

Design Framework for Trustworthy User Interfaces

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IIRO PÄÄKKÖNEN: Design Framework for Trustworthy User Interfaces

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This thesis studies the relationship between user interface (UI) design, microinteractions and perceived trustworthiness in software systems. The thesis combines a narrative literature review with an empirical user study. The literature review gathers together research from trust psychology, human-computer interaction (HCI) and UI design to identify the most critical elements and decisions in UI design that contribute to trust formation. Based on already established trust models, such as the work of Mayer et al. and Hancock et al. the review finds functionality, helpfulness, predictability, visual trust signals and trust reinforcement actions as the core aspects of trustworthy UI design.

Based on the literature review, the Trustworthy User Interface Design Framework (TUIDF) was created as a practical checklist for UI designers. To validate the framework, two mobile banking application prototypes were created using Figma Make, an artificial intelligence model made for UI design. The control prototype was designed using traditional UI design principles while the experimental prototype was designed according to the TUIDF. Ten participants divided into two focus groups completed tasks to evaluate the prototypes with a questionnaire combining the STS and the System Usability Scale (SUS). The TUIDF-prototype scored higher on most dimensions that were measured, including purpose, process, visual appeal and general trust. This suggests that the framework can improve perceived trustworthiness. The findings show that UI design based on the TUIDF produces measurable improvements in user trust, although further validation with a larger sample size is required.

Keywords: user interface design, trust, perceived trustworthiness, microinteractions, human-computer interaction, design framework

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1 Introduction

This master's thesis explores the relationship between user interface (UI) design, microinteractions and the user's perceived trust in the software system. The thesis consists of a narrative literature review and empirical user research. The literature review aims to provide background information about user interface design, microinteractions, trust psychology and trust models to create a solid academic base. Based on the information found in the literature review, a theoretical framework will be developed to provide ways to design UI while taking into account perceived trustworthiness factors. The empirical portion of the thesis will attempt to validate and evaluate this framework by conducting a user study based on two prototypes: one designed according to traditional UI design principles and one designed using the framework guidelines.

1.1 Purpose

The reason I decided to study this topic is that in my master's degree studies I have really enjoyed the UI design courses included in my degree. Designing user-friendly interfaces has sparked much interest in the topic as a whole, but especially finding out deeper connections between the thought processes of humans and user interface intrigues me. Trust and reliability are also a crucial part of software design and development. With today's evermore increasing digital world, the trust towards systems we use is highly important to users. Thus, connecting the topics of user

interface design with trust formation felt like a logical choice when deciding the topic for this thesis.

1.2 Research Questions

This thesis aims to study the effect of UI design and microinteractions on perceived trust of a software system. To help study this topic and create a structure for the thesis, the following research questions (RQs) are presented:

RQ1 How do user interface design and microinteractions affect the formation of trust in the user towards the software?

RQ2 For achieving trust, what are the most critical qualities in user interface design and microinteractions?

RQ3 What kind of instructions about user interface design and microinteractions will best support a user interface designer in creating trust?

RQ4 Can we detect a noticeable difference in perceived trust between traditionally designed software and software designed to support trust?

This thesis aims to answer the above mentioned questions based on the source literature and the user study.

1.3 Structure

This section describes the major structure of the thesis. The thesis consists of two main portions: the literature review and the empirical user research portion. However these portions are divided into smaller sections and must be covered.

Chapter 1 of the thesis goes over the introduction and the purpose for researching the topic at hand. The same chapter then explains the research questions that the thesis attempts to answer as well as the structure.

Chapter 2 goes over background information that the author feels are required to understand the main content of the thesis in case the reader is not familiar with the given topics. User interfaces, user interface design and microinteractions are covered as well as Figma, the platform used to design the prototypes presented in this thesis. Trust is also slightly grazed as a topic, but will be covered more thoroughly later in the thesis.

Chapter 3 introduces the research methods used to gather data for the thesis as a whole, explaining thoroughly the steps that were taken to gather data for the literature review. Chapter 3 also explains how the empirical study was conducted and what steps were taken to gain the results that will later be shown in this thesis.

Chapter 4 starts of the major parts of the thesis with the literature review. The literature review covers topics such as trust theory (including trust factors and trust formation), trust in HCI, usability and trust, design elements and trust and finally goes over creating the Trustworthy User Interface Design Framework. The formation of the framework is done in this chapter completely.

Chapter 5 starts the second major part of the thesis by beginning with the design process of the prototypes mentioned in the Research methods Chapter 3. The design process is explained thoroughly, followed by analysing the prototypes and moving on to the empirical study design. The empirical study is conducted in this chapter. The results of the study follow the study design process and finally the results are analysed at the end of the chapter.

Chapter 6 closes the thesis by answering the research questions presented in the thesis one by one, explains some of the author's own thoughts about the subject and what was learned during the research process as well as ideas for future research.

A list of references is given after the main text in the thesis, followed by Appendices A through C, which contain a figure of the full process of trust formation, the Trustworthy User Interface Design Framework as a whole and the questionnaire used in the empirical user study.

2 Background

This chapter goes over the most important background information that the reader must know to better understand the content of the thesis. First, the chapter will introduce user interfaces and their design and then explain microinteractions in the context of the thesis. Lastly, this chapter discusses the meaning of trust in the same context.

2.1 User Interfaces

A user interface is the point of interaction between a person and a system. Meaning the visible and perceivable layer through which a user sends inputs to the computer system and receives outputs from it. The UI is comprised of everything the user can see, hear, touch or otherwise perceive in the system. In its simplest form, a traditional UI may include buttons, text-fields, alerts or audio feedback and be operated with a mouse and a keyboard. A more complex UI may also include voice commands, touch-screens, gesture recognition or mixed-reality interfaces.

All the aforementioned properties of user interfaces may seem confusing, that come clearer with examples. Let's think of a gaming console, like the one in Figure 2.1.



Figure 2.1: The controller of a gaming console is a user interface of its own [1]

Its controller is already a user interface because the user interacts with the console by pushing buttons on the controller. At the same time, the console's graphic user interface (GUI) is a user interface because it shows the user what they can do and what happens when elements are interacted with. Even further, after launching a game on the console, the game will most likely have a user interface telling the user what they can do inside the game. All of these examples are user interfaces in their own way and thus defining a specific user interface is very important in its own domain. For the purposes of this thesis, the focus will remain on traditional user interfaces operated in computer systems by mouse and keyboard or with a touchscreen, and in particular on how trust can be designed into them through UI design decisions and microinteractions.

User interfaces have been studied from many different perspectives for decades now. Possibly the most studied subject in UI research is usability; *the ease of use*, *efficiency* and *learnability* of a system. Parts of usability can be quickly verified by using Jakob Nielsen's 10 usability heuristics for user interface design. These

heuristics have been around since 1994 and have remained the same since. [2] Following these heuristics helps designers create more usable and accessible designs.

Trust is arguably a less studied subject in UI research. However, trust is a key factor in the growth of certain software system usage. Gaining and maintaining trust is critical for users to continue using software systems [3]. The concept of trust in UI design can be difficult to define. For this reason, trust overall will be defined in Section 2.5

2.2 User Interface Design

Ever since computer interaction has been a thing, people have been designing interfaces for users to interact with. Some have also tried to create and promote guidelines for good design [4]. Design as a concept can be seen as two things. The plan that helps build a product as intended and the process of planning the parts or structure of the product. [5] In the context of this thesis, design is thought of as the process of outlining and prototyping the UI, critically thinking of features included in the UI and as the final plan of the UI. It is important to realise, that UI design does far more than provide access to the user. It mediates the user's experience of the system's capabilities, limitations and trustworthiness. It also mediates the system's status, ways to interact and how the system should be utilized. Effective interface design supports usability, learnability, and trust.

UI design and user experience (UX) often go hand in hand. User experience in UI design refers to the physical, emotional or perceptive feelings caused by the UI design choices of a system. UI concerns the visual and interactive components, whereas UX encompasses the overall experience, emotions, and effectiveness of using the system. Thus, good UI design can lead to better UX, but does not necessarily guarantee it.

2.3 Figma

Figma is a modern software for designing different user interfaces made by Figma Inc. Figma is one of the industry standards for UI, user experience and product designers. Figma focuses mainly on online collaboration and allows designers to work on the same project in real-time. The software emphasizes the use of vector graphics and prototyping tools to create more than just visual interfaces in prototypes that are functional. Figma is seen as the main software product of Figma Inc. but Figma also encompasses multiple smaller products. These products are Figma Design, the main design tool used by UI designers; Figma Draw, an illustration tool with advanced vector graphics; FigJam, a collaborative digital whiteboard; Figma Slides, a slideshow tool for collaborative online presentations and Figma Make¹, an artificial intelligence model that utilizes Large Language Models (LLMs) to help designers easily create Figma Design prototypes based on prompts. [6]

Figma Make utilizes different LLMs to allow the user different outputs based on user needs. As of June 2026, the models used by Figma Make are Claude Sonnet 4.6, Claude Opus, Gemini 3 Flash, Gemini 3.1 Pro and GPT-5.5. There is also a "default" model that is not specified by Figma Make, but is explained to be one of the aforementioned models that the Figma team deems best for the current use of the product [7]. Figma Make allows the user to prompt the model with commands, questions and any sort of choices the user wants with the goal of building a working user interface and prototype. Figma Make can not only build visual interfaces but can also create interactions, multiple views and inputs. The user can also publish ready sites made with Figma Make, allowing for no-code solutions when building web pages.

¹Figma Make: <https://www.figma.com/make/>

2.4 Microinteractions

Microinteractions are small and subtle forms of interaction between a software system and the user. They are intentionally smaller features than product features, but are still as important to the overall feel of the product. Microinteractions most often provide feedback to the user conveying the state of the system. For example, a rotating loading icon is a microinteraction telling the user their content is being loaded and that they should wait a moment. [8] However, feedback is not the only use case for microinteractions. They can also be used to prevent errors, encourage engagement or even communicate product brand [9].

The difference between traditional interactions and microinteractions can be subjective, so it is not set in stone as to which features of a product are microinteractions and which of them are full product features. However, based on Jergović et al. [8] the most common microinteractions can be seen as:

- button interaction, motion feedback and visual indication of clicking and hovering.
- progress bars and icons, a bar or circle indicating system status and telling the user to wait.
- audio feedback, playing sounds to indicate actions happening or alerts going off.
- transition effects, animations and motions displaying movement of system components or screen status changes.
- visual feedback, changes in the visual outlook of the system due to user actions.

In Aleksy et al. [10] research paper *Microinteractions in Mobile and Wearable Computing*, four parts are mentioned for the structure of microinteractions. They are *triggers*, *rules*, *feedback* and *loops/modes*. Triggers are what start the interaction

process and can be triggered by either the user or the system. The rules of a microinteraction determine the behaviour of said microinteraction. Feedback is what happens after a microinteraction is triggered. Feedback tells the user that a microinteraction has been triggered and displays it somehow to the user, be it visually or audibly. Lastly, the loops or modes describe if the microinteraction ends right away, keeps going and how fast or slow should it send feedback. In Boyd and Bond [11]’s paper *Can microinteractions in user interfaces affect their perceived usability*, they conclude that microinteractions can help increase the likeability and learnability of user interfaces.

2.5 Trust

Trust in human-computer interaction is a subjective, multi-dimensional construct that can be seen as a reflection of a user’s willingness to be vulnerable towards the system they are using. Trust is most typically based on the expectations of competence, integrity and perceived benevolence of a system. [12], [13] A user that trusts the software system is more likely to input their personal details, click links and interact with the system than a user that does not trust the system. In 1995 Mayer et al. [14] proposed a model of trust that presents trust as a multiphased process, as shown in Figure 2.2. The model includes factors of perceived trustworthiness; ability, benevolence and integrity. Simply put, ability refers to the trustee’s (the person whom one trusts) competence in the given domain of trust. Benevolence refers to the trustee’s perceived willingness to do good to the trustor. Integrity is arguably slightly more complicated than the other two. Integrity is seen by Mayer et al. [14] as the trustor believing that the trustee follows principles found acceptable by the trustor.

The three factors of perceived trustworthiness can be fairly easily transferred from human-human interaction to human-computer interaction. Ability can be seen

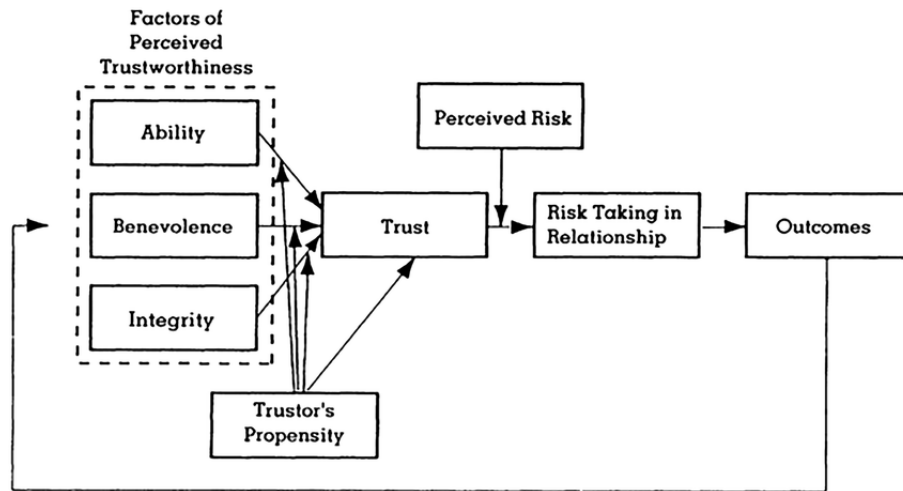


Figure 2.2: Proposed trust model by Mayer et al. [14]

as the system's competence to execute the task(s) given to it by the user. Benevolence on the other hand can be seen as the perceived good intentions of the system. However, benevolence is also partly still human-human interaction, since the benevolence of the system reflects the benevolence of the developer of said system. Lastly integrity can be seen as the system following a known set of rules or principles that the majority of users accept. The set of rules could, for example, be the 10 heuristics of user interface design by Jakob Nielsen. [2]

Trust as a construct is rather difficult to measure especially in an environment such as UI research. Luckily, Alarcon et al. [15] have developed and validated the System Trustworthiness Scale (STS). The system trustworthiness scale was developed to fill a gap in research about trust in human-computer interaction. It measures the perceived trust of a system from three perspectives; performance, purpose and process. Performance refers to system's effectiveness in the context. Does the system truthfully and accurately perform its job? Purpose refers to if the system is made with the intended use in mind. Is the system designed to assist the user? Process refers to the transparency of the system and how it operates. Does the system indicate how it got to this state or decision?

Because the STS is not developed with a specific system or field of systems in mind, it is very adaptable and can be used in this thesis quite easily. The division into three different components of system trust also allows the user study of this thesis to more accurately measure the trustworthiness of a user interface system. The STS and its usage is further elaborated in Chapter 3.

3 Research Methods

This chapter details the research methods of the thesis, the main methods being a literature review and empirical user research. This chapter explains how information was gathered for the thesis for both the literature review and the empirical portion and what methods were used.

As explained before, the thesis aims to review relevant literature and understand the connection of user interface design, microinteractions and perceived trustworthiness of a system. From this review, the thesis aims to create a solid theoretical framework that can be used in UI design to design more trustworthy and reliable software. Building on top of itself, the thesis then aims to conduct a user study testing the reliability validity of the framework. The whole research process of the thesis is presented in the following Figure 3.1.

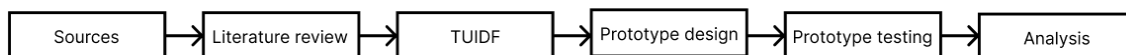


Figure 3.1: The research process of the thesis

As seen in Figure 3.1, the thesis first finds relevant sources to base the literature review on. After that, the thesis analyses this literature and academic writing in the form of the review and develops a framework based on the findings. Then a prototype based on existing principles is developed alongside a prototype according to the framework. These prototypes are then tested with users and finally, the results are analysed.

3.1 Literature review research methods

The literature review section of the thesis reviews relevant information in the context of the thesis. The literature review was conducted to find specific information about human-human trust theory, trust psychology, human-computer interaction, user interface design and other related sources. This thesis employed a narrative literature review approach [16].

Literature identification was conducted iteratively, beginning with publications and papers on trust between humans, followed by trust in human-computer interaction and user interface design. The first searches were performed using academic search engines such as Web of Science, Google Scholar and the University of Turku Volter-database. As relevant sources were found, their references and citations were examined to find additional related sources.

As the literature review proceeded, additional search terms were used to find emerging themes such as trust in usability, trust theory and user interface elements. The sources were used to create a cohesive literature review pinpointing user interface design elements that enforce the perceived trustworthiness of a user interface.

Based on the literature review findings, a framework was created. The Trustworthy User Interface Design Framework (TUIDF) compiled the most important aspects of user interface design for trust formation in a list. This list is intended for UI/UX designers' use so they can quickly view the list and design more trustworthy user interfaces.

3.2 Empirical user research methods

The empirical user research portion of this thesis was conducted to validate and evaluate the TUIDF created in the literature review. The validation would give valuable information on whether or not the framework could be productively used

to improve the perceived trustworthiness of user interfaces. First, two prototypes were designed with an artificial intelligence model Figma Make. Figma Make allowed the design process to be fast and prompt-based. Artificial intelligence was chosen to speed up the process of the research and more importantly to eliminate any biased decisions the author might make in the designs. The goal was to create one prototype using traditional user interface design principles (in this case, the Figma Make internal design system, which was deemed to follow traditional principles) and one prototype using the TUIDF guidelines. The guidelines were written in natural language and had to be reformed slightly into more AI-friendly commands. The prompt given to design both prototypes was:

Create a modern mobile banking application interface for a smartphone. The design should feel realistic, clean, and minimal, similar to a contemporary European digital banking app. The design should follow conventional and traditional UI design principles and practices. The interface should include the following screens: 1. Home Dashboard. 2. Transfer Money Screen. 3. Request Money Screen. 4. Cards Screen. 5. More-screen. The screens should have navigation between them. The design should have as many interactive elements in the prototype as possible. Ask me clarifying questions if needed.

Some questions were asked by the model, but most of the design happened with just one prompt. More detailed discussion about this process is in Chapter 5.

The prototypes were then given to two groups of five people each. All participants were asked to test the prototype by completing a set of tasks with the prototype. The participants were then instructed to fill in a questionnaire about how they felt using the prototype. The questionnaire had six domains to map out the perceived trustworthiness of the prototype. The questionnaire was based on the System Trustworthiness Scale (a validated scale for measuring perceived trustwor-

thiness) and the System Usability Scale with more questions added to fit the context of the study.

The questionnaire results were then gathered together and evaluated by calculating the mean score of each of the six domains for both prototypes. These mean scores were compared to each other between the prototypes and qualitative data through open-ended questions was added to the evaluation process to analyse the results further. The results of this process can be found in Chapter 5 Sections 5.4 and 5.5.

4 Literature review

Having established the background information needed and the importance of trust in digital interfaces, this literature review examines how UI design elements contribute to trust formation. The review will include research based on human-computer interaction, trust psychology and design studies to find out how trust is constructed, communicated and reinforced through UI design. By bringing together different studies of multiple fields, the review aims identify key design principles and psychological mechanisms that influence trust formation in digital environments. The review is structured to first introduce studies of trust and trust theory, followed by studies of UI design, usability and trust in HCI.

4.1 Trust theory

To study trust in information systems and UI design specifically, one must understand what trust is and how it is formed in both human-human interaction and human-computer interaction. This is where the domain of trust theory comes in. Trust theory encompasses the entire theoretical research around the perception or feeling of trust, but this section only goes deeper into the factors affecting trust as well as the formation of trust between people.

4.1.1 Factors affecting trust

In *An integrative model of organizational trust* Mayer et al. [14] studied the concept of trust in human-human interaction. They defined trust as the willingness to be vulnerable towards the actions of another party. While trust is not inherently risk-taking, it is the willingness to present oneself as assuming risk in human-human interaction. It is important to note that for the action to be defined as trust, the article suggests that the trustor should not be able to monitor or control the actions of the trustee. Thus, the trustor allows freedom to the trustee to do as they please and expects them to act as agreed. The article also notes that trust should not be confused with cooperation. While cooperation can occur due to trust, it also might not. As well as due to trust, cooperation also can occur due to control mechanisms (e.g. rewards or punishments) or a lack of alternatives. All cooperation does not involve the willingness to be vulnerable though, so the authors do not recognise it as trust itself.

As discussed earlier in the background chapter, Mayer et al. also introduced the concept of perceived trustworthiness building on three primary factors: ability, benevolence and integrity. These factors along with perceived risk and the trustor's propensity (i.e. the natural tendency to behave in a certain way) form the model of trust shown in Figure 2.2 in page 11. [14]

In the article *How and Why Humans Trust: A Meta-Analysis and Elaborated Model*, Hancock et al. [17] build on Mayer et al. [14] research and model of trust. However, they feel the model proposed by Mayer et al. is limited, since even more factors affect the trust formed in human interaction. Therefore, they propose a more detailed model of trust shown in Figure 4.1.

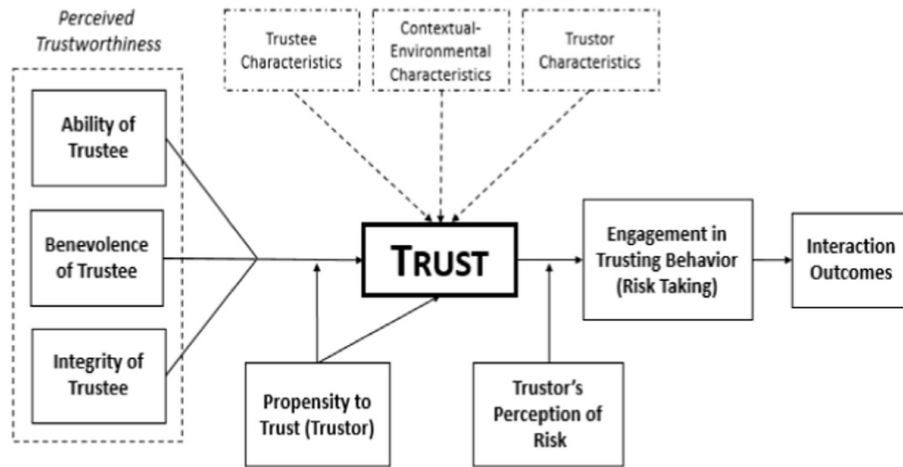


Figure 4.1: Proposed trust model by Hancock et al. [17] building on the model proposed by Mayer et al. [17]

In the new model, the most prominent difference to the earlier model is the addition of *trust characteristics*. Hancock et al. [17] propose that trust is also a factor of characteristics found in the trustor, trustee and the context and environment of the interaction. These characteristics include ability-based characteristics, performance-based characteristics and individual characteristics as well as variables in the context and environment.

Ability-based characteristics refer to the trustor's own competence and experiences such as expertise and prior trust experience. Performance-based characteristics point to trustee and their behavior and predictability. Individual characteristics are characteristics that affect both the trustor and trustee. These characteristics are more personal and include traits such as personality, attitude towards people, reputation and even gender. Contextual and environmental factors refer to the surroundings and the specific situation the trust interaction happens in. These characteristics are more broad and include factors such as culture, level of certainty, task complexity, work environment and communication type. Putting all the characteristics together, a clear image of factors affecting trust can be created. For this purpose, Hancock et al. [17] have also expanded their trust model to include all

characteristics they see as factors of trust. This model can be seen in Figure 4.2.

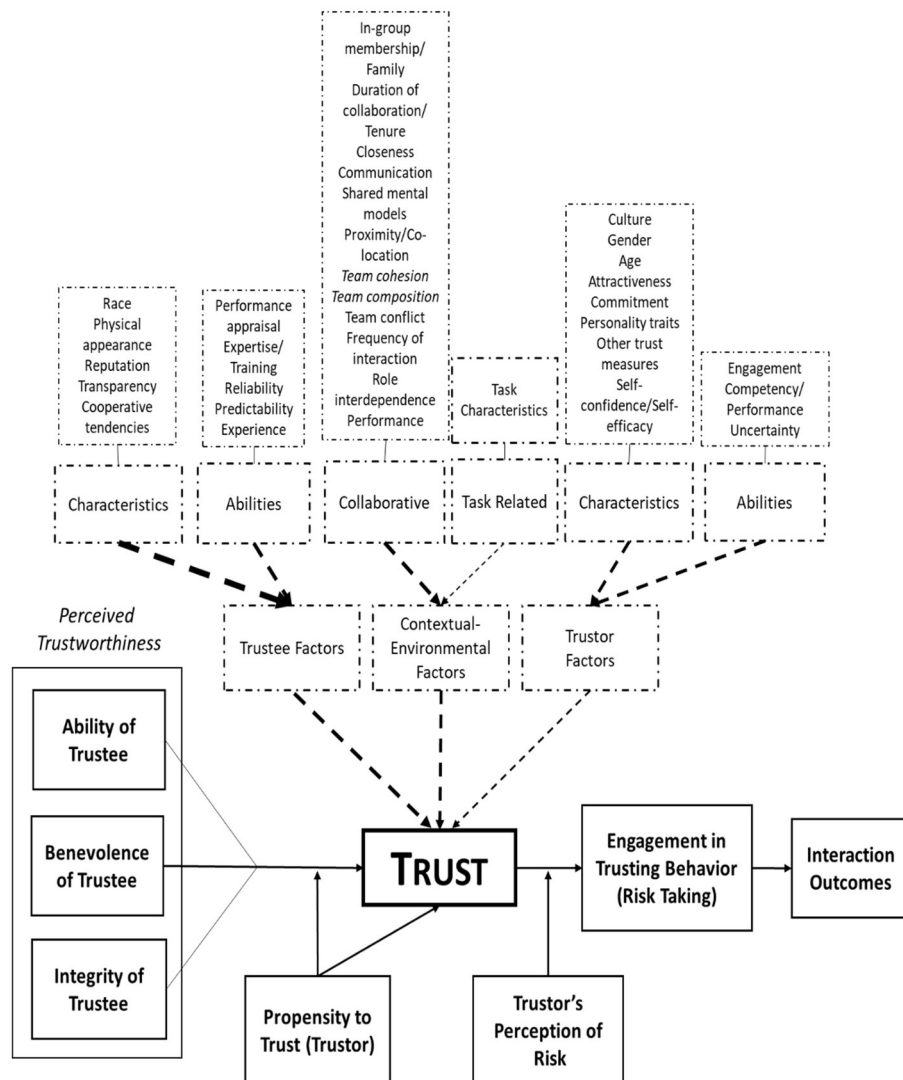


Figure 4.2: Finalized, revised model of trust by Hancock et al. [17]

It can be noticed from Figure 4.2 that Hancock et al. [17] found multiple characteristics affecting the larger factors affecting trust as a whole.

4.1.2 Formation of trust

After having found the factors affecting trust between people, the next logical step is to find out how trust is formed. As stated by Mayer et al. [14] the above-mentioned models show factors that affect trust between two individuals before any interaction

has occurred. After some sort of interaction has begun, a relationship between the trustor and trustee will form. This relationship fundamentally affects the formation of trust. In *Neurobehavioral Mechanisms Supporting Trust and Reciprocity*, Fareri [18] reviews evidence that the decision to trust others is formed by implicit assessments of others' social signals as well as explicit results based on outcomes of past and present actions in trust scenarios. These neurobehavioral mechanisms suggest that trust builds up gradually and dynamically: early impressions and past knowledge shape initial expectations and subsequent reciprocity reinforces or diminishes these expectations. This indicates that each trust scenario either strengthens or weakens the trustor's trust of one or more trustees.

Putting together Fareri [18]'s findings of trust formation and Mayer et al. [14] and Hancock et al. [17] research on trust factors, a thorough process of trust formation can be formed. The basis of trust is built on implicit expectations formed from the perceived trustworthiness of the trustee. This trustworthiness consists of the above-mentioned ability, benevolence and integrity of the trustee as well as their individual characteristics. These implicit expectations along with contextual and environmental variables affect the early stages of trust formation. At the same time, the trustor's own characteristics and abilities affect their view of the trustee's trustworthiness. Much of this process happens intuitively without the trustor's own recognition. All of these characteristics put together then get compared with past experiences in trust scenarios and form a new view of trust. After this process, the trustor engages in trusting behavior and possibly takes risks in trusting the trustee. This leads to an outcome of the interaction that gets compared with the expectations formed earlier and then either strengthens or weakens the trust in the relationship. This cycle can then be repeated. The full process can be seen in Appendix A.

4.2 Trust in HCI

Having established the key factors and processes involved in interpersonal trust formation, attention turns to understanding trust formation in human–computer interaction and how it can be reinforced. Mcknight et al. [12] propose that similarly to interpersonal trust, trust in HCI refers to a user becoming willing to rely on a specific technology in situations involving uncertainty or potential negative outcomes. They also build on Mayer et al. [14] research and model of trust by comparing computer trust factors to the trustee factors presented in Mayer et al. model as perceived trustworthiness. They state that ability can be compared to the functionality of a computer system. [12] In human cases, the trustor can assess and make assumptions about the trustee’s ability and competence in the given domain. This applied to computer systems can be seen as making assumptions of the system’s functionality and furthermore the ability to complete the given task. Next, the benevolence of perceived trustworthiness can be compared to helpfulness [12]. In human-human interaction, when trusting, the trustor assumes the trustee wants to do good and help. In human-computer interaction, the trustor makes assumptions about how the system can help them and if it has the capability to help them properly. Lastly, according to Mcknight et al. [12] integrity can be compared to the predictability of a system. A human trusting another human assumes the trustee adheres to a set of principles. While one cannot make sure a computer system adheres to a set of principles or rules, a system behaving in a predictable and consistent manner can be compared to following a certain pattern or list of actions. The comparison between human-human interaction and human-computer interaction trust factors are shown in the following Figure 4.3.

Taking the findings of Mcknight et al. [12] into consideration, it is plausible to state that to create trustworthy computer systems, one must make sure they are capable, helpful and consistently reliable. The authors also propose that consistent

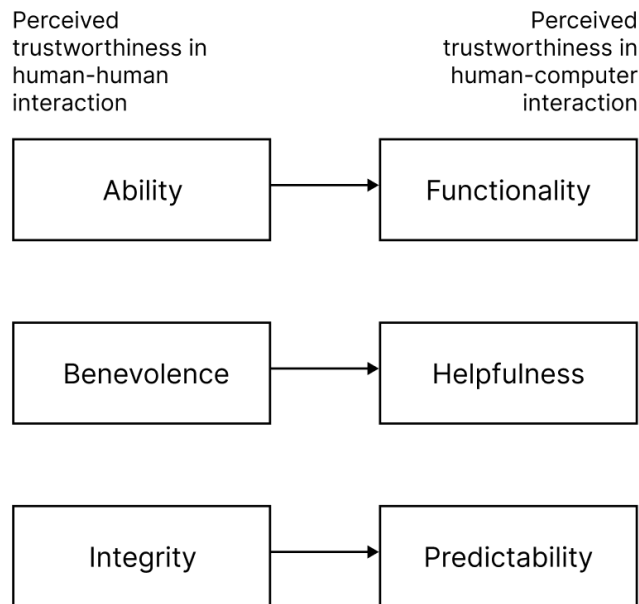


Figure 4.3: The trustee factors in human-human interaction can be compared to functionality, helpfulness and predictability in HCI.

and continuous usage leads to the users learning to use the system more efficiently, thus understanding it enough to believe it has the needed factors to form trust. This finding can then be compared to the looping nature of trust formation in human-human interaction. A person trusting another person takes risks and compares the results of those risks to their earlier assumptions of the trustee. This leads to either strengthening or weakening the trust between the individuals. Similarly, a user using a computer system takes risks in using and trusting the system. Based on their earlier assumptions of the system's functionality, helpfulness and predictability, they create an image of the system's perceived trustworthiness. This then gets compared to the end results of the interaction and once again strengthens or weakens the trust towards the system. This trust created through a feedback loop can be seen as knowledge-based trust, since it revolves around existing and newly created knowledge of the system's trustworthiness. Knowledge-based trust is thus developed through repeated interaction and experience.

Comparing knowledge-based trust on initial trust, knowledge-based trust is formed from experiences from system usage and based more on functionality and performance than on visual appeal. Initially though, users tend to confuse visual appeal with functionality [19], which is why UI design is studied in this thesis; to show if initial trust and furthermore knowledge-based trust can be affected with UI design.

4.3 Usability and Trust

Before getting into UI design affecting trust, we should find out how usability can affect trust formation in HCI. Usability is a largely studied area of UI research [20]. In UI research, usability refers to the degree a system can be used to fulfil a given task. Usability is a multifaceted construct consisting of five attributes: learnability, efficiency, memorability, errors (or their prevention) and satisfaction [21]. Usability is highly linked to user experience (UX). In *The impact of interface usability on trust in Web retailers*, Roy et al. [22] concluded that better system usability leads to higher trust in e-commerce. They used the aforementioned model of trust by Mayer et al. and linked the ease of navigating a website, considering human perception and user guidance as significant factors in creating strong perceived ability, the most strongly influenced trustee factor (by usability dimensions). In the case of perceived benevolence, also a strongly influenced factor, ease of navigation, ease of learning, consideration of perception and user guidance were all significant factors. Lastly, perceived integrity was found to not be as strongly influenced by usability factors as ability or benevolence. It was also stated that website consistency is the only factor that does not seem to affect perceived trustworthiness. These findings lead to the assumption that usability factors stated in the article (ease of navigation, ease of learning, perception and support) can be used in design to affect the perceived ability and benevolence of a retail website. However, one factor was linked to affecting all

three aspects of perceived trustworthiness and thus is the most important factor in creating trust in these systems, this factor being perception [22]. Perception can be linked with visual appeal and possibly even initial trust through well-established and trustworthy UI design.

Another study in usability tackles the subject of microinteractions, a subject also included in this thesis. Microinteractions are subtle single-purpose design elements that usually include animation to guide the user to interact in certain ways. Boyd and Bond [11] conducted A/B testing with two different user interfaces, one with microinteractions and one without. They concluded that the design with microinteractions could slightly enhance the usability of a user interface. Moreover, they found that microinteractions have the effect of increasing interestingness, likeability, and learnability, thus leading to better usability and user experiences. This increased usability may point to an increase in trust, according to the research conducted by Roy et al. [22]

4.4 Design Elements and Trust

In earlier sections, the topic of visual appeal and initial trust has come up. Visual appeal in UI design is seen as the aesthetic quality or attractiveness that makes a design pleasing to look at. Thus, visual appeal is one of the first factors a user takes into consideration when viewing a computer system's user interface, simply because visual appeal is what the user will first see. As mentioned earlier, visual appeal can also be confused with functionality [19] and possibly even usability. This idea is enforced by the psychological phenomenon known as *the halo effect*. In short, the halo effect refers to humans making snap-judgments in a certain domain based on information from a different domain. [23] In UI design, this can be seen as a user liking the visual appeal of a system and thus thinking it is also trustworthy, even though they have no other data about the system's trustworthiness. Therefore,

it is also worthwhile to study how visual appeal can affect the perceived initial trustworthiness of a computer system. According to a study conducted by Pengnate and Sarathy [24], the visual appeal of an e-commerce website strongly affects the customers' formation of trust towards the online seller. Furthermore, they conclude that visual appeal has a stronger impact on trust than the perceived ease of use of the system.

Pengnate and Sarathy do not, however, focus on specific design elements, such as buttons, colours or layout. In contrast, Nissen et al. [25] conducted a study about colours and shapes in websites using evolutionary psychology and neuroscience as a base. They conclude that in buttons and text boxes, rounded corners are seen as more approachable and trustworthy than sharp ones. Furthermore, the authors conclude that coloured websites increase the perceived trustworthiness compared to websites without colour and between the colours blue and red, blue is seen as more pleasurable and trustworthy, whereas red is seen as inducing distrust and aggression due. This is further supported by a study conducted by Alberts and van der Geest [26], where the authors found that blue is seen as the most trustworthy colour in multiple website domains and black is the least trustworthy. However, Alberts and van der Geest also conclude that while colour has a significant effect on website trustworthiness, the effect is not so significant that colour alone could affect the user's perceived trustworthiness. To create more trustworthy websites, one should consider other design elements as well. In Maryam Hina's Master's thesis *Emotional Design: Creating user interfaces that evoke emotions* [27], Hina discovers that users surveyed about mobile application interfaces enjoyed subtle animations in design. These enjoyable features invoked positive emotional responses in users, possibly leading to more trust. Thus, microinteractions, subtle animations and responsive features, can lead to more enjoyable interaction and more trustworthy design.

In many of the articles and studies cited in this thesis, the subject of aesthetics and aesthetically pleasing design is discussed. However, it is challenging to pinpoint what makes a design aesthetically pleasing and which elements of the design contribute to it being considered aesthetically pleasing by the user. This makes it even more challenging to create a framework for designers if they do not know what is meant by aesthetically pleasing user interface design. Luckily, this phenomenon has been studied from the perspective of psychology in design by Hekkert [28] in *Design Aesthetics: Principles of Pleasure in Design*. In his research, Hekkert outlines four general principles of aesthetic pleasure that apply across design domains. These four principles are:

- **Maximum effect for minimum means:** Designs that achieve high impact with minimal effort or complexity are seen as beautiful or pleasing. This principle explains why sources cited earlier sometimes consider minimalistic design as aesthetic.
- **Unity in variety:** Designs that are complex but allow the user to find underlying structures and relations through symmetry, grouping or closure (the brain automatically filling in empty space to create completion) are seen as pleasing and rewarding.
- **Most advanced, yet acceptable (MAYA):** Pleasing designs strike a balance between familiarity and originality according to this principle. New things attract the user's eye and familiarity retains the feeling of safety. Finding a balance between these two in a design makes it successful.
- **Optimal match:** Designs that include multisensory experiences should make sure the sensory messages are congruent and consistent with one another. Experiencing multisensory aspects that match feels rewarding and pleasing.

These principles provide key points to look at while trying to understand aesthetic pleasure in design. They show that aesthetically pleasing design is not completely subjective and in the eye of the beholder, but rather follows identifiable patterns based on psychology. These principles can therefore be turned to serve as a practical reference point for studying aesthetic pleasure in design and as stated before, an aesthetically pleasing design can increase the perceived trustworthiness of the system.

In Table 4.1, the design elements affecting trust formation are compiled together to help create a clear picture of what to include in the framework.

Table 4.1: Design elements and their effect on trust formation

Design Element	Attribute	Effect	Explanation
Buttons & Text Boxes	Rounded corners	Positive	Seen as more approachable than sharp corners
Use of colour		Positive	Colourful elements are seen as more pleasurable and trustworthy than no colour
Colours	Blue	Positive	Induces pleasure and calmness
Colours	Red	Negative	Induces distrust and displays aggression
Microinteractions	Subtle animation	Positive	Invoke positive emotional responses
Minimalism	Simplistic design	Positive	High impact with minimal effort is seen as pleasing
Unity	Symmetry, grouping, closure	Positive	Similarity and structure in complexity creates pleasure
MAYA	Familiarity + originality	Positive	Harmony between new and old design elements is seen as pleasing and trustworthy
Multisensory designs	Matching sensory experiences	Positive	Multisensory matches feel rewarding and trustworthy

Most elements in Table 4.1 are marked as positive, since most literature focused on finding positive aspects of user interfaces. However as can be seen, the colour red is marked as having negative effects on trust formation. This is later ignored in the framework to prevent designers from straying away from the colour red completely.

4.5 The Trustworthy UI Design Framework

Having studied trust and user interface design from multiple different domains and sources, it can be stated that UI design can affect the perceived trustworthiness of an information system. The usability, form, visual appeal and aesthetics of an information system can have an effect on the user's view of the system's trustworthiness. Different design elements can sway the user's opinion one way or another.

Based on the literature referenced earlier in the thesis, something aiming to enforce trust formation should communicate ability, benevolence and integrity. This translated to HCI means a system should communicate functionality, helpfulness and predictability. By designing a user interface adhering to these aspects of trust formation as well as including positive visual appeal, trust can be enforced in the system or software. The Trustworthy UI Design Framework (TUIDF) is divided into five core design principles promoting trustworthy design through functionality, helpfulness, predictability, aesthetics and trust reinforcement. These core principles are based on the literature review's findings, connecting functionality to ability, helpfulness to benevolence and predictability to integrity to help form trust towards the computer system. These three principles directly integrate to the models of trust discussed earlier in this thesis, forming the perceived trustworthiness of the trustee: the user interface of the computer system. Aesthetics as a core principle is based on the findings connecting concrete visual elements to perceived trustworthiness, and trust reinforcement as a core principle is grounded in trust theory connecting reinforcing actions to further helping build trust.

By following this framework, designers can make their own checklist to ensure they create and design trustworthy user interfaces that support both initial and knowledge-based trust. On top of just designing new user interfaces, designers can also use the framework to refine existing ones by following the principles presented

in the framework. The TUIDF as a whole is represented by Table 4.2 and can be found as a check-list in Appendix B.

Table 4.2: The TUIDF Guidelines per core design principles.

Principle	Guidelines	Reasoning
Functionality Interfaces should appear to work as intended and support the user when needed.	Use clear navigation and structure. Minimize cognitive load and keep designs simple. Support learnability with familiar patterns. Provide guidance and enforce usability.	This supports ability/functionality and initial trust formation.
Helpfulness Interfaces should signal that they work in the user's interest.	Reduce friction in tasks. Use supportive and encouraging microinteractions. Design for accessibility and confidence. Reduce navigation and clicks needed in tasks.	This supports benevolence/helpfulness and knowledge-based trust.
Predicability Interfaces should adhere to established conventions	Keep layouts and colour schemes consistent. Ensure transparent system responses. Avoid deceptive or unexpected behaviour. Enforce symmetry, grouping and closure.	This supports integrity/predictability and initial trust.
Visual Trust Signals Visual design should reinforce trust perceptions.	Show as much as possible with as little as possible. Favour rounded corners and shapes. Use colour intentionally (e.g. blue for calm and trust, red for errors). Balance familiarity and originality. Promote multisensory matching when present.	This supports initial trust.
Trust Reinforcement Interfaces should reinforce trust formation through feedback-loops.	Provide clear feedback on outcomes. Ensure reliable performance. Reinforce successful interactions (e.g. with microinteractions). Handle failures clearly and gracefully.	This supports knowledge-based trust and trust formation as a repeated action.

5 Framework Validation

In this chapter, an attempt at validating the Trustworthy UI Design Framework will take place by designing two prototypes of a user interface and testing them with users. One prototype will be a UI designed with traditional UI design principles and the other will be designed according to traditional UI design principles as well as the TUIDF. The designs will be created by Figma Make, Figma's artificial intelligence (AI) model. Using AI is increasingly popular in 2026. Thus testing if AI, prompted with the TUIDF can create more trustworthy UIs, gives valuable information for present and future UI and UX design. Another upside of using AI to validate the TUIDF is eliminating the danger of human bias. If I, the author, were to design two UIs with the goal of making one more trustworthy, I could accidentally make the control prototype worse through pure bias.

To best find out if and how much the TUIDF affects the perceived trustworthiness of user interfaces, a very trust-critical platform must be chosen. According to Chen et al. [29], the most trust-critical apps are mobile banking apps. For this reason, mobile banking was chosen as the target UI to be designed using the TUIDF.

5.1 Design Process

The design process covers the decisions and ideas that went into the development and design of the prototypes for the empirical user study. First, the framework will be made more AI-friendly to allow easier prompting. After that, the prompt for

the prototypes will be chosen and the AI will be prompted to start designing the prototypes.

5.1.1 Making the framework AI-friendly

Because the research behind the TUIDF is focused on human interaction and HCI, the TUIDF is also designed first and foremost for human usage. Because of this, some points of the framework are left up to interpretation to have a human hand in design. However, to allow the framework to be used by AI, it has to be tweaked slightly to have less interpretive sections. The fine-tuned framework for AI usage has more command-like key points instead of suggestions and interpretable lines. The framework for AI usage is as follows:

1. Functionality

- Make interfaces appear reliable and capable
- Use clear navigation and logical structure
- Minimize cognitive load and unnecessary complexity
- Use familiar interaction patterns
- Provide guidance and strong usability support
- Ensure users can quickly understand how to complete tasks

Goal: Support perceptions of competence, functionality, and initial trust.

2. Helpfulness

- Design interactions that feel supportive and user-centered
- Reduce friction, clicks, and unnecessary steps
- Use encouraging and reassuring microinteractions
- Prioritize accessibility and user confidence

- Make workflows efficient and effortless

Goal: Support perceptions of benevolence, helpfulness, and knowledge-based trust.

3. Predictability

- Follow established UI conventions and patterns
- Keep layouts, spacing, and colour usage consistent
- Make system responses transparent and understandable
- Avoid deceptive, surprising, or inconsistent behaviour
- Use symmetry, grouping, and visual closure principles

Goal: Support perceptions of integrity, predictability, and initial trust.

4. Visual Trust Signals

- Use minimal but informative visual design
- Prefer rounded corners and softer shapes where appropriate
- Use colour intentionally (e.g., blue for calm/trust, red for errors/warnings)
- Balance familiarity with originality
- Maintain visual coherence across all elements
- Support multisensory consistency when applicable

Goal: Reinforce immediate visual trust perceptions.

5. Trust Reinforcement

- Provide immediate and clear feedback for user actions
- Ensure reliable and stable performance

- Reinforce successful interactions with subtle feedback and microinteractions
- Handle errors and failures gracefully and transparently
- Create positive feedback loops through repeated successful interactions

Goal: Reinforce long-term trust formation and knowledge-based trust over time.

General Requirements

- Prioritize clarity over decoration
- Reduce uncertainty wherever possible
- Make interactions feel safe, stable, and understandable
- Maintain consistency across the entire experience
- Optimize for user confidence, comprehension, and perceived reliability
- Avoid dark patterns, ambiguity, and unnecessary friction

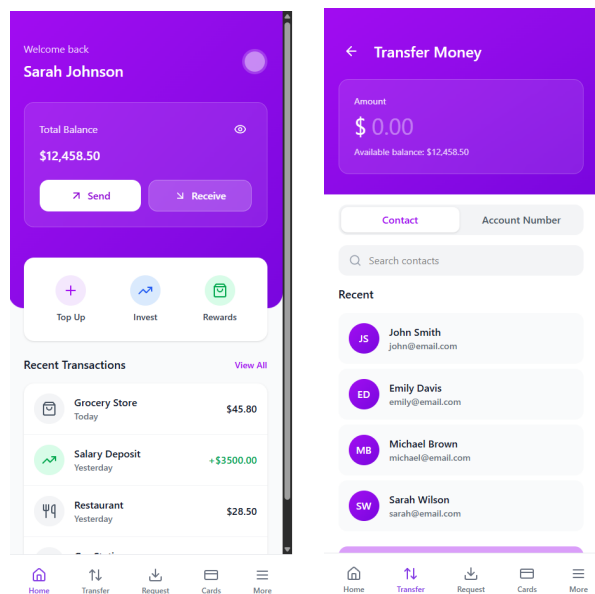
5.1.2 Designing the first prototype

The first prototype to be designed is the so-called *control prototype*. In other words, the first prototype will be a typical mobile banking user interface that is designed by the AI using traditional UI design principles and practices. The prompt given to Figma Make was:

Create a modern mobile banking application interface for a smartphone. The design should feel realistic, clean, and minimal, similar to a contemporary European digital banking app. The design should follow conventional and traditional UI design principles and practices. The interface

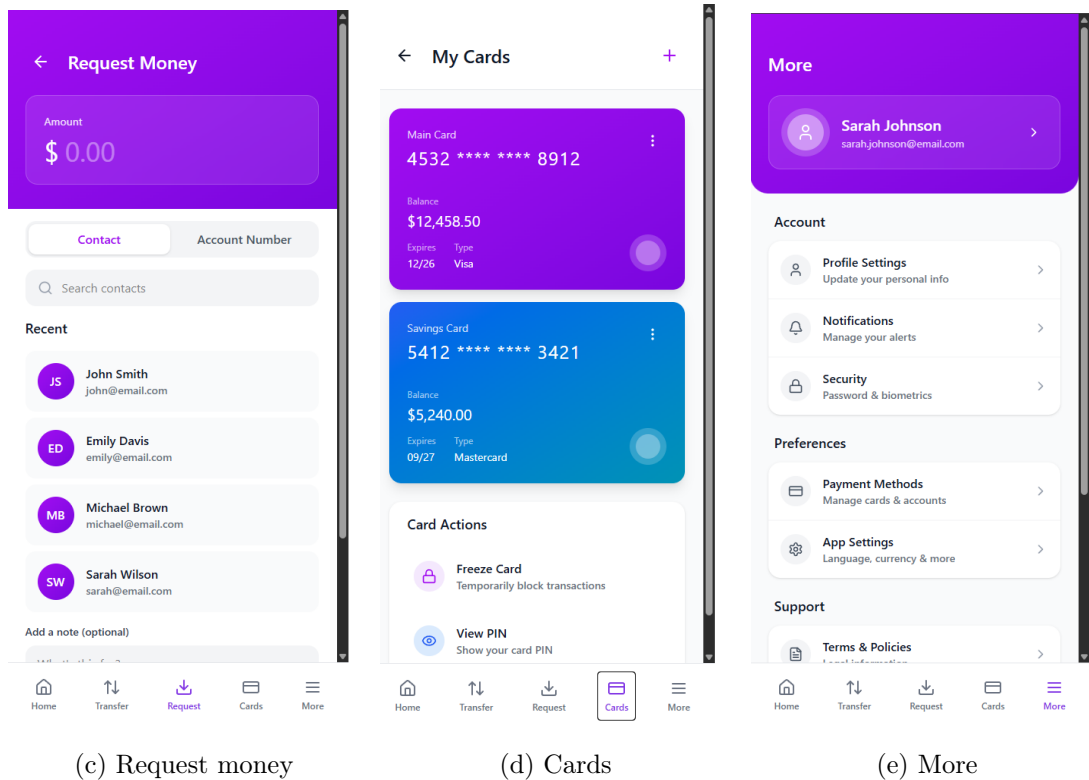
should include the following screens: 1. Home Dashboard. 2. Transfer Money Screen. 3. Request Money Screen. 4. Cards Screen. 5. More -screen. The screens should have navigation between them. The design should have as many interactive elements in the prototype as possible. Ask me clarifying questions if needed.

As expected with the allowance of questions, Figma Make started asking clarifying questions. First, it asked if the colour scheme should be light with a blue/teal accent colour, light with purple/violet accent colour or dark/premium theme with minimal colours. I chose to tell it to create a light theme with purple/violet accent colour since it recommended it as a modern/fresh design. The next questions was if the account balance should be visible or not and if a toggle-feature should be added. I decided to tell it to add a toggle feature but display it by default. After these questions, Figma Make started building the prototype. The prototype created can be seen in the following Figure 5.1.



(a) Home

(b) Transfer money



(c) Request money

(d) Cards

(e) More

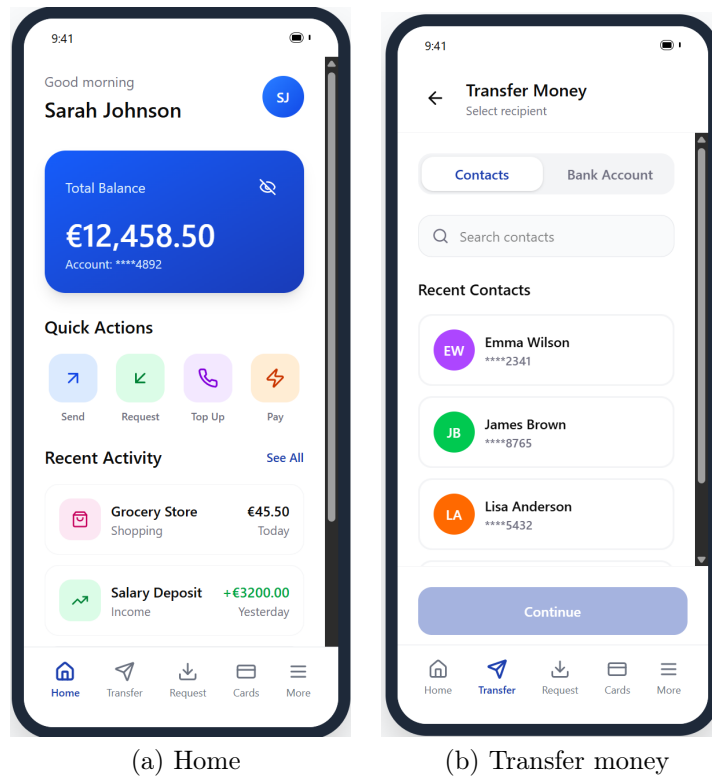
Figure 5.1: The control prototype screens. The screens can be changed through the bottom navigation bar and the buttons.

I now had my control prototype created with Figma Make to demonstrate a mobile banking user interface designed with traditional design principles. Next, the goal was to create a prototype that adhered to the TUIDF. The prompt given to Figma Make was exactly the same as the one given to it when creating the control prototype, with the TUIDF added as extra. Along with the *AI-friendly* framework, I added:

Following the rules is absolutely necessary and each section must be adhered to.

Once again, Figma Make asked me exactly the same question about the colour scheme, but I decided to choose blue this time as the TUIDF suggests blue is a more trustworthy colour. However, this time I was not asked about toggling the visibility of the account balance as in the first prototype. This feature had been

added to the second prototype by default, so it does not affect the end result. After the initial question, the prototype was built and can be seen in the following Figure 5.2.



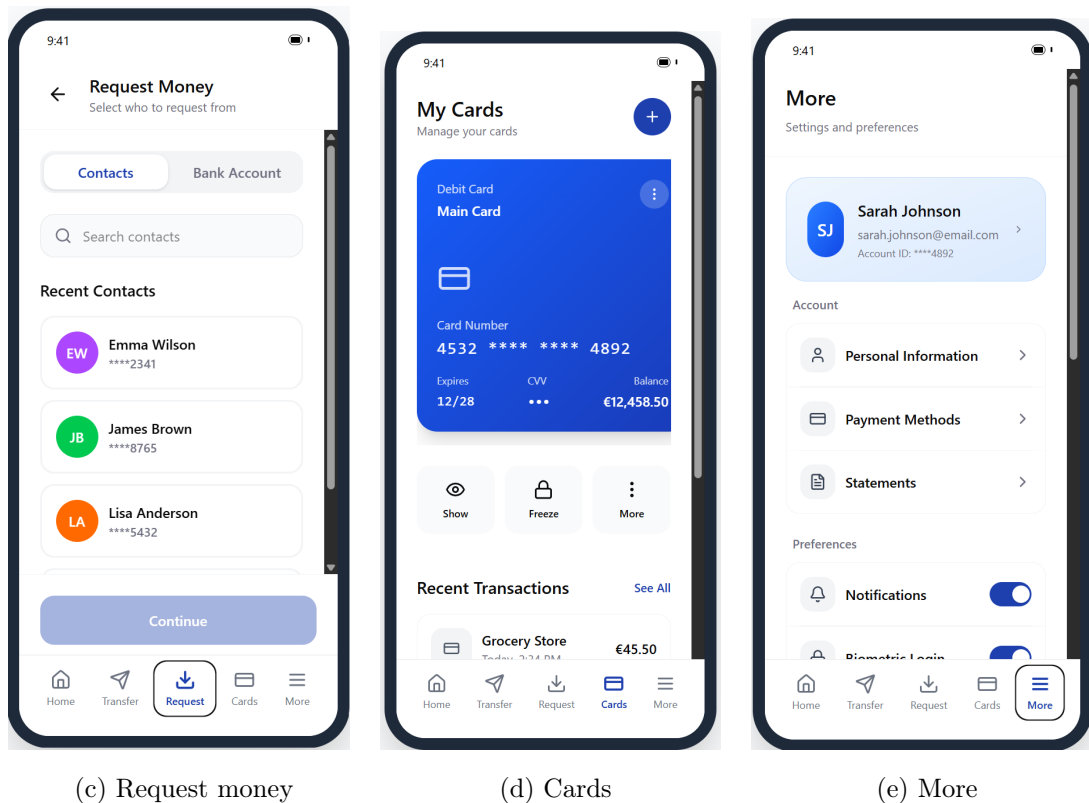


Figure 5.2: The TUIDF-based prototype screens.

Now that both prototypes were designed to a degree that was acceptable for user testing, they can be analysed and taken to testing.

5.2 Analysing the prototypes

Before validating the framework with users, I thought it would be useful to analyse the prototypes to see if adding the TUIDF to the prompt had any effects on the design. The colour scheme choice can be disregarded as it was not directly chosen by the AI during its design process. Other aspects that can be compared include clarity, simplicity, interactions/microinteractions, shapes and feedback loops.

Both designs seem clear, simple and organized. The second prototype's home page uses more elements that fill up the space, giving it a more packed look. It does use colours intentionally to separate features, though. Even though the designs have

a different colour scheme, the second prototype uses the scheme colour of blue much less than the first one uses purple. This is something we can not deduce as better or worse without user feedback later in the empirical study.

The interactions differ greatly. The first prototype only has interactions that lead from one page to another and some hover features as well. However, these hover features are limited to colour changing in buttons while hovered. The second prototype includes microinteractions in the form of transition animations. All transitions from page to page are animated. E.g. moving from the Home page to the Transfer page looks like the transfer page slides into view from the right. Some buttons also have hover features that enlarge the button slightly when hovered.

The prototypes do not have multiple feedback loops. They only include feedback in the form of actions happening from pressing buttons such as navigation and when transferring or requesting funds, a success screen is shown. The second prototype includes asking the user confirmation before giving them the success screen.

Finally, the shapes of the prototypes differ just slightly. Both prototypes do use rounded corners, but the second prototype uses them exclusively while the first prototype includes sharp some sharp corners as well.

Overall, the prototypes have slight differences and one might not instantly say that one is better than the other. Thus testing with end-users can show which prototype actually feels more trustworthy.

5.3 Empirical study design

To find out if the prototypes have any significant difference in perceived trustworthiness and furthermore if the TUIDF is a valid framework, a study with users must be conducted. For this purpose, the System Trustworthiness Scale was chosen as a validated scale to measure the perceived trustworthiness of a system. The STS divides perceived trustworthiness into three dimensions: performance, purpose and

process [15]. These dimensions can loosely be compared to the aspects of perceived trustworthiness in HCI: functionality, helpfulness and predictability. Thus, the STS is an effective scale for measuring the perceived trustworthiness of the prototype user interfaces.

As stated earlier in the literature review of this thesis, usability has a high impact on perceived trustworthiness. The TUIDF also highlights usability features to enforce trust formation. Therefore, another scale that can be used to test the prototypes and help validate the TUIDF is the System Usability Scale. The SUS focuses on the usability and ease of use of the prototypes, contributing to the overall perceived trustworthiness. With the STS and the SUS combined, a stronger result can be expected.

Based on the STS and SUS research as well as the prototypes, a questionnaire was developed. The questionnaire contained questions in six different domains: the STS performance, purpose and process, the SUS usability, visuals and additional general trustworthiness. Two open-ended questions were added to the end of the questionnaire for slight qualitative results. The full questionnaire can be found in Appendix C. A task-based prototype test was conducted where users were asked to complete tasks using the prototype user interfaces. One group was given the control prototype and then asked to fill in the questionnaire while the other group was given the framework prototype and asked to fill in the questionnaire. The groups consisted of five participants each. This gave a total of ten answers to the questionnaire. The user evaluation portion of the validation process was first intended to be given to a much larger audience, but due to time constraints, the smaller focus group had to be accepted. The tasks given to the users were as follows:

1. Transfer 100\$ to a user in your contacts.
2. Request 50\$ from a bank account number of your choosing.

3. Tell me your main card balance.
4. Locate logging out of the application.

The prototypes were shared as a link given to the user that took them straight to the Figma Make prototype page. This is a default feature of Figma. Here, the participants completed the tasks based on the given statements. They were not allowed any additional information to remove factors of outside help. After completing the tasks, the participants answered the questionnaire.

5.4 Empirical study results

From the questionnaire, the results of the empirical study could be calculated. The results were calculated simply by adding up each participant's scoring of each domain and taking the mean of the scores. These means were then added up with the other participants' means and a mean of the overall score was taken so that the mean score of the whole domain for the given prototype could be calculated. The scores of each domain in both prototypes can be seen in the following Table 5.1. In the questionnaire the control prototype was named Prototype A and the framework prototype was named Prototype B.

Measure	Prototype A	Prototype B
Performance	4.68	4.72
Purpose	4.10	4.45
Process	4.30	4.75
Usability	4.52	4.50
Visuals	3.60	4.10
Trust	3.70	3.80

Table 5.1: Prototype comparison by measure

As seen in the table, prototype B (the prototype designed with the TUIDF) scored higher on all measured domains except for usability. In performance trust-

worthiness, the difference is quite undetectable (0.04 difference in means). In other domains, however, the differences start to add up more. In purpose trustworthiness, the framework prototype scored 0.35 better than the control prototype. This hints at Prototype B showing more visibility in its design and the decisions behind it. In process trustworthiness, the difference in means was 0.45, indicating that Prototype B was cleared with its own process of working and system status. In visuals, Prototype B scored the best against Prototype A with a difference of 0.50 in means. According to the questionnaire questions, this indicates that the users enjoyed looking at Prototype B more and felt the layout was more clear. In general trust questions, Prototype B scored 0.10 points better, showing that users felt slightly more secure using the prototype compared to Prototype A.

The domain where Prototype A was stronger was usability. Prototype A scored 0.02 better than Prototype B so some users felt it was more usable and user-friendly than Prototype B but like in performance, the difference is quite trivial.

The open ended questions of the questionnaire give some perspective of the prototypes as a whole and show what specific aspects the participants focused on. When asked about the aspects of the interface increasing the users' trust towards the prototype, both prototypes were described as having visual clarity, simple design and professional look. Both prototypes also gained at least one positive mention of:

The details of accounts and cards are hidden by default.

However, while both prototypes had this feature, Prototype B got this mention four out of five times while it was mentioned about Prototype A only once. Other aspects increasing trust in Prototype A were:

Easy navigation, simplicity

and

It's simple but also very clear and easy to use

Aspects mentioned about Prototype B included:

Consistent professional design and clear intentional layout.

and

Transparency and visibility in transaction and activity information

When asked about the aspects of the user interface that decreased the trust Prototype A only got two answers: feeling clunky and the colour scheme feeling off. Other participants left this field empty. Related to this, it seemed like participants answering questions about Prototype A answered the open-ended questions in a much conciser way compared to participants answering the questionnaire about Prototype B. The aspects of Prototype B that decreased the trust of the participants included not having a logo or a name on the application itself, meaning that branding would have been a good addition. Users also felt they needed more information in some places and that the prototype felt too simple. One participant also said:

No check for the authenticity of the account number/name, just confirmation

The "top up" action in both prototypes was also unclear to users and was even described as feeling "scammy" (trying to scam the user in some way) as it was related to quick loans in their minds. All positive and negative aspects of the user interfaces were compiled to Tables 5.2 and 5.3 respectively.

Table 5.2: Interface aspects that increased perceived trust

Prototype	
A	Simple, clear, and easy to navigate
A	Visual clarity and overall ease of use
A	Clean and professional appearance
A	Card protection settings
B	Censoring of account numbers and masking of sensitive data by default
B	Transparent and visible transaction and activity information
B	Privacy and security options, including the ability to hide vulnerable information
B	Familiar and clean UI design
B	Consistent and professional design with a clear, intentional layout
B	No transfer fees displayed

Table 5.3: Interface aspects that decreased perceived trust

Prototype	
A	Interactions felt clunky
A	Colour scheme was considered unsuitable
B	Unclear purpose of the “Top Up” quick action, which felt untrustworthy
B	No bank logo or other app-specific identity markers
B	No visible indicator of a secure connection
B	Unfamiliar placeholder text in the money transfer field
B	Account balance visible by default
B	No validation of the recipient account number or name before confirming a transfer
B	Some areas felt overly simplified, with insufficient information displayed

5.5 Analysis

Before analysing the results of the prototype testing further it must be said that with a sample size as small as ten participants, a completely proven validation of the TUIDF cannot be concluded. This will be discussed further in the Conclusion chapter and Further research section of the thesis. It is also important to notice the fact mentioned earlier that for some reason participants testing Prototype A

answered more concisely than participants testing Prototype B. This might be a factor that could be eliminated with a larger sample size as well.

However, the results do show some visible improvements in perceived trustworthiness between the prototypes. Prototype B numerically outscored Prototype A in all dimension except for usability. This shows that the direction is consistent and further testing may very well lead to an even higher score difference. The fact that the Visuals -domain scored much higher (0.5 difference in mean) indicates that the design decisions made while following the TUIDF guidelines lead to a UI that felt more appealing and aesthetic as well as the layout feeling intentional. As stated earlier in the literature review visual aesthetics and a clean layout furthermore affect the perceived trustworthiness of a UI. According to the System Trustworthiness Scale, the Purpose and Process -domains scoring higher indicate that users felt that Prototype B was designed with the intention of helping and guiding the user while keeping system status visible and clear. This was furthermore explained by the qualitative data gathered in the questionnaire, showing users appreciated visibility and transparency in system actions from a trustworthiness point of view.

Nevertheless, while Prototype B was numerically stronger in perceived trustworthiness according to the STS, Prototype A had multiple aspects similar to B that users felt affected their trusting of the software. For example, both prototypes included the option of hiding vulnerable information, which users felt was important. It can be said that multiple users felt that a *privacy-by-default design* was crucial to their opinion of perceived trustworthiness. The problem with this is that it is not a feature strictly mentioned in the TUIDF guidelines and falls more on the domain of mobile banking. However, it can be thought of as a feature falling under the Helpfulness intent of the TUIDF and more precisely in the guideline *Design for accessibility and confidence*.

While Prototype A only slightly outscored B in usability, the open-ended questions lead to believe that A's usability was visibly higher than B's. The certainty of this, however once again could only be tested with a larger sample size.

Overall, the empirical study and user testing suggests that the TUIDF is at least in some ways a suitable framework for designing user interfaces with increased trustworthiness compared to traditional UI design principles. At this point, it can possibly be given to artificial intelligence agents to increase the perceived trustworthiness of an existing product by changing design decisions not thought of by a designer without the TUIDF. Further research can show more evidence on whether or not the TUIDF is also applicable for UI designers across all domains of UI design.

According to the empirical study, we can partly answer the thesis' research question RQ4.

RQ4: Can we detect a noticeable difference in perceived trust between traditionally designed software and software designed to support trust?

The answer to this research question is yes. With a small caveat. We were able to detect a small noticeable difference in perceived trust between the two designs, but it is not completely sure if this difference is tied to this focus group only.

6 Conclusion

This thesis aimed to find out connections between perceived trustworthiness and user interface design and microinteractions. Related studies and literature were examined to find out the most crucial elements of user interface design and trust theory to create a Trustworthy User Interface Design Framework (TUIDF). UI designers could then use the TUIDF as a frame of reference while designing software to ensure their designs were as trustworthy as possible. The TUIDF was validated through a small empirical user research. Two prototypes were created with the help of Figma Make (Figma’s artificial intelligence model) for the research, one using traditional design principles and one using the TUIDF guidelines. Two focus groups of five people each tested the prototypes and answered questions related to trust. The questionnaire used in the study was built and analysed with the System Trustworthiness Scale as well as the System Usability Scale. Results showed a slight increase in perceived trustworthiness in the prototype designed following the TUIDF guidelines.

6.1 Answering the research questions

In Section 1.2, four research questions were presented. This section answers them or points to the part of the thesis where the questions are answered.

RQ1: How do user interface design and microinteractions affect the formation of trust in the user towards the software?

As discussed in the literature review portion of the thesis in Chapter 4, UI design and microinteractions play a large part in the formation of perceived trustworthiness. The designer can ensure the user interface is e.g. reliable, usable, indicates system status and uses colours known to be connected with trust to portray trustworthiness to the user. A more detailed discussion is provided in Chapter 4

RQ2: For achieving trust, what are the most critical qualities in user interface design and microinteractions?

This research question was also discussed in the literature review in Chapter 4. From relevant literature, it was found that qualities such as functionality, helpfulness, predictability, visual trust signals (Rounded shapes, colours, balance of familiarity and originality), feedback and positive reinforcement were some of the most critical qualities in UI design.

RQ3: What kind of instructions about user interface design and microinteractions will best support a user interface designer in creating trust?

As discussed earlier, based on the literature review an academically sourced framework was created to support UI designers when trying to design software that enforces trust formation. The TUIDF contains guidelines that designers can easily check and follow while designing. The reasoning of each guideline adds further help for the designer when they need to focus on a distinct domain of perceived trustworthiness.

RQ4: Can we detect a noticeable difference in perceived trust between traditionally designed software and software designed to support trust?

By attempting to validate the TUIDF, this research question could be answered. A small noticeable difference can indeed be detected in the two prototypes designed

for the empirical user study in this thesis. Especially the perceived trust towards the system showing its status and being transparent increased with the prototype designed using the TUIDF. The visuals of the prototype also improved by using the TUIDF and according to the related research, this increases the perceived trustworthiness further. A more detailed discussion of results can be found in Chapter 5 Sections 5.4 and 5.5.

6.2 My own thoughts

I wanted to dedicate a small portion of this thesis to my own thoughts about the subject and what I learned during the writing and research process. Even though I researched this subject for a full study year and wrote this thesis for the whole of the Spring term, I still am quite interested in the subject. With so much of our daily lives being digitised, trust remains a significantly important detail sometimes ignored by software specialists. That is why I still think the study of trust and trustworthiness in user interfaces is extremely important to upkeep user retention and customer loyalty in all digital media.

During the writing process I noticed I procrastinated a lot and thus had to do some sprints with my whole research. I was very keen on graduating during the Spring/Summer term, that I had to rush some parts of this thesis to account for that. I slightly regret not writing my thesis in the Fall term, since that would have allowed me to have more time in the Spring and Summer to e.g. conduct a more thorough empirical study and gain more data to validate my framework further. This, however, will be another teaching of time management and commitment to my own work, which will further educate me during my time as a student. With this finished Master's thesis, I hope someone (perhaps even myself) will continue this sort of research to find out how trustworthiness can be reinforced with UI/UX design.

6.3 Further research

Because the sample size of the empirical study conducted in this thesis was so small, further research could and even should be conducted to further validate the TUIDF. With a larger sample size more data could be collected to indicate if the data collected in this thesis and the conclusions drawn from it were just this focus group's results. More testing will could also result in validating the TUIDF to see if it could be used as a universal standard framework for designing trustworthy user interfaces.

Another important point in further research would be to test the framework with user interfaces designed by professional *human* designers. The usage of artificial intelligence in this thesis was mainly due to time constraints and the fact that this thesis was written by a single person and thus bias in the design process was a very imminent threat. By giving the TUIDF to multiple professional designers and allowing them to create their version of trustworthy user interfaces could help in validating the framework as well as actually creating trustworthy UIs. A much larger study would have to be conducted with both designers using the TUIDF and their own design principles. These prototypes would then have to be tested with a massive amount of people to gain proper data that could help in the process. This is something I myself would love to do and work on, but will most likely not be doing since I will have graduated once this thesis is complete and will move on to other things.

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Appendix A Trust Formation

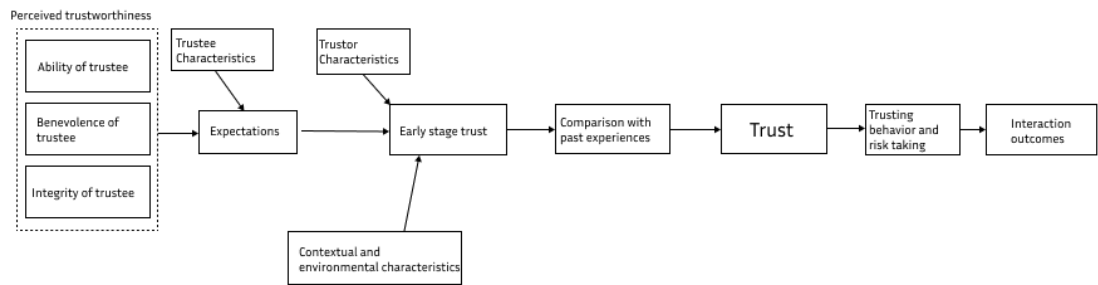


Figure A.1: Full process of trust formation

Appendix B The Trustworthy User Interface Design Framework

How to Use the Trustworthy User Interface Design Framework

This framework is intended as a practical design aid for UI/UX designers. The five principles represent aspects of trustworthy user interface design and should be considered throughout the design process. Each principle includes:

- **Design Principle:** The goal of the category.
- **Guidelines:** Practical recommendations that can be applied during interface design.
- **Trust Outcome:** The dimension of trust primarily supported by the guidelines, based on the theoretical research of this thesis.

The principles are not mutually exclusive and many design decisions contribute to multiple trust dimensions. Designers should thus use the framework by selecting and combining guidelines according to the context and goal of the system being designed.

The framework is intended to support the development of new interfaces as well as the refinement of existing ones by providing a structured way to assess trust-related design decisions.

1. Design for Functionality

Interfaces should appear to work as intended and support the user when needed

Guidelines:

- Use clear navigation and structure
- Minimize cognitive load and keep designs simple
- Support learnability with familiar patterns
- Provide guidance and enforce usability

This supports ability/functionality and initial trust formation

2. Design for Helpfulness

Interfaces should signal that they work in the user's interest

Guidelines:

- Reduce friction in tasks
- Use supportive and encouraging microinteractions
- Design for accessibility and confidence
- Reduce navigation and clicks needed in tasks

This supports benevolence/helpfulness and knowledge-based trust

3. Design for Predictability

Interfaces should adhere to established conventions

Guidelines:

- Keep layouts and colour schemes consistent
- Ensure transparent system responses
- Avoid deceptive or unexpected behaviour
- Enforce symmetry, grouping and closure

This supports integrity/predictability and initial trust

4. Design for Visual Trust Signals

Visual design should reinforce trust perceptions

Guidelines:

- Show as much as possible with as little as possible
- Favour rounded corners and shapes
- Use colour intentionally (e.g. blue for calm and trust, red for errors)
- Balance familiarity and originality
- Promote multisensory matching when present

This supports initial trust

5. Design for Trust Reinforcement

Interfaces should reinforce trust formation through feedback-loops

Guidelines:

- Provide clear feedback on outcomes
- Ensure reliable performance
- Reinforce successful interactions (e.g. with microinteractions)
- Handle failures clearly and gracefully

This supports knowledge-based trust and trust formation as a repeated action

Appendix C Questionnaire

Instructions

Please complete the following questionnaire based on your experience using the mobile banking application prototype.

For each statement, indicate the extent to which you agree or disagree.

- 1 Strongly Disagree
- 2 Disagree
- 3 Neutral
- 4 Agree
- 5 Strongly Agree

Performance

1. The mobile banking application performs tasks accurately.
2. The mobile banking application is reliable.
3. The mobile banking application is incompetent.
4. The mobile banking application performs its job well.
5. The mobile banking application's navigation is clear to me.

Purpose

6. The mobile banking application is designed specifically to support banking tasks.
7. The mobile banking application executes its designers' intentions.
8. The mobile banking application is designed to assist users in this context.
9. The mobile banking application is designed to be efficient.

Process

10. I understand how the mobile banking application is supposed to work.
11. The mobile banking application communicates its actions clearly.
12. It is clear how the application completes its tasks.
13. The mobile banking application works as I expect it to.

Usability

14. I think that I would like to use this system frequently.
15. I found the system unnecessarily complex.
16. I thought the system was easy to use.
17. I think that I would need the support of a technical person to be able to use this system.
18. I found the various functions in this system were well integrated.
19. I thought there was too much inconsistency in this system.
20. I would imagine that most people would learn to use this system very quickly.

21. I found the system very cumbersome to use.
22. I felt very confident using the system.
23. I needed to learn a lot of things before I could get going with this system.

Visuals

24. I enjoy the use of colours in the application.
25. The layout of the application is clear to me.
26. The application's visuals follow standards I am used to.
27. I feel at ease looking at the application.

Trust

28. I would trust this application to manage my finances.
29. I would feel comfortable conducting important financial transactions using this application.
30. I would choose this application over competing mobile banking applications.
31. I do not trust this application.

Open ended questions

Which aspects of the interface **increased** your trust in the application?

Which aspects of the interface **decreased** your trust in the application?