build a type of dramatic suspense when the user is ushered to carry out an action without precisely knowing its results. This tension is dissolved when the result of the interaction becomes apparent and the user can appreciate their newly learned ability.

Gestures are taught when the user encounters a new screen for the first time. The idea is that the artefact’s gesture teaching method, through the dramatic tension described above, sparks curiosity and encourages users to follow the actions it suggests, leading the user to new screens. It is important to note that the artefact does not force or require users to follow its instructions but merely suggests possible interactions. Consequently, the users themselves becomes the driving force behind the teaching process inadvertently.
4.4.2 The Challenge Prototype

The challenge prototype (shown in Figure 11) has another type of approach towards teaching gestures. The first time a user opens the app they will have to complete a collection of small assignments in a game like fashion to learn the artefact’s gesture interactions. A “goal” is provided in a small box which

Figure 11: Sketches summarising the intended interaction flow of the challenge prototype. The macro sketch outlines how the prototype move users between the different gesture introductions. The micro sketch addresses how the teaching concepts of intro, description and summary would be handled for the individual gesture (Author’s Image).
is a representation of the state the user is supposed to reach to complete the
challenge.

In contrast to the dramaturgical prototype the challenge prototype has a more
guided approach. The user is required to overcome all of the challenges that
the artefact presents before being able to use it freely.

4.5 Prototyping

Time constraints led to only one of the prototypes being constructed. It was
deemed more important to construct a single prototype that could adequately
convey the animated aspects of the prototype rather than opting for less
interactive materials may not have been capable of conveying the idea to
testers satisfactorily. The dramaturgical prototype was chosen over the
challenge prototype for further prototyping and testing due to a number of
factors:

- **Frequency in research data:** The ideas, phenomenon and
teaching methods which the dramaturgical prototype catered to were
markedly more recurring and prevalent in the master–apprentice
workshops than those of the challenge prototype (Workshop notes,
2019).

- **Greater adherence to fundamental NUI guidelines:** Looking
towards Wigdor & Wixon’s base guidelines for designing NUI (2011,
p.13) the dramaturgical prototype was deemed closer the suggested
requirements. The dramaturgical prototype's focus on using
animation as a vehicle for providing feedforward and driving users to
interaction through mimicry was found to, in line with the guidelines:
  o Avoid mimicking other real-world phenomenon (Wigdor &
    Wixon, 2011, p. 13), as opposed to the video game metaphor of
    the challenge prototype.
  o Be more context sensitive in its metaphors,
    feedforward/feedback and visual cues (ibid.). This due to the
    presumed potential for fully customizable animations to
    better communicate a wide array of gesture interactions. The
    challenge prototype might have suffered a significant
drawback on this point. Simply letting users explore the
    interface being provided only with the same type of
    visualisation of their goal regardless of the intended gesture
    wasn’t deemed to be neither dynamic nor descriptive enough.
  o Make better use of previously learnt skills (ibid.), in this case
    mimicking a demonstrated behaviour. In contrast, the
    challenge prototype’s conceptual model might have been
easier to learn for users with video gaming experience, giving
this group an unfair advantage. Consequently, it could be argued that the dramaturgical prototype would not require the user to be an expert in a specific area to the same extent as the challenge one. Therefore, the dramaturgical prototype would arguably align better with the second NUI guideline of feeling equally natural to users of all levels of experience (Wigdor & Wixon, 2011).

- **Lesser emphasis on on-screen graphics:** Interpreting statements made by Wigdor & Wixon the interface that accommodates the gestural system should, instead of trying to predict the user’s actions, have users react to on-screen objects (2011, p. 145). Both prototypes could be said to fulfil this criterion. However, it is also stated that gestures should be conveyed using a minimum of visual UI elements (ibid). This to make the gesture learning process more implicit (ibid.). The dramaturgical prototype would, according to the prototype sketches made during the ideation phase, use visual components more sparingly than the challenge prototype.

The ideas presented in the dramaturgical prototype sketches were implemented into the picture gallery environment that was previously constructed. *Figure 12* shows a collection of screenshots from the prototype.
Figure 12: The teaching process of a single gesture as incorporated into the final prototype. The icon appears and mimics the intended gesture, in this case by sliding upwards. As the user tries carrying out the same motion the result of the action becomes apparent, placing the user in “image edit”-mode. The next gesture, for filters, appear (Author’s Image).

All key interactions were assigned an icon, a gesture and a condition for when to appear. Swiping up and down for switching between view and edit modes, swiping right and left for switching between images in view mode and applying filters in edit mode. Long-pressing in edit mode would bring up controls for brightness and contrast.
4.5.1 Relation to existing designs

Looking back towards existing designs it became apparent that the dramaturgical prototype held several similarities to one of the prototypes presented in Hofmeester & Wolfe's case study on self-revealing gestures in Windows 8. According to the authors this design was based on previous work within gesture teaching aimed at Microsoft’s Surface device (Hofmeester & Wolfe, 2012, p. 818). In similarity with the icons used in the dramaturgical prototype it used a visual element for signifying interactions, in the text exemplified with a cross in a circle for closing. User’s tendency to initially tap on interface elements is utilized as an initiator for feedforward. When users tapped such an element an arrow showcasing the direction and length of the expected gesture would be shown. The expected length was also marked with a text instruction as an additional signifier (ibid.).

However, the dramaturgical prototype is very much different in its behaviour. It uses the animated movement of icons to signify the expected gesture instead of additional visuals. Furthermore, its teaching mechanism is initiated by the artefact rather than the user with gestures being introduced one-by-one as soon as the interface is opened. With these two factors combined it could be argued that the prototype that Wolfe and Hofmeester describes relies on user inquiry (in this case the tap) and subsequent guidance (the visual instruction signifier) which the user follows to learn the gesture. The dramaturgical prototype instead makes use of mimicry. The artefact provides an icon that showcase a motion path with users being expected to imitate its movement to complete, and subsequently learn, the gesture itself.

4.6 User Testing

A total of three user tests were devised with the same expert users that participated in the master-apprentice studies. Tests were held individually with each tester. Participants were handed the prototype being informed that it was a picture gallery app with basic editing functionality, akin to what could be found preinstalled on most mobile devices (see Figure 13). They were asked to freely explore the app while thinking out loud and tell the researcher when they were satisfied with their exploration. After the exploration, the designer held a quick debrief with the participant.
4.6.1 Results

![Image of a prototype testing session](image)

*Figure 13: One of the participants testing the prototype. Gesture interactions are introduced as the user moves around to new parts of the interface (Author's Image).*

The user tests led to several key insights on how the prototype could be developed further. These insights derived from participants’ thoughts when thinking out loud, their behaviour and use of the app as well as from the debrief discussion. As participants largely expressed similar thoughts regarding the prototype ideas were grouped according to the issue they addressed.

**Further clarification on what action is expected**

Certain aspects of the animated icons proved to be unclear in a practical use scenario. What action the pictograms themselves represented were not always clear to users. Some requested more descriptive pictograms while some thought they should be replaced by a single visual indicator due to the added confusion of using different pictograms for each action.

Icon animations which would mimic the expected gesture did not always succeed at communicating this effectively. Swiping motions were largely understandable through the animations. In contrast, the “long-press” animation for adjustment controls failed to adequately communicate the intended action in every test. Instead it left participants confused as to what
to do. Its animation was in some cases perceived as trying to invoke a pinch action.

Furthermore, the pictograms; meant to signal a functionality, and the animation; meant to signal how to invoke that functionality were mixed up. The icon for adjustments took the shape of a set of levers. This also gave the impression that an up-down-swipe would be the correct gesture. In the case of the long-press action one of the participants gave an additional explanation:

“The long-press is a bit more tentative. You get more careful when it is a more precise thing you are about to do.” (Workshop Notes, 2019)

When the prototype failed to successfully communicate gesture interactions it affected the experience negatively. As animations repeated themselves and users had difficulties finding the correct gesture the repetitions became more of a taunt than something helpful. This would also undermine trust in the artefact:

“At first, I trust the indicators, but then when I don’t understand them it feels more like they’re in the way and then I want to explore what I can do myself.” (Workshop Notes, 2019)

**Address ambiguities in certain interface components**

In addition to uncertainties regarding the animated icons some interface components were falsely interpreted as being gestural entities. The thicker corners of the edit grid gave an impression of them being handles to resize or crop the image. Conversely, the handle for opening an album at the overview section, which was engaged through a downwards swipe, were not perceived as gestural but tappable. Testers expressed that they would much rather be able to tap the images directly stating that the swiping motion did not feel natural to the context.

**Direct feedback on user action**

Although the movement of icons indicated what gesture was expected there was nothing to enforce users’ presumptions when trying a gesture themselves. Instead when users initiated a gesture the icon would continue its existing animation, which did not clarify if the gesture was correct or not. It was suggested that when the correct gesture is invoked by the user the icon would “latch on” to the motion of the finger to support the action. Likewise, the artefact did not give any response when a presumed gesture did not work.
The prototype isn’t always up to speed with users

In this first prototype there would be a certain delay before an icon would initially appear and go through its animation cycle. This was done so that the transition between different gesture introductions would not feel too stressed. However, this would prove to be problematic when the user’s proficiency in using touch interfaces - and subsequent speed of exploration – made them quicker than the inherit speed of the introduction. When moving around the interface quickly the animations would be interrupted and fail to show, inadvertently leaving the user with a seemingly haphazard guiding experience.

In general, the prototype’s base qualities were well received

Although there is a need for refinement regarding the appearance and behaviour of the prototype it seemed to hold some base qualities that were well received by testers. Using the animated icons to illustrate swiping motions were mostly perceived as concrete and effective but would be in need of added clarity. When asked to compare the prototype to traditional step-by-step tutorials testers were generally critical towards these sometimes feeling like an artificial environment, as one participant expressed it:

“I don’t want to put time into something that’s fake; not some kind of test image” (Workshop Notes, 2019)

Another tester commented on a tutorial-like environment that was present in a certain operating system’s updates:

“[When updating] ...there’s like a wizard, but it’s taken out of its context so I don’t think you would remember that. I think the chance of that is greater when it’s actually happening.” (Workshop Notes, 2019)
5 Discussion

This section aims to discuss the results and future of this project while also bringing certain aspects of its process under critique. The work is then discussed in its relation to related fields and methods.

5.1 Results

The prototype which became the final result of this study was based off insights that were generated by analysing the master - apprentice workshops. However, several areas for improvement were uncovered through the testing phase. It would seem that the participants testing the prototype could discern what aspects were currently found to be confusing or lacking in communication. User feedback mainly addressed issues that could be related to implementation. Clarifying expected actions, avoiding visual ambiguities, adding more feedback and accommodating for different speeds of exploration could potentially be addressed by modifying certain aspects of this prototype’s appearance and behaviour. However, it could also be that other prototype ideas would be more suitable for introducing gestures. Additional development and evaluation of this study’s prototype as well as the ideation and construction of other prototypes would have been helpful for fully assessing the successfulness of the touch-gesture introduction that arose as a result of this project.

5.2 Future Work

If this project had continued further prototypes would have been created, tested and evaluated. A potential iteration of the dramaturgical prototype would have addressed the ambiguity of certain interface constituents. Animations for communicating the expected gestures would have been revised and refined. The prototype’s icons would also, if correct, latch on to users’ gestures for it to feel more responsive and supportive. The interaction flow would also be adjusted so that the prototype could either keep up to the users’ speed of exploration or, if not possible, perhaps be designed in a way that makes for a more leisurely exploration process.

5.3 Critique of This Work

Only a total of three participants were present in the master – apprentice workshops and prototype testing session of this work. It is important to note that the limited demographic spread of the participants regarding age, background, occupation and previous relation to the designer may have affected the results of this study. For the purpose of this project the
limitations on time and resources as well as the already considerable amount of work that were put into the workshops and testing sessions conducted is stated as the reason for this. More extensive research and testing with a greater sample size and wider demographic would be needed to fully assess the validity of this study’s results.

Likewise, this study would have benefited from the opportunity to construct a greater number of gesture introduction prototypes to test in a variety of domains rather than confining to the mobile picture gallery.

This study’s workshop activities were grouped according to a categorization scheme based on the data collected. Another type of data grouping may have yielded other insights and results. Reliability could had been tested by having a second researcher analyse the same data using the same categorization scheme, as suggested by Preece, Sharp and Rogers (2015, p. 293). However, this was not possible due to the nature of this project’s scope and resources.

5.4 Relation to related fields and methods

This thesis project was an experimental study meant to utilize a user-centred design process to investigate how feedforward might be provided within a gesture-based touch interface. Section 2.2 briefly outlined the role of the touch screen and its interactions within the interaction design field. Section 2.3, similarly, gave an account on gestural interactions. In subsequent sections a potential lack of presence of feedforward within gesture-based touch interfaces was identified and a possible design space was uncovered through interaction design theory and related works. The prototype which arose as a result of this study has a variety of possible implications for its related fields and methods.

5.4.1 User-centred design research

Applying a user-centred design research approach proved valuable for the results of this study. Hopefully this decision and the project that ensued as a result could illustrate the value of applying such research methods even for investigating individual interactions within interaction design work. The results of this project’s process raise the question of whether studying how people provide feedforward-like information to one another could be valuable for other designers aspiring to design feedforward in a way that feels human-like.
5.4.2 Touch-gesture interactions

In relation to the interaction model provided by Baudel and Beaudouin-Lafon, outlined in section 2.3, the dramaturgical prototype’s animations is arguably coherent with the three stages of the model. The animation itself could be said to encompass a start position (the location at which the icon first appears), a dynamic phase (its animation which illustrates the intended movement) and end position (where the icon stops its movement). Effectively, the prototype inadvertently uses the interaction model as the base for its feedforward. This could indicate the model’s value not only for when designing gestural commands but also for when designing the introduction of these commands.

5.4.3 Touch-screen interfaces

This thesis’ prototype may also have implications for designing touchscreen-interfaces. As stated in section 2.2, the touch screen has the capability to provide rich experiences and interactions. The touch screen’s visual capabilities (providing feedforward directly on-screen through animations) and interactive capabilities (making use of touch-gestures for input) were used in close conjunction to encourage users to mimic the animations the prototype provided. This highlights a certain quality of touch screen technology; allowing users to interact with the surface in the same manner and at the same place as a descriptive animation. As such it could be argued that the touch screen medium is an interesting domain for using gesture mimicry as a means of providing users with feedforward. Making use of a carefully designed interplay between an animated visual cue and an expected gesture in this manner might be used to introduce novel gestural commands into the variety of interactions that the touch screen can provide.

5.4.4 Interaction design

This thesis may also have implications for the field of interaction design, which was described and defined in section 2.1. Since touch-gesture interaction seems to be an area relevant for research, development and refinement within the interaction design discipline this thesis could be seen as an attempt to further such developments in the field. Hopefully, future efforts akin to this project might enable interaction designers to find new uses and embodiments for touch-gesture interactions. Consequently, these types of interaction could prove useful for suitable artefacts, human activities and possibly society at large.
6 Conclusions

The user-centred research process of this study gave insight into several phenomenon that were used to ideate different ways of introducing touch gesture interactions. The single prototype that was constructed from the ideation work proved to contain several areas for improvement regarding implementation and behaviour. Apart from that, its base methods and qualities were well received. Further development and testing would be needed to fully assess whether this particular gesture introduction prototype would prove valuable to users or not. Implementing the feedback received during user tests may hopefully yield a more viable solution. Using animated icons as a method for feedforward within touch-gesture interfaces seem to hold potential for further investigation into its viability as a way of introducing touch-gesture commands to users.

Applying user-centred research methods to explore how touch gestures might be introduced yielded many insights which contributed to the project’s results. It highlighted relevant aspects, methods and issues that were not considered initially when the project was still meant to be based entirely in explorative sketching and prototyping. Therefore, this project could hopefully contribute to showcase the potential of using these types of methods for designing touch-gesture introductions.

Based on the research, investigations and design work of this project there seems to be potential for designers to further explore the possibilities for ensuring the discoverability of touch-gesture interactions. Hopefully this project may prove useful for designers interested in pursuing the same or similar issues within their work.
7 Summary

The goal of this project was to explore how we might introduce users to the different functionalities present in a gesture-based touch screen interface that lack visual representations of interaction through a user-centred research process. This was done by conducting a set of master-apprentice studies in which expert users would teach the designer an artefact or activity of their own choosing. The designer would then try the same activity under their guidance. Their ways of teaching and coaching the designer during these workshops were analysed for phenomenon relevant for introducing gesture interactions. Based on the insights generated, ideas for touch gesture introduction prototypes were sketched whereas one of these was implemented into a digital, interactive prototype. This prototype was in turn subject to a set of usability tests. Several improvements were suggested in regard to implementation and behaviour although the base idea was well received by testers. The prototype would need to be iterated and tested to fully determine its viability.
8 References


Norman, Donald, & Nielsen, J. (2010). Gestural interfaces: a step backward


