Is it Better With Onboarding? Improving First-Time Cryptocurrency App Experiences

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ABSTRACT

Engaging first-time users of mobile apps is challenging. Onboarding task flows are designed to minimize the drop out of users. To this point, there is little scientific insight into how to design these task flows. We explore this question with a specific focus on financial applications, which pose a particularly high hurdle and require significant trust. We address this question by combining two approaches. We first conducted semi-structured interviews (n=16) exploring users' meaning-making when engaging with new mobile applications in general. We then prototyped and evaluated onboarding task flows (n=16) for two mobile cryptocurrency apps using the minimalist instruction framework. Our results suggest that well-designed onboarding processes can improve the perceived usability of first-time users for feature-rich mobile apps. We discuss how the expectations users voiced during the interview study can be met by applying instructional design principles and reason that the minimalist instruction framework for mobile onboarding insights presents itself as a useful design method for practitioners to develop onboarding processes and also to identify when not to.

CCS CONCEPTS

• **Human-centered computing** → *Empirical studies in HCI*; • **Security and privacy** → *Usability in security and privacy*; • **Applied computing** → **Digital cash**.

KEYWORDS

mobile onboarding, minimalist instruction, cryptocurrency, blockchain

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1 INTRODUCTION

A user's initial interaction with a mobile app is critical to reaching subsequent adoption [47]. Industry reports indicate that as much as 25% of apps are abandoned after only the first use [48]. So it is not surprising that mobile app designers regularly resort to onboarding task flows to help their users discover application functionality and show them how they could benefit from it [47].

While popular among UX practitioners, the overall usefulness of mobile app onboarding appears to be a disputed topic in the research community [30]. Some scholars view them as an opportunity to educate users [25, 47], Others argue that mobile apps should be intuitive by themselves [36]. For practitioners, there is an obvious trade-off to consider: Does onboarding help new users get started and increase engagement, or does it actually stand in the way of it? The scientific literature on the topic is sparse [47]. However, recent work by Strahm et al. proposing a systematic design method for developing mobile app onboarding [47] offers an opportunity to address this question. When does mobile onboarding provide value for new users?

Financial applications are especially interesting to look at in this context, as users may perceive them as critical and hold additional expectations regarding trust and security. With cryptocurrency apps being particularly challenging, we selected them to evaluate the impact onboarding processes can have. According to literature, cryptocurrency applications are difficult to use (e.g., [4, 16, 20, 22, 35]), especially for new users [2, 32, 40] who do not exhibit an above-average technology affinity [23], and users often hold misconceptions about how they work [39].

To investigate user expectations and properties of efficient onboarding, we combined two studies. We conducted semi-structured interviews (n=16) exploring users' experiences, behaviors, and opinions engaging with new mobile applications. The results of the study informed the planning and execution of the subsequent user study. While most users indicated skipping the onboarding processes in general, some expressed appreciation in specific situations – in new types of apps and when engaging with feature-rich apps. We then created and evaluated onboarding processes with 16 additional participants for two cryptocurrency apps using the minimalist instruction framework [47]. Based on our interviews, we selected two apps that differed in the richness of their features.

Our results indicate that onboarding processes can improve the perceived usability of feature-rich apps for first-time users while holding less value for apps with fewer features. While onboarding can support the initial learning process for first-time users of

feature-rich apps, we reason that it does not substitute usable app design in the long term. Minimalist instruction principles align with users' expectations of good onboarding in mobile applications and provide a solid theoretical basis for designers. Presenting the first study deploying Strahm et al.'s method to generate design insights, we discuss its usefulness and how it can be used by practitioners not only to design onboarding processes but also to decide when an onboarding process is not appropriate.

Contribution Statement. The contributions of this work are threefold: (1) We report and characterize users' opinions and behaviors related to onboarding processes and discuss these parallel to minimalist instruction theory. (2) We developed and evaluated onboarding processes for two cryptocurrency apps and discuss under which conditions they are helpful. (3) We present the first evaluation of the minimalist instruction framework for mobile onboarding insights in a different domain, showing it to be a valuable design method. We conclude by discussing how our findings on financial apps generalize for other use cases.

2 BACKGROUND

Framing our research, we first draw on the literature on mobile application onboarding and then introduce the state of cryptocurrency wallets.

2.1 Onboarding For Mobile Applications

The term *"onboarding"* has its roots in human resources, where it refers to the process of efficiently integrating a new hire into an organization [19]. The purpose of onboarding in the context of mobile applications can be understood analogously. Strahm et al. define the onboarding process as *"a key aspect of the user experience that allows users to discover application functionality in a timely manner and identify how this functionality might allow them to achieve their personal goals"*. In practice, this can take different forms. For example, instructional texts and media, just-in-time hints, or interactive tutorials are common [47].

Onboarding new users to mobile apps has been of great interest among practitioners [47]. It is not surprising to see why: 25% of apps are opened just once [48] and mobile apps lose 77% of daily active users within the first three days [10]. While learnability has been a longstanding topic in the HCI community, the value of onboarding seems to be disputed among scholars [30]. Joyce et al. theorize that the historical ineffectiveness of printed documentation and online help may have caused this sentiment. While their results do not support this theory, their survey shows a wide range of perceived usefulness among 60 HCI experts [30]. Unfortunately, no qualitative insight underpins these assessments.

Overall the scientific literature on mobile application onboarding is sparse. Some scholars applied onboarding to specific application domains such as a photo editing extension [18], a citizen science platform [9], gaming [44] and education [38].

The first systematic investigation into the topic was presented by Strahm et al. at DIS' 2018: They characterized nascent practitioner guidance, discussed it in the context of the minimalist instruction theory, and proposed a context-free design method for creating onboarding processes for mobile applications [47]. While most practitioner resources are comprised of rather general recommendations, they highlight a few exceptions providing more substantial guidelines [26, 28] and relate them to Van der Meij's and Caroll's minimalist instruction principles and heuristics [49].

Based on the surveyed practitioner literature, they emphasize focusing on the user journey during the design process and identifying the *aha! moment* and a *quick win* [28] as two critical steps during onboarding. The *aha! moment* refers to the moment in which users first realize how the application can benefit them personally. To guide users towards that moment, it is recommended to explain the application's purpose and provide an emotional reason to be interested. The *quick win* refers to a meaningful yet easily attainable benefit that new users can achieve in their first session, thereby providing closure and a positive conclusion [47]. Allowing users to make tangible progress early engages them in a learning process and provides confidence and control [47, 49].

The core contribution of their paper is the development and evaluation of a research-informed design method for generating insights for mobile onboarding. The method is grounded in the theory of minimalist instruction [49] and engages users in an interactive set of design and evaluation activities. Mediated interaction with a prototype is combined with structured mini-interviews to extract design insights by leveraging users' meaning-making process. The results of their evaluation using a low-fidelity educational application indicate that the method supports the elicitation of design insights to create onboarding processes. While they strongly argue for the value the method provides, they acknowledge the need for future work, specifically regarding evaluations in different domains and contexts [47].

Overall, scientific literature on mobile app onboarding is sparse. Yet, Strahm et al.'s recent work provides an opportunity to look at onboarding experiences systematically. Our interview study addresses the lack of qualitative insight into how users perceive onboarding processes in mobile apps. Our user study builds on Strahm et al.'s proposed design method to develop and evaluate onboarding processes, and we discuss how the method could be extended. Doing so, we are the first to apply and report on the method.

2.2 Cryptocurrency and HCI

More than a decade ago, Bitcoin [41] was introduced as the first cryptocurrency. Since then, more than 8,000 alternative cryptocurrencies have come forward [11]. Often overshadowed by rising valuations, the cryptocurrency space has also been steadily growing in terms of social media traction, developer engagement, and startup activity [14]. Recent investments by traditional institutional investors into Bitcoin further indicate a growing acceptance of cryptocurrencies in the public eye [31]. With PayPal aiming to enable its 361 million users [12] and 26 million merchants to buy, sell, and hold cryptocurrencies in 2021 [24], the adoption will likely increase.

These developments indicate progress in the ongoing adoption. However, work remains to be done. Cryptocurrency applications are still difficult to use (e.g., [4, 16, 20, 22, 29, 35]), especially for new users [2, 32, 40] who do not exhibit an above-average technology affinity [23]. Cryptocurrencies are difficult to understand, and both

users and non-users often have misconceptions [39]. Key management poses a major usability challenge, [16] and self-induced errors are a common source of loss [35]. Custodial wallets seem to offer an alternative for users with less technical knowledge by taking care of key management aspects for the user but require users' trust in the custodial service [20]. Even though they re-introduce a new intermediary, custodial wallets appear to be widely used, either as a gateway service or a permanent alternative to self-managed wallets [6]. However, key management does not appear to be the only issue cryptocurrency apps suffer from. Recent research has shown that "blockchain apps" are overall rated worse than comparable finance applications [27] and in a qualitative investigation we find that custodial wallets are difficult to use for first-time cryptocurrency users [21]. Glomann et al. identified one potential reason for this in the "*Onboarding Challenge*" – the initial challenge of gathering the basic knowledge of using a service or product [23].

While the HCI community has started to recognize its crucial role in improving the design of blockchain applications [15] and several publications brought forward the first recommendations related to cryptocurrency applications [2, 20, 23], we lack studies that prototype and evaluate solutions. For a technology believed to *"democratize"* financial services [45] and discussed for its potential to foster financial inclusion [42] for 1.7 billion unbanked people [13] worldwide, the initial entry barrier is problematic. It potentially marginalizes people without deep technical understanding from participating in the crypto economy (e.g., decentralized lending markets) and could contribute to a new form of second- and third-level digital divide [46]. For cryptocurrencies to truly become the currency of the internet – the currency of "nowhere and everywhere" – it is necessary to break down entry barriers so everyone can participate.

Motivated by the potential impact, the open issues, and scholars calling for more participatory design in the space [15], we think cryptocurrency apps are a fitting subject for our study.

3 METHOD

We conducted two studies: First, an interview study with 16 participants to better understand users' behavior and opinions regarding onboarding in mobile applications. Second, we conducted a user study with additional 16 participants to design and evaluate an onboarding experience for two selected cryptocurrency wallets following the minimalist instruction framework proposed by Strahm et al. [47]. The goal of the interview study was to understand users' behavior and expectations regarding onboarding experiences in mobile apps. The understanding developed during the interview study informed the design of the subsequent user study, specifically the focus on a domain novel to participants and the comparison between a simple and complex app. Both studies were held in English and conducted remotely via Zoom[1]. The interview study was fully transcribed for analysis.

3.1 Participants

For the interview study, we recruited 16 people in Germany and Austria. Participants qualified if they owned and used a smartphone. For the user study, we recruited 16 additional participants. Participants from the first study were excluded from the second one. Since Strahm et al.'s framework is designed to elicit design insights for onboarding, we made sure that participants of the second study had not used any of the two apps before and represented a fitting target group. For both studies, we aimed to recruit participants from different age groups.

Table 1: The participants' demographics for both studies (n_1=16 and n_2=16). Both samples show relatively young and well educated participants.

Demographic	Interview Study	User Study
Gender		
Male	10 (63%)	9 (56%)
Female	6 (38%)	7 (44%)
Age		
∅	35.5	28.1
20 – 29	4 (25%)	12 (75%)
30 – 39	8 (50%)	2 (13%)
40 – 49	1 (6%)	2 (13%)
50 – 59	3 (19%)	0 (0%)
Highest Completed Education		
High School	4 (25%)	3 (19%)
Bachelor Degree	0 (0%)	8 (50%)
Master Degree	10 (63%)	5 (31%)
PHD or Higher	2 (13%)	0 (0%)
Own Cryptocurrencies		
Yes	2 (13%)	3 (19%)
No	14 (88%)	13 (81%)
ATI Scale		
∅	3.95	4.46
1 – 1.99	0 (0%)	0 (0%)
2 – 2.99	3 (19%)	1 (6%)
3 – 3.99	4 (25%)	3 (19%)
4 – 4.99	7 (44%)	5 (31%)
5 – 6.00	2 (13%)	7 (44%)

Table 1 shows the demographics of the sample. Our sample skews towards male participants with an average age of 35.5 years in the interview study and 28.1 years in the user study. In comparison, previous quantitative work found the sample of cryptocurrency users to be predominantly male (85%), with an average age of 28.56 [35]. The Affinity for Technology Interaction (ATI) score describes a person's tendency to engage in or avoid technology interaction (6=high affinity, 1=low affinity) [3, 17]. Our sample – interview study (min: 2.33, max: 5.11, mean: 3.95), user study (min: 2.00, max: 5.56, mean: 4.46) – ranks slightly above average compared to the general German population (mean: 3.61) [50]. Looking at the highest completed education, we recognize that our sample of the interview study, with 63% of participants having completed a Master's degree, is not representative of the wider population. We did not notice any differences concerning formal education during the study and think that our findings hold despite this limitation. Future work may address this with a similar experiment covering a wider range of the population.

[1] https://zoom.us/

3.2 Apparatus

The interview study first explored how users typically engage with new mobile applications. During these semi-structured interviews, we focused on the following topics and probed deeper when interesting points emerged. The full questions catalog can be found in the supplementary material.

- Initial behavior when interacting with mobile applications
- Problem-solving in mobile applications
- Experience with onboarding in mobile applications
- Experience and expectations regarding mobile apps dealing with finances

In the user study, we engaged participants in an iterative set of design and evaluation activities to generate design insights, which were then used to develop onboarding processes for two selected cryptocurrency wallets. We selected two existing mobile cryptocurrency wallets – TenX[2] and Klever[3] – to base our prototypes on. We chose TenX because of its focused feature set and Klever because of its rich feature set. Figure 2 illustrates the difference between the two apps. Data collection for the user study was centered around participants' interaction with detailed recreations of the apps as interactive, high-fidelity prototypes. This approach allowed us to later integrate the developed onboarding processes.

3.3 Procedure

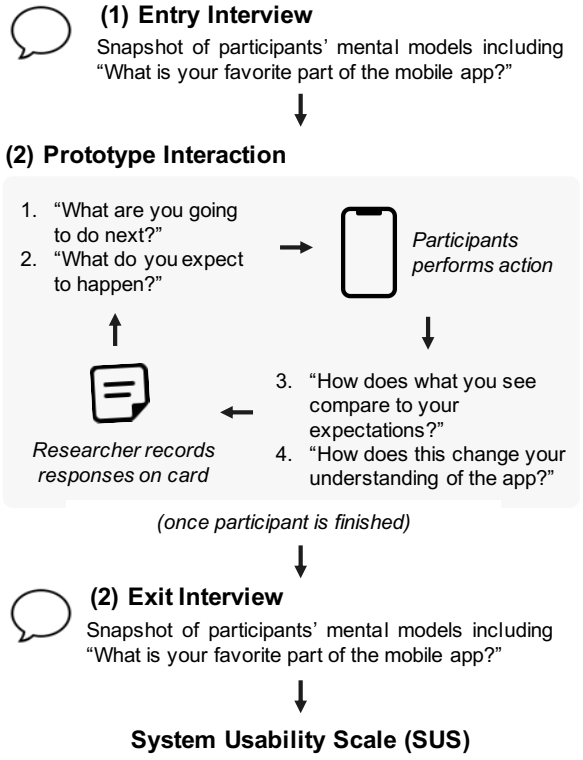
For the user study, we applied the minimalist instruction framework proposed by Strahm et al [47]. The method's purpose is to generate design insights by engaging with participants' meaning-making process during prototype interaction. We followed the recommendation to involve 4 participants per session [47]. For both apps, we conducted (1) an initial session without any onboarding, (2) analyzed the collected data to develop the onboarding, and (3) conducted a second session with 4 new participants to evaluate the efficacy of the mobile app with the onboarding experience. Both the initial and evaluation session followed the same protocol (cf. Figure 1). A short entry and exit interview captured the expectations and opinions of participants. In the entry interview, participants were asked for their expectations and which tasks they would like to accomplish with the app. In the exit interview, they were asked for their favorite part of the app and explained the app to their former self before the start of the user study. The researcher moderated the interaction with the prototype: Participants were asked two questions addressing their next action and expectations, performed the action, and were asked two questions probing for their reaction to the app's behavior. After each step, the researcher noted participants' responses on a card. After the exit interview, participants filled out the System Usability Scale (SUS) [5]. While originally described as a "quick-and-dirty" scale to evaluate the usability of a system, the SUS has been widely used and proven to be a reliable tool to measure perceived usability [37].

3.4 Data Analysis

We coded salient statements based on the transcribed interviews and used affinity diagramming to cluster salient topics from the user interviews [43]. Data analysis of the interview study was completed before and informed the subsequent user study. The analysis of the artifacts collected during the user study was conducted iteratively after each session and only considered data from the respective session. The data set consisted of the collected responses recorded on the cards and salient observations from the video recordings. The goal of the analysis was to review the app exploration and extract common patterns in participants' meaning-making processes. Following the method by Strahm et al., we focused on identifying moments of realization (*aha! moments*) and moments of closure (*quick wins*) [47] common among participants.

[2]https://tenx.tech/
[3]https://klever.io/

Figure 1: Process for conducting the sessions with participants: After a short entry interview, the participant interacts with the prototype following a strict routine: First, expressing their expectations; second, interacting with the prototype; third, reflecting on the app's behavior. Answers are recorded by the researchers on cards. Once the participant is finished, they reflected on their experience in a short exit interview. Filling out the system usability scale (SUS) concludes the process. *(adapted from Figure 3, Strahm et al. [47])*



4 INTERVIEW STUDY

The purpose of the interview study was to understand the experiences and opinions of users regarding mobile app onboarding, as we could not find any study on the topic in the literature. Through the interview process and subsequent analysis, topics emerged characterizing users' interaction with new apps, their experience, and expectations regarding mobile app onboarding.

4.1 Interaction With New Apps

During our interview, we explored users' behavior when engaging with new mobile applications.

New App Discovery: Participants in our sample report to install new apps between "*once a year*" (P3) and "*every second week*" (P4). These numbers are in line with industry reports [33]. While some report discovering new apps through advertisements, newspapers, or magazines, finding new apps is an intentional, need-driven process for most participants. P10 explains, "*I am not the guy who is in the app store and is looking for some new apps because he is bored or something. But I only install apps when there is a need*". P12 uses the app store to identify suited apps quickly, "*I have a special use case [...] and I would then just enter into the search bar in the app store and see if there's any reasonable search results*", while P2 reads recommendations upfront to understand the apps they download fully, "*I think I carefully choose which apps I download on my phone. [...] I try to read recommendations and other statements about the app before*". Sometimes apps are known by users through their social or work context. P10 mentions Zoom as an example from work, "*When I installed Zoom, I did know that I can do some calls*". Word-of-mouth recommendations of friends and family seem to be an additional important source for some users. P5 recalls, "*I think usually it is another person telling me about an app. And so, yes, I'm getting informed by talking to someone else*".

Install Decision: Users deploy different strategies to decide whether to install an app. While some perform a background check before installing apps, others are quick to install new apps, try them, and abandon them if unsuited. P3 explains, "*I want to know, who is working behind this app? How do they use the information?*", whereas P11 states, "*If I find something interesting, I would rather install it*".

Participants report to include app store ratings and comments, data privacy, and permissions, the price, as well as reports found on the internet and recommendations of friends and family into their decision process. P6 elaborates, "*I would ask friends if they use it [...] or I check the reviews if people use it and if they're happy with it. Yeah, that's pretty much it*".

Initial Behavior: Participants in our sample reported surprisingly consistent behavior when first engaging with newly installed mobile apps. Users engage in an unstructured exploration, navigating through all screens and trying out features. The fact that all participants reported the same approach was an unexpected finding, as we assumed that users would deploy different strategies. P9 explains, "*I'm curious [...] I want to try everything what I can do with the new app*". They expect to be able to use the app without any further explanation. P4 clarifies, "*For me a smartphone app should be self-explaining. There should be no manual needed for proper usage of this app*". This initial exploration phase is decisive for users' decision to engage with the app. P7 explains, "*I try basically out everything that it's got just to see what I can do with the app. And then yeah, I just think if I should use it or not*". If the purpose behind an app and the benefit for the user is not clear, users are quick to look for alternatives, abandon or uninstall the app. While P8 reflects, "*The thing is, not every app can keep me using it for a longer time...*", P16 takes a more active approach, "*There's not a lot of mercy involved. If it's not solving my problem, it's gone*".

Problem Handling: When facing problems while interacting with new apps, users deploy different strategies. For non-essential tasks uninstalling the app is common, indicating a low tolerance for errors, if users have alternatives to using a specific app. P11 illustrates, "*If I really get stuck, and it's not something that I have to do, I uninstall the app*". Participants reported several further strategies dealing with problems. We elicited five strategies from the interviews: Trial and Error, Ask Friends and Family, Search Engines, FAQs, and to Contact Support.

- Trial and Error: The initial reaction of most users when getting stuck is to try to resolve the issue themselves by trial and error. Participants report searching for alternative ways, restarting the process, restarting the app, or waiting for some time before trying again. P11 explains, "*Just leave it and go back, come back to it after like 30 minutes and try again. It's trial and error all the time [...] I've learned that sometimes you have to give technology some time to adapt*".
- Ask Friends and Family: When unable to resolve the problem on their own, users resort to help from their social environment. P12 says, "*If I already got stuck, my wisdom is exhausted, then I would just call somebody who should be knowledgeable*". P5 often asks her sons for help, "*I asked one of my sons, for instance, because they are more used to using apps*".
- Search Engines: Another strategy mentioned by the several participants is to verbalize the issue and use a search engine to find solutions. P4 explains, "*I usually google. Most of the time you find answers in internet forums. And most of the time, another person had already a similar problem. And then you find the solution on the internet, usually*". P11 specifies what they would search for, "*(I would search for) the name of the app and then try to sort of summarize the problem*".
- FAQ: Looking for FAQ sections on the developer's website directly was mentioned by participants with both positive and negative perceptions. While P11 says they would go to the FAQ section first, "*I'd go to FAQs first*", P1 tries to avoid them, "*Often there is a Q&A section, but I don't want to go to the Q&A section and search for my problem*".
- Contact Support: As a last resort, some users contact the support to help resolve the issue. Experiences and opinions when contacting support were split in our sample. P7 recalls, "*I hate calling a support line. And I'm just waiting 15 minutes listening to their stupid music. For me that is a point where I say "Okay, I'll never use this app again"*". In comparison, P14 prefers calls, "*I would rather like to call somebody. I don't like like typing the error, the problem, what I have into a smartphone, where the screen is so tiny*".

Users may deploy combinations of these strategies to overcome a problem. P3 illustrates their approach, "*First, I try to find it on my own [...] checking it with Google, trying to find it out myself. And the last thing is to ask my son*". We find it noteworthy that participants' answers in our sample consistently indicate that users do not expect to find help within a mobile app. P10 recalls, "*I didn't even think about a help section in the app, to be honest. I've never looked up anything in a help section, in any app*".

4.2 Onboarding Experiences and Opinions

We explored past experiences, user behavior, and opinions.

Experiences and Behavior: Most participants could recall one or several situations where they were confronted with onboarding. While some participants were quick to dismiss onboarding processes and report they would just skip through them, others noted they would carefully read them. P13 on the one side of the spectrum says, "*The truth is that when something like this happens, I always close it as fast as possible*". P5 recounts more moderate behavior, "*It also depends on how complicated the whole thing is. I mean, if it's not difficult, I'm just swiping through it and I don't want to waste too much time on those kinds of introduction. I'd like to just discover it myself, on my own*". In contrast, P3 sees onboarding processes as complementary to the subsequent exploration of the app, "*I read it, try to understand it, and then do it myself*", and P9 associates a positive feeling with them, "*It makes me feel more comfortable with the whole "How does it look like?". So I see it and I know what I can do with this app in a very quick way*". Some participants reported specific situations. Experiences with onboarding were perceived positively when users were interacting with feature-rich apps in new domains. For example, P4 explained in great detail how the onboarding of an advanced photography app helped them, "*I was not familiar with more complicated photography apps, where you can change lenses and focus settings, and so on. So it was quite helpful. So because it was a really new field for me*". P4 contrasted this with messenger apps, for which they thought onboarding to be unnecessary, "*If it is just like another messenger app – so I'm quite familiar with those things. So I just click further, further, further*". Statements by other participants underline this perception: newspaper apps, cooking apps, translation apps were mentioned as examples of familiar or simplistic apps, which did not need onboarding.

Expectations and Opinions: To elicit expectations for useful onboarding processes, we asked participants for positive and negative experiences and probed deeper into why they perceived the situations as such. For example, P4 describes their idea of annoying onboarding as follows, "*To make it really annoying, put a lot of information on it. So that I really have to scroll up and down until I find this "skip" and "further" button and do this 5, 6, 7 times. [...] And if it's really useless information. So if we start with the welcome screen telling me that this is now a messenger app and I can use it for chat. Yeah, of course I can use it for chatting*". Users expect onboarding processes to be short, skippable, focused, integrated, and lightweight.

- Short: Onboarding processes should not take up much time. Answers on the maximum acceptable time ranged from 1 minute to 10 minutes, with most answers between 1 and 3 minutes. P4, for example, says, "*Five short pages, so time-wise it shouldn't be more than 2 minutes or maybe 3 minutes*".
- Skippable: If users are not interested, they should be provided with an option to skip onboarding. P13 illustrates this point, "*I prefer when there is a little cross right away, but sometimes you have to swipe through them and there's like four or five screens. But as soon as it's longer, or more, I'm just like, Oh, my God, what do you want from me?*".
- Focused: Onboarding processes should focus on the most relevant features of the app. Obvious information, as well as further educational background information, should not be part of it. P8 elaborates, "*I think they should give you an overview with bullet points [...] but not too much information and then you can choose what interests you*".
- Integrated: Onboarding processes should be integrated into the app and not feel like a separated part from it. They "*should be supporting, but should not get in the way*" (P12).
- Lightweight: Onboarding processes should feel lightweight. Text- and information-heavy processes are perceived negatively. Information should be presented at bullet point level with the support of media. P7 states, "*I think good onboarding is just like a few pictures, a few short sentences, but that's it*".

Some participants expressed their desire to have no onboarding at all – instead, they expect apps to be intuitive and self-explanatory. P16 states, "*I would like to have no information because I think the user interface should be more or less self-explaining. If it's a good one, I don't need any explanations, then I will see through the design of the app what I can and what I can't do*". P12 also summarizes their expectations that developers should identify the need for onboarding through user testing, "*If there's certain relevant information that is not easy to be discovered without any explanations. In those cases, I would appreciate onboarding. But that's a very generic statement. It really depends. And I think it is very much with the developers to understand and also to test maybe with users in better versions whether they're struggling*".

5 ONBOARDING DESIGN

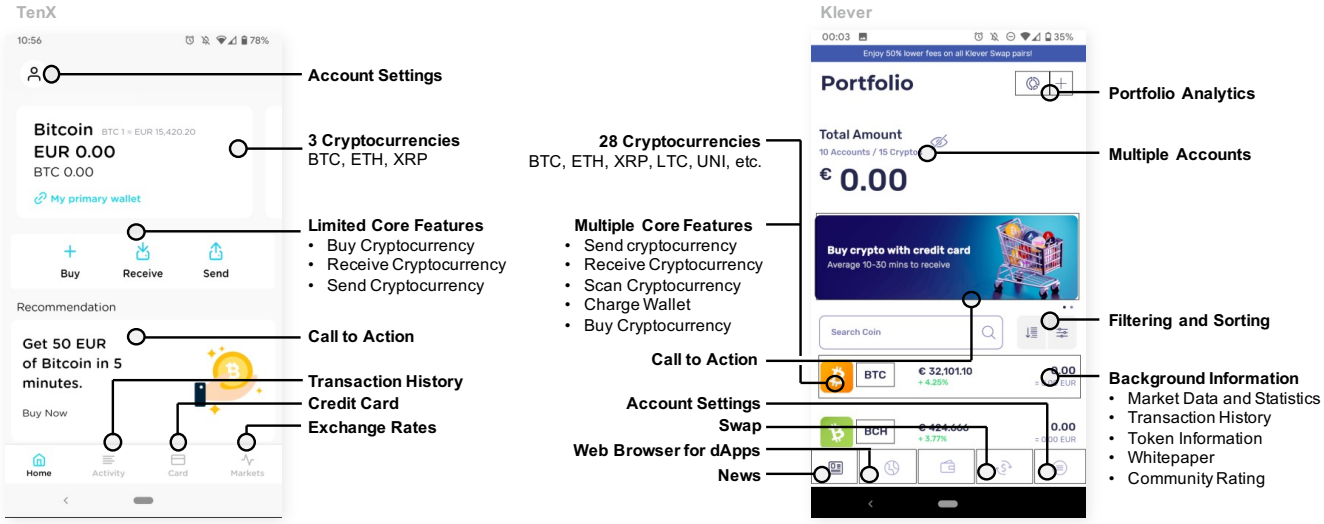
To test the impact of onboarding in a realistic setting, we selected two cryptocurrency apps. Based on our interview study, we hypothesized that onboarding would provide more value for users when (a) added to apps with novel context than apps users are familiar with and (b) when added to feature-rich apps compared to apps with fewer features. We further expected that cryptocurrencies are a sufficiently new domain for most users so that onboarding could provide value. We selected TenX (few features) and Klever (feature-rich) as examples and recreated both apps as high-fidelity prototypes. Figure 2 depicts the differences between the two apps.

5.1 Design Insights For Cryptocurrency Apps

The first step of the user study was designed to understand users' meaning-making process and generate design insights. The moderated interaction with the prototypes led to the following design insights. Statements from participants during the user study are denoted with a prefixed "U" (e.g., U1).

(1) Before interacting with the prototype, participants' expectations regarding features differed only slightly among the sample. All participants expected to have an overview of available cryptocurrencies, trendlines, and a way to purchase cryptocurrencies. Some users expected additional features. U4 explained, *"I would expect to have an overview of different cryptocurrencies, what the value is in different real currencies, and also to be able to buy them, maybe to sell them, to trade them into other currencies, to have like a whole stock market kind of situation"*.

Figure 2: The initial screen after opening the TenX (left) and Klever (right) mobile apps. TenX offers a limited set of features and cryptocurrencies. Klever provides a wide range of features and cryptocurrencies.



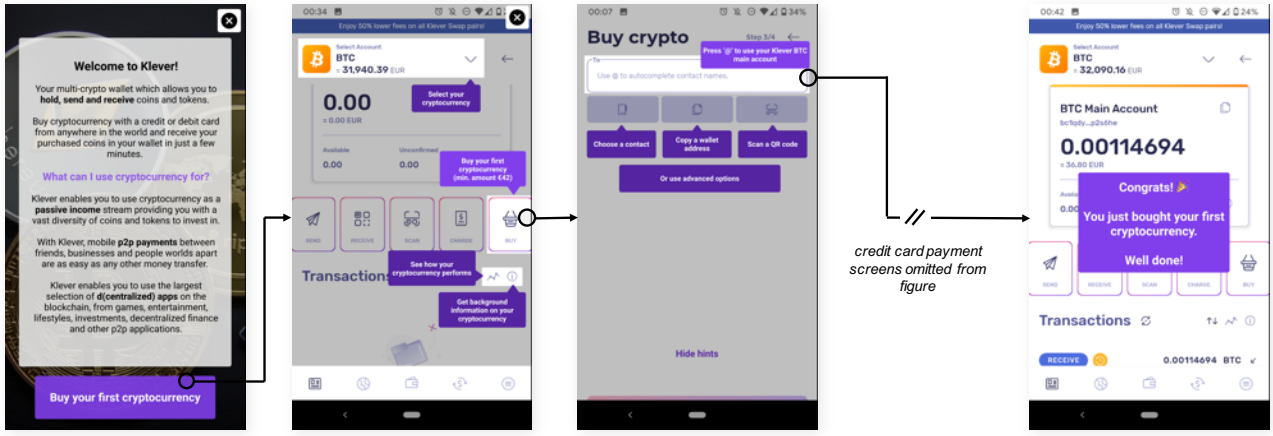
(2) Users expect a portfolio overview and the value of their own portfolio to be easily accessible on the main screen. U6 noted, *"The main thing I instantly need is the information there on the top. That is my total amount, how much I own, and how many cryptocurrencies I own. So that's, that's very good"*.
(3) All participants initiated the buying process during the prototype exploration. In the intro interview, most users stated they would need to inform themselves extensively before investing in cryptocurrency. After the buying process, most users were surprised that they could buy cryptocurrency easily. U8 reflected, *"It shows me that it's really easy to buy it. [...] It makes it more transparent that it's also only a way of having a currency. Because to me, it was a bit of a bubble"*.
(4) Users primarily expected cryptocurrencies to be used as an investment. Features to send currency to friends or receive it from them came as a surprise for some. U4 elaborated, *"I have some recent experience with Trade Republic. I looked at the app quickly, and it looked very similar. So maybe I already have a little bit of an image in mind about general trading apps. I mean, this is just normal stocks, not cryptocurrency, but I expected it to be similar to that. And it looks really similar. So this is what I expected. [...] And then you can also [...] exchange cryptocurrency between your friends, which I think is also nice. I didn't think about that"*.
(5) Participants struggled to understand some concepts specific to cryptocurrencies, such as buying fractions of coins, abbreviations of the different coins and tokens, and the fees associated with buying cryptocurrency. U8 said, *"I didn't know that I could also buy parts of crypto"*.

During the user study, participants explored similar features in both apps. However, we observed some differences. Participants were faster in the prototype based on TenX (mean: 26 minutes) than in the one based on Klever (mean: 46 minutes). The duration is also reflective of the misconceptions users had during prototype exploration. When asked in the exit interview whether an onboarding process would have supported them, participants using TenX were rather doubtful as they perceived it as intuitive already. U3 said, *"It's good that it doesn't have too many buttons or too many options to choose from. Because I think this is what makes it easy to handle. [...] Just looking at this app, I can say for me, it's intuitive. And I would know what to do if I want to buy bitcoins"*. Taking the buying process as an example, we reason that the linear user interface of the TenX prototype provided clearer guidance for participants. In comparison, the Klever prototype offers configuration options at each step that give the user more control but also complicate beginners" meaning-making process.

5.2 Developing Onboarding

We used the compiled cards, recorded videos, and the transcribed recordings of participants as a basis for our analysis. Our primary goal was to identify an *aha! moment* shared among participants that could then be used to guide users to a first *quick win*. While participants named a wide range of features when asked for their favorite part in the app, we found the task flows visualized with the cards combined with the recordings to be a valuable combination to develop a deeper understanding of participants' behavior. During our analysis, the buying process emerged as a shared *aha! moment* guiding users to a *quick win* – completing their first cryptocurrency purchase and becoming cryptocurrency owners. We identified the buying process as particularly suited for several reasons. First, all participants expected to buy cryptocurrencies and went through the process during their exploration. Second, most participants expected buying cryptocurrencies to be more difficult. Third, we observed that participants started to reflect on the personal utility of cryptocurrencies after completing the buying process.
Based on our analysis, we developed an onboarding process for both prototypes leveraging the identified design insights and minimalist

Figure 3: The screens of the prototyped onboarding process for the Klever app. After a brief explanation of the app's purpose and benefits, coach marks guide users through their *aha! moment* to the *quick win* of purchasing cryptocurrency.



instruction principles. Figure 3 shows the main screens adapted for the prototype based on Klever. We used a similar structure for the onboarding process in the TenX prototype. We decided to use coach marks to guide users through the buying process, reasoning that the onboarding would remain short, increase focus, and support the natural exploration process while not "getting in the way".

During the design, we applied the minimalist instruction principles – choose and action-oriented approach, anchor the tool in the task domain, support error recognition & recovery, and support reading to do, study & locate [49]. We included a welcome screen to each onboarding task flow to provide users with the app's purpose and features, as suggested by Strahm et al. [47]. Following the action-oriented approach, we directed participants directly to the screen on which they could initiate the buying process. While this was already the default screen for TenX, we skipped one screen for Klever. With this structure, we could provide an immediate opportunity to act without hindering the app exploration by the participants. Based on the elicited design insights, we clarified points of misunderstanding (i.e., abbreviations, vocabulary, currency fractions) while also supporting the user's experimentation. During the buying process, help buttons would further aid the user's error recognition and recovery. To provide closure and a distinct end to the onboarding process, we included a celebratory message after the successful purchase.

5.3 Impact of Onboarding

In a final step, we repeated the study with the implemented onboarding processes to evaluate its impact on participants' meaning-making. We strictly followed the same procedure with 4 new participants for both apps. We assess that onboarding supported participants' meaning-making process. For TenX, we found little changed compared to the first iteration. U14, a participant of the TenX user study, expressed, *"It was quite intuitive. You could just select how much bitcoin you want, add your credit card details and information [...] and then it does the rest for you. [...] So for me, it doesn't really need an onboarding"*. For Klever, we observed reduced misconceptions and quicker exploration of the app:

(1) All four participants understood from the information overlay that they could buy frictions of cryptocurrencies. U11 reflected, *"From the info screen before we know that 42 euros is the minimum which I can invest. So 42 euros equals to 0.001 whatever bitcoins. Okay, then I will invest 42 euros"*.
(2) Two users pointed out that Klever made them feel comfortable in the buying process as they knew where to inform themselves first. When asked to explain Klever to their former self at the beginning of the session, U10 answered, *"Klever gives you the ability to get an overview of all the coins available and their key figures, and then make kind of like, educated or informed decisions to buy coins"*.
(3) During the buying process, all four users were able to identify their main account as their wallet. One user could make the connection to set up different accounts for different cryptocurrencies. U11 observed, *"I directly understood that I need an account for every cryptocurrency without having an (additional) info screen [...] which is really good"*.
(4) When asked whether using the app made them more comfortable to try cryptocurrency apps, users commented on the ease of the buying process: *"buying crypto is a very complicated thing in my mind, but that [the buying process] was really easy"* (U12).

In addition to our qualitative analysis, we recorded the duration of each app exploration and surveyed participants for the perceived usability using the SUS [5, 37] after the prototype interaction from participants. Table 2 provides an overview of these measures. For context, the average SUS score of mass-market consumer software (74) [37], for mobile apps (77) [34], with a SUS score of 80 being the industry goal [37].

Table 2: Overview of SUS scores and average time needed for app exploration for both apps with and without onboarding.

	TenX		Klever	
	normal	onboarding	normal	onboarding
SUS	83.1	77.5	57.5	78.8
Duration	26 min	15 min	46 min	30 min

In the case of Klever, the addition of onboarding led to improvements in both duration and usability. Question item 10, "I needed to learn a lot of things before I could get going with this system", improved from an average score of 3.00 before onboarding to 1.50 after onboarding (with 1=strongly disagree and 5=strongly agree). In the case of TenX, the addition of onboarding had a less pronounced effect – participants needed less time, but the SUS score dropped slightly. These results are in line with the qualitative observations and analysis of the generated artifacts.

6 DISCUSSION

We have presented the results of our interview study and explored the design of onboarding in the context of cryptocurrency apps. Our results suggest that onboarding can support users in the initial exploration of mobile apps and that design insights for onboarding can be successfully elicited with the used method. In the following, we summarize our findings and discuss opportunities and open questions related to designing onboarding processes for mobile applications that can be generalized from our studies. While we do not claim relevancy for all domains, we believe the findings presented hold value for designers of mobile apps in general.

6.1 Efficacy of Onboarding for Mobile Applications

The results of our interview and user studies suggest that onboarding is not a silver bullet. Given this, the question is, under which conditions does onboarding provide value? We hypothesized from the interview study that novelty of context and complexity of mobile apps could be relevant factors. Our user study data indicates that onboarding supports users in their first interaction when added to complicated apps. The implications for apps with fewer features are less conclusive. In the case of TenX, the onboarding did improve the duration of the study but reduced perceived usability. Comments by participants testing TenX (both without and with onboarding) document their perception that they would not have needed the onboarding. Overall, this suggests that the novelty of context might be less relevant for the value of onboarding compared to a mobile app's complexity. In our study, we operationalized complexity as the number of features a mobile app provides and ignored other sources of complexity (i.e., novel interaction methods). Future research might look into which further sources of complexity could require onboarding.

Features of good onboarding: Strahm et al. were the first to connect Minimalist Instruction Theory [7, 8] to onboarding experiences in mobile applications. Our interview study extends the body of knowledge with an empirical account of user experiences and opinions related to onboarding experiences. The reported aspects of good onboarding – short, skippable, focused, lightweight, integrated – overlap with Minimalist Instruction Theory and confirm its applicability to mobile applications. We discuss our findings in the context of Van der Meij's and Caroll's minimalist instruction principles [49], and argue that minimalist instruction theory is well-suited to guide the design of onboarding experiences for mobile applications.

Principle 1: Choose an action-oriented approach. The first principle argues that meaningful action is necessary for effective learning [47, 49]. Strahm et al. connect this principle to their concept of the *quick win*, which allows users to progress toward a short-term goal [47]. This principle is also reflected in participants' expectations that onboarding in mobile applications should be *integrated* and *skippable*. Simply spoken, onboarding should not get into the way of users' desire to explore and respect users' approach to their exploration.

Principle 2: Anchor the tool in the task domain. The second principle advocates designing instructional activities as real tasks. The organization of the instruction should reflect a real task, and learners should be provided a relevant reward [49]. This principle is reflective of participants' expectations for *focused* onboarding. Onboarding should focus on few relevant features and guide users to make tangible progress towards them.

Principle 3: Support Error Recognition and Recovery. The third principle emphasized preventing mistakes whenever possible and provide on-the-spot error information if that is not possible [49]. During the initial app exploration, users are likely to hold misconceptions, and it is reasonable to expect that some will run into errors because of that. Users reported different error recovery strategies during our interview study. With hardly anyone expecting to receive in-app help for problems, we argue it is still important for designers to provide accurate error information. Users are likely to resort to search engines, FAQs, or friends or family to help them resolve the issue in case trial and error fails them. Being able to articulate the problem at hand is equally crucial for each of them.

Principle 4: Support reading to do, study, and locate. The fourth principle reminds designers to be brief and provide closure for chapters [49]. This closely relates to the concept of the *quick win* [47] and also aligns with users' expectations for *short* and *lightweight* onboarding experiences.

These principles proved to help guide the development of our onboarding processes. We used coach marks as they would allow for an action-oriented exploration while not getting in the way. We guided users through the real buying process, thereby anchoring the onboarding in the task domain. We tried to avoid errors by guiding users through a highlighted default path but provided an explanation for additional configuration options in case users deviated from it. We aimed for a short process, providing closure with the successful purchase of cryptocurrency.

Informational content should not be part of onboarding: During our interview study, participants clearly expressed that onboarding "*should not get in the way*". While it might be tempting to include educational information in an onboarding process, we reason practitioners would do better not to do so. Informational content, often presented in the form of tutorial cards, is not actionable and tends to get in the way of the user's desire to explore the app. Information that goes beyond the app's usage – in the addressed case, for example, *How do cryptocurrencies work?* – are likely explored by users outside of the app.

6.2 Reflections on Strahm's Framework for Onboarding Design Insights

Our experience showed that the framework proposed by Strahm et al. could be successfully used to generate design insights in the context of financial applications using high-fidelity interactive prototypes. Overall, we perceived the method to be a valuable framework aiding the design process of onboarding experiences. The moderated interaction with the prototype allowed users to reflect on their behavior while generating artifacts for the subsequent design process. Some participants even commented positively on the nature of the process. During the analysis part, the insights recorded on cards allowed us to reconstruct the task flow of different users and compare their differences and similarities. While providing structure to the sequence of steps, valuable insights emerged only in combination with video recordings and transcriptions of the user study. In the case of TenX, we observed that the generated design insights also indicate when onboarding might not be necessary or appropriate. During both iterations of the user study with the TenX prototype, participants raised doubts on whether onboarding would improve their understanding of the app.

Improvements and Extensions: From our experience in applying Strahm et al.'s procedure to develop two onboarding processes, we derive suggestions on how to adapt the procedure in the future.

(1) We found adding the System Usability Scale [5] after completing the prototype interaction a valuable addition to evaluate the impact of the prototyped onboarding. This modification adds little overhead to the procedure but provides a reliable quantified measure complementing the qualitative observations for evaluation.
(2) We also reported the duration of the prototype exploration (measured post hoc). We followed the rationale that the duration would demonstrate the difference between the two tested prototypes – i.e., the longer duration in the more feature-rich app demonstrated that users had more difficulty during their exploration. We argue that for evaluation of the efficacy of the onboarding, it is less suited, as researchers administering the study could (potentially unconsciously) influence it.
(3) One practical downside in reporting our results was the missing name of the method Strahm et al. proposed. While Minimalist Instruction Theory informs the creation of the onboarding prototypes, the design method focuses on eliciting users' meaning-making process. For designers, it might be helpful to have a dedicated name for the protocol itself (see figure 1), as it might be used to generate design insights for different ends than onboarding. We humbly suggest *Iterative Moderated Exploration Framework (IMEF)* as a suitable name.

Future research: From our interviews, we found that the initial familiarization with mobile apps happens in an unstructured exploration – simply said, by clicking through all screens. While the moderated exploration is valuable for designers to understand users' meaning-making processes, it is an open point for future research to investigate whether participants would act the same way when exploring the app independently.

An additional avenue for further research would be the long-term impact of onboarding on usability perception and engagement. Is the onboarding effect a one-time improvement, or can successful onboarding interventions achieve increased engagement in the long term? In a similar light, it would be interesting to understand onboarding beyond first-time use. With feature-rich apps such as Klever, it is not realistic to onboard users to all features at once. How would the procedure need to be adopted to elicit valuable design insights for established users? How would users react to such onboarding? And which impact would it have?

6.3 Modeling App Installation as Intentional Process

From our interviews, we draw on the observation that the decision to install a new app appears to be an intentional process in most cases. Users reported that they would inform themselves with the help of online resources and reach out to friends and family to decide on whether to install certain apps. In the same notion, some participants mentioned during the interviews in our user study that they would learn more about cryptocurrencies before engaging with an app outside of the study setting. This indicates that when users first engage with a cryptocurrency app, they have already started the knowledge gathering process beforehand. Presumably, not all app installations are that intentional. Apps that serve an immediate need – i.e., public transport apps, translation apps, games – are likely installed without extensive research beforehand. Nevertheless, modeling the decision leading up to an app installation as an intentional process could extend our current understanding of user behavior and open up new avenues for research – i.e., how to guide users to trustworthy and factual sources.

In the context of cryptocurrencies, we hypothesize that users form the intention to engage with the technology over an extended period before they first download an app and buy cryptocurrencies. Future research in the area of cryptocurrency (and likewise in different domains) should investigate how users engage in the exploration, gather knowledge and form the intent to engage with a topic or not. Planned Behavior Theory [1] might provide a theoretical starting point for research in this direction.

7 CONCLUSION

In this paper, we have explored the impact of onboarding processes at the example of two prototypical cryptocurrency apps. We complemented the design and evaluation with a preceding interview study with 16 participants characterizing experiences and opinions regarding mobile app onboarding in general. Our findings indicate that mobile app onboarding improves usability for first-time users of feature-rich apps but might not do so for simpler ones. We discuss the results of both studies in the broader context of minimalist instruction principles, concluding that they are aligned to users' expectations regarding onboarding and thus represent a valuable set of guidelines for designers of mobile apps.

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