



Comparing User Experience in Interactions with Different Types of Digital Products

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Abstract. User experience varies when using different types of digital products. Previous research has studied the relationship between product properties, user behaviors, and emotional experiences. In this research, we conducted a diary study of 29 students over two weeks to examine users' emotional experiences of mobile apps, PC software, and terminal devices in relation to product features, interaction results, and users' feedback. Results show that: (1) Users were less "disappointed" when they interact with mobile apps. (2) Users were often "surprised" when using a terminal device. (3) Users mentioned "aesthetics" more with mobile devices than with terminal devices. (4) Users cared more about task complexity and chose to overcome the problem they have met when using a personal computer. These results provide an exploratory understanding of the relationships between product types and other factors and could be useful to cross-platform designers. The results also suggest that user expectation might have an impact when measuring user experience, and this needs further investigation.

Keywords: Emotional experience · Digital products · Diary study

1 Introduction

We are living in a world that is increasingly pervaded by technology. The digital products we interact with on a daily basis are becoming more and more diversified. For example, we use our smartphones to post first decorated selfies on Instagram, computers to make keynotes for presentations, and terminal devices to buy subway tickets. What users experience is a result of a user's internal states such as expectations and motivations, the properties of the product such as complexity and functionality, and the context such as setting and task [1]. Users' experiences differ when they interact with different types of products [2]. Previous research has studied the relationship between factors of product properties, user behaviors and emotional experiences [3]. Jordan and Persson suggested that approaches to affective design need to consider different types of the product [4]. However, relatively less research has examined and compared the different emotional experiences users undergo when interacting with different types of digital products. In this research, we aim to examine users' emotional experiences of different types of digital products in relation to product features, interaction results, and users' feedback.

The rest of the paper is organized as follows: we first give a review of related research, describe the study design, present the results, and conclude with a summary and discussions of the findings.

2 Literature Review

The term “User Experience” (UX) is widely used in many HCI-related fields ranging from psychology to design and business. For example, Alben defined “experience” as all the aspects of how people use an interactive product, “how well they understand how it works, how they feel about it while they’re using it, how well it serves their purpose” [5]. Law and others drew the conclusion that UX is dynamic, context-dependent, and subjective [6].

UX is constituted of several elements [7], such as usability, user interface, interaction design, emotional experience and so on [8]. Previous research also discussed how these elements affect the quality of user experience over time [9]. For example, learnability and novelty may be crucial at first, but product’s usefulness and social capital will motivate prolonged use. In this paper, we adopt Kuniavsky’s definition that the user experience is “the sum of users’ perception as they interact with a product” [10]. These perceptions include effectiveness, efficiency, emotional satisfaction, and the quality of the relationship with the entity that created the product.

We refer to emotional experiences as those typically considered in everyday language about emotions, such as happy, excited, worried, and disappointed. Reeves and Nass suggested that on-screen products evoke emotions, both negative and positive [11]. These emotions have different impacts on action readiness: whereas negative emotions stimulate individuals to withdraw from the object, positive emotions inspire individuals to approach the object [12]. The field of engineering took consumer’s feeling into account when designing the products [13]. Relationships between product experience and product properties were used to design more attractive products [14]. Previous research has found that positive emotions are considered to be profitable during product usage. For example, the fact that what is considered beautiful is usable in users’ opinion highlights the tight relationships between users’ positive emotional experience and system’s usability [15]. Products that evoke positive emotions are purchased more often and used more often [16].

Users’ responses differed markedly when they interact with different types of the product [4]. Obviously, different types of product bring different features, functions, and aesthetic experiences. There has been a large body of research focusing on these differences. For example, the assessment of a product’s novelty affects users’ preference [17]. Venkatesh and Davis found that system-specific perceived ease of use will adjust to reflect objective usability and subjective enjoyment [18]. But few research has investigated how basic features such as size, weight, speed, and sound affect user experience.

Previous research also discussed users’ feedback when interacting with mobile devices and computers. For example, consumers hold positive attitudes for mobile learning, allowing them to view mobile learning as an efficient tool [19]. Park et al. suggested that domain knowledge and accessibility as external variables had a direct effect on experience in computer use [20]. But how the users’ feedback different from interaction with different types of product is still need further exploration.

3 Methods

3.1 Data Collection

Twenty-nine undergraduate students were recruited from two sessions of an information management curriculum. Over a two-week period, the participants were asked to record their interaction process with any kinds of digital products (mobile phones, desktops or terminal devices) in a semi-structured text form.

We received 136 records in total: 41 of mobile apps, 50 of PC software, and 45 of terminal devices. Table 1 shows some example records of the three types of digital products.

Table 1. Example records.

Record ID	Digital product	Record
3805	Camera APP (mobile app)	I used my cell phone camera to take selfies with my friends and captured some beautiful sceneries at Peking University. There were 2 cameras build on my cellphone: the front camera (with lower resolution) and back camera (with higher resolution). Sometimes I felt frustrated to use the front camera because I could not stable my hand when I took selfies and the images got blurred. To completely avoid this problem, I need to use a traditional digital camera or the back camera of my cell phone that have optical image stabilization function when taking selfies. But it will be relatively inconvenient. Therefore, the best solution will be to practice more
2903	PKU course registration (PC software)	As an exchange student, I was required to enroll courses through the course registration portal. However, I had an awful experience towards the Portal System. The biggest problem I encountered was that the webpage did not include a guideline for the first-time user. I did not know what tasks I should do at the current stage and I needed to spend extra time contacting the exchange officers to figure out ways to use the system
209	Carrefour storage machine (terminal device)	I used this machine to save package and take package. There was only one white button on the stocker with the word "save" in the middle, a bar code in the middle, the following was the scanning code to take place, and the screen display position was full and the bar code corresponding to the number of boxes. The machine was simple to meet user needs, the downside was that the "save" button was white, not very noticeable

3.2 Data Analysis

We used ground theory approach to analyze the diary data. After open coding, we further refined our coding scheme based on the emotional categorization provided by Cowie et al.'s typology [21]. Figure 1 shows our final coding scheme. We used Nvivo 11 to conduct the analysis. To ensure the coding stability, two coders coded 50 randomly

selected records (30% of all data) independently. The overall Kappa coefficient was 0.62. We then asked the third person to join the discussion and resolved the disagreement in coding, updated the coding scheme, and completed the rest of the coding.

A Emotion				
A1 Engage	A101 Interested	A102 Excited	A103 Pleased	A104 Confident
	A105 Amused	A106 Proud	A107 Calm	A108 Content
A2 Unpredictable	A201 Worried	A202 Surprised	A203 Relived	
	A301 Anxious	A302 Bored	A303 Disappointed	A304 Guilty
A3 Withdraw	A305 Despairing	A306 Hurt	A307 Sad	A308 Ashamed
	A309 Disgust	A310 Annoyed	A311 Embarrassed	A312 Afraid
	A313 Frustrated	A314 Miserable	A315 Tired	
B Feature				
B1 Category	B11 Mobile App	B12 PC Software	B13 Terminal Devices	
B2 Attribute	B21 Capacity	B22 Size	B23 Weight	B24 Aesthetic
	B25 Speed	B26 Strength	B27 Complexity	B28 Sound
C Result & Feedback				
C1 Result	C11 Success	C12 Failed	C13 Stuck	C14 No feedback
	C15 Unclear	C16 Pop-up	C17 Content Error	C18 Misoperation
	C19 interrupted			
C2 User Feedback	C21 Re-interact	C22 Wait	C23 Ignore	C24 Overcome
	C25 Giveup	C26 Delete & discard		

Fig. 1. Coding scheme.

We then looked for patterns in the codes across different product categories (B1), for example, whether users experienced different emotions (A) or whether different product attributes were mentioned (B2) when interacting with different product types. In general, we explored whether different types of products have significant differences across other factors. We also examined the contexts of use collected through a questionnaire which will be described in Sect. 3.3.

3.3 Questionnaire Design

In addition to the diary entries, we collected additional information about the context of use, the user proficiency of the product, frequency and motivation of use through a questionnaire. Participants filled in a questionnaire for each diary entry they submitted.

The questionnaire results show that 75% of participants defined themselves as a skilled user (score 4–5) of the mobile apps and PC software, and the other 25% defined themselves as novice users (score 1–3). 64% of participants used their product once a day or once a week, 13% used once a month, and the rest were used much less frequently.

As for contexts of use, 31.6% cases were for studying and 31.6% percent were for entertainments. The other contexts included shopping (11, 8%), social (3, 2.2%), transportation (7, 5.1%), finance (3, 2.2%), dining (7, 5.1%), and others (19, 13.9%). When we asked about the product attributes that they were more concerned about on mobile apps and PC software, the top three attributes were: speed, complexity, and aesthetics. As to terminal devices, participants considered complexity more important than speed, followed by aesthetics.

4 Findings

4.1 Emotional Experience

60% of emotions the participants experienced were “withdraw” emotions such as annoyed, disappointed and frustrated. 30% were “engage” emotions such as pleased, relaxed, and excited. 10% were “unpredictable” such as worried and surprised. It seems that participants were more likely to record a bad experience than a pleasant one. The top 10 most frequently mentioned emotions are shown in Fig. 2.

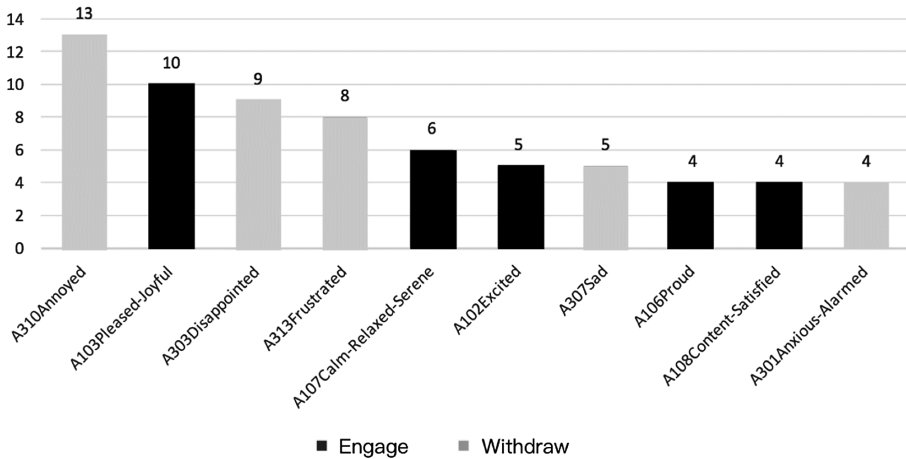


Fig. 2. 10 most frequent emotions.

As Fig. 2 shows, the top three most mentioned “withdraw” emotions are “annoyed” (13, 14.7%), disappointed (9, 10.2%), and frustrated (8, 9%). The top three most mentioned “engage” emotions are “pleased” (10, 11.3%), calm (6, 6.8%), and excited (5, 5.6%).

“Withdraw” emotions were often caused by unsuccessful and interrupted interaction, such as being disrupted by pop-up windows, waiting for the device to respond, or having to repeat the interaction process again. For examples, participants mentioned in the following records:

“I felt annoyed, because a lot of pop-up windows come out when using the bike-sharing app and I must manually close all of them.” (Record-27)

“For an electronic device interactive system, the most basic requirement was to run smoothly and do not often crash. This did not meet the most basic requirements. I feel disappointed when system crashed a lot.” (Record-2201)

“For this product, If I was a non-paying user, which means the basic functions of the product were not able to use, then the user would feel treated differently, not respected, even resulting in frustration.” (Record-3301)

For “engage” emotions, participants could feel good about several things, such as winning a game, a thoughtful tip from a mobile app or even a certain color theme could make them happy. For examples, participants mentioned in the following records:

“It provided Chinese and English subtitles at the same time, I was very happy about it.” (Record-4108)

“When using Google Chrome, I felt that it gave me a very comfortable experience compared to other browsers, but I didn’t know why.” (Record-802)

“I felt a little nervous when using the subway ticket machine for the first time. I think it’s from the environment, my heart is full of curiosity and excitement.” (Record-806)

4.2 Mobile Apps

Mobile apps are commonly used interactive products in everyday activities. From the questionnaire, we learned that the participants used mobile apps mostly for studying and entertainment. During the interaction with a mobile app, participants reported 13 different emotions in 43 records. The frequency distribution is shown in Fig. 3.

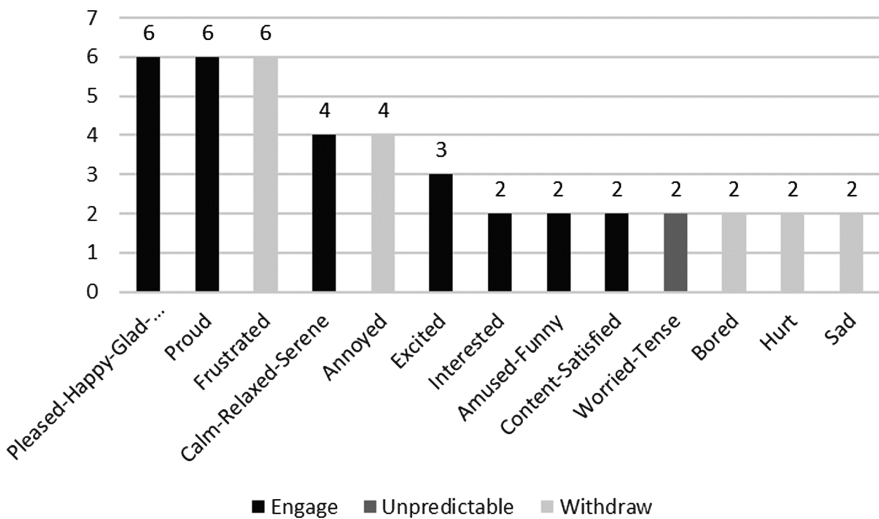


Fig. 3. Emotions mentioned during interaction with mobile apps.

Users often felt pleased when using mobile apps with quick feedback. For example, Participant P33 reported, *“I felt very pleased with this mobile app showing changes of scores when I was playing games.”* (Record-3303).

Users were proud of being praised by a mobile app. For example, Participant P33 mentioned, *“I felt proud when the application generates an interface with an MVP cup, saying I was doing well.”* (Record-3303)

When interacting with mobile apps, participants also experienced negative emotions such as annoyed and hurt. Participant P8 recorded: *“I am annoyed when something goes*

wrong with the mobile phone, for example when the camera was difficult to focus. At this point, I would be dissatisfied and annoyed.” (Record-805)

As to product features, users mentioned about aesthetics, speed, and complexity when they interact with mobile apps. The enjoyment of simple and beautiful interface was mentioned. For example, Participant P2 said, “I like the application whose interface design is simple and attractive.” (Record-202) Participant P27 preferred the quick response speed and fast feedback of mobile apps. “Mobile applications collect information instantly and give response quickly.” (Record-2704) Easy to use was also considered as an important factor: “Mobile apps were easy to learn and use with useful functions.” (Record-2708)

Regarding the results of interaction with mobile apps, participants felt confused and frustrated when they got wrong results or no response during their interaction process. “When I used the OFO app, its GPS positioning was always inaccurate.” (Record 2702)

It seems that users got used to the quick feedback on mobile apps, and they expected clear instruction when interruptions occurred. Users often chose to re-interact with the mobile app when they failed in the previous try: “Because Internet connection failed, I had to re-interact with the applications.” (Record-2702)

4.3 PC Software

Since the participants were all university students, they used personal computers mostly for studying purposes. Figure 4 shows their emotional experiences when they interacted with PC Software.

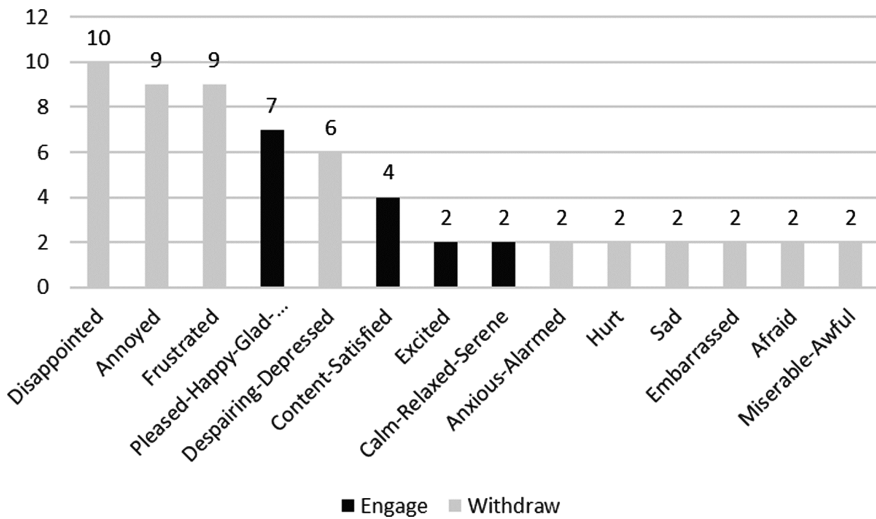


Fig. 4. Emotions mentioned during interaction with PC software.

As Fig. 4 shows, participants felt more negative emotions when they used computer software as opposed to mobile apps. Participants experienced frustration with the slow

speed or interruptions of interaction. For examples: “*When the speed is low using Mac Air, I felt devastated and angry.*” (Record-3802) “*Too many pop-up windows made me frustrated.*” (Record-3904)

Participants felt content with good visual experience on computers. “*My eyes felt relatively comfortable because the screen light was auto-adjusted based on environment.*” (Record-3802)

When interacting with PC software, participants also focused on features such as aesthetics, speed, and complexity. For example, when Participant P22 used a code editor application, the color used for highlighting was very helpful. “*The computer always shows a red background to highlight your mistake.*” (Record-801) Particularly, participants mentioned the sound that evokes negative emotions during the interaction. “*When I made some mistakes, the computer sounded an awful system beep, which made me really embarrassed in public.*” (Record-1103)

As for the results of interaction with computers, “pop-up” windows and “interruptions” were mentioned a lot together. The pop-up windows including ads and help interrupted participants when they were working. “*There were so many pop-up windows when I used a download tool which disturbed me.*” (Record-205) Computer software often didn’t give any response or instruction when participants did not know how to operate. “*After clicking the ‘YES’ button, the system had no response and no indication of error.*” (Record-205) Faced with these results of interaction, participants often chose to overcome the difficulties when using computers. For example, Participant P35 mentioned he googled the online documentation to find a solution. “*I don’t know how to import the music files to my Mac iTunes, so I googled the solution online.*” (Record-3506)

4.4 Terminal Devices

The emotions participants experienced when using terminal devices seem to be different with the former two types of digital products. It is possibly because terminal devices were less frequently used and participants were unfamiliar with the operations on terminal devices. The most frequently mentioned emotions during interaction with terminal devices is shown in Fig. 5.

Participants felt disappointed most during interaction when the terminal devices did not work properly as expected. “*I felt very disappointed and frustrated when the vending machine did not dispense goods.*” (Record-2210) Participants experienced surprise with terminal devices’ unexpected operations. For example, terminal devices can automatically identify user location to save user input. “*When I used the ‘intelligent’ washing machines, it was a pleasant surprise when it identified my location automatically so I did not need to input my location manually.*” (Record-3304)

Regarding product features, participants also mentioned aesthetics, speed, and complexity a lot. At the aesthetic level, besides simple and attractive interface design, participants focused on good typesetting and clear information display. “*The screen shows the information of my prescription that clear and easy to understand.*” (Record-2701) As for complexity, the voice prompt and flowchart were helpful to use the terminal devices for the novice users. “*The vending machine has simple but enough*

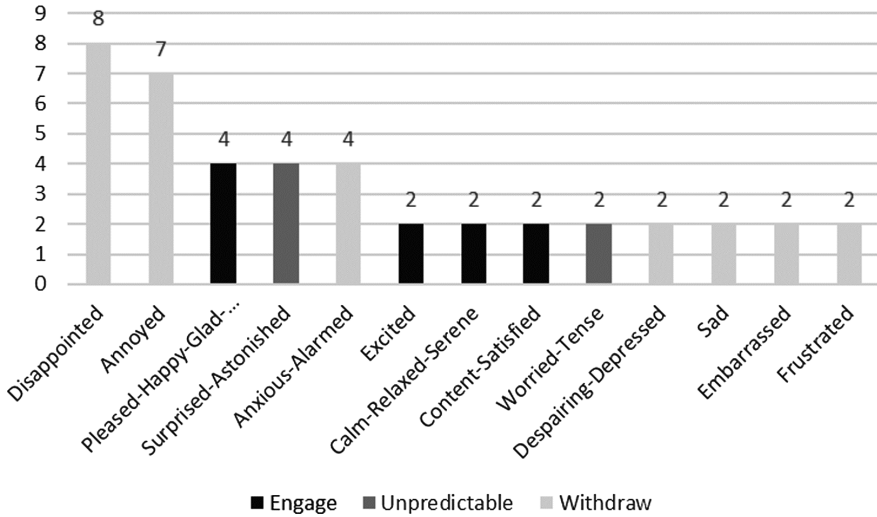


Fig. 5. Emotions mentioned during interaction with terminal devices.

introduction and flowchart that guide people interact with it, which helps me a lot.” (Record-2703)

As to the results of interaction with terminal devices, “no feedback” and “content error” was mentioned mostly. Because participants were less familiar with the terminal devices, they felt more confused when there was no response. *“I pushed the button, but nothing happened, and I waited for a while, but still no response. I felt annoyed because I’m not sure if I should push the button again.”* (Record-3604) Participants also seemed to experience more Internet connection failure when interacting with terminal devices. *“The vending machine failed to load the QR Code.”* (Record-2703) Participants usually re-interact with the devices, either solved the problems or just gave up in the end. *“When the interruption happened, if I couldn’t find the solution and I didn’t want to wait any longer, I would give up right away.”* (Record-701)

4.5 Comparison

Emotions. There is a significant difference in the frequencies of emotions across mobile apps, PC software, and terminal devices ($\chi^2 = 74.30, p < 0.05$). Figure 6 shows the comparison. Participants felt more positive emotions when they interacted with mobile apps while felt more negative emotions when they interact with PC software. Specifically, the emotion “proud” and “relaxed” were mentioned much more when participants interacted with mobile apps, and the emotion “disappointed” appeared much more when users interacted with computers. Participants were more often “surprised” when using a terminal device.

Product Features. The participants mentioned different features of the product when they interacted with different types of product. For example, “aesthetics” were

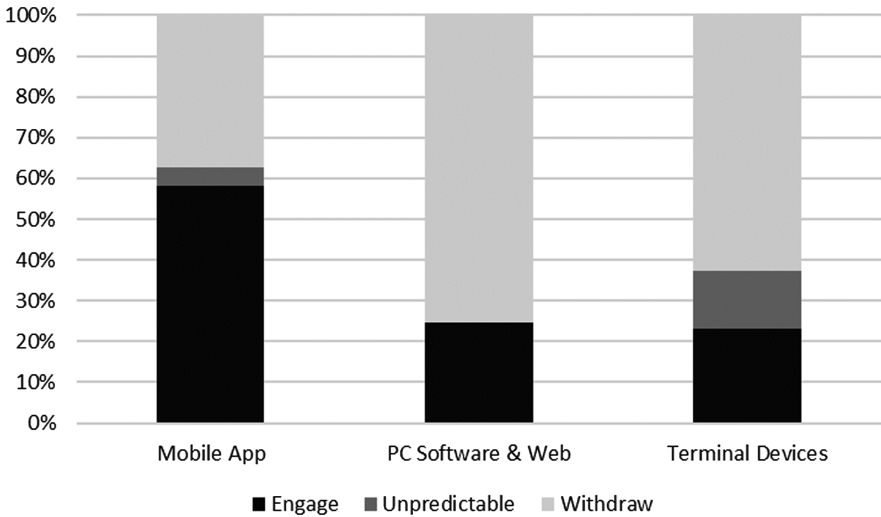


Fig. 6. Users' different emotional experience with different types of product.

mentioned more often with mobile apps than PC software and terminal devices. "Speed" seemed more important when using mobile phones while "complexity" was more relevant when using PC software and terminal devices. It is probably because mobile apps were used more frequently than the other two types of products. Users are used to the quick speed of mobile devices' feedback and they expect easy-to-learn features from unfamiliar devices. The results are shown in Fig. 7.

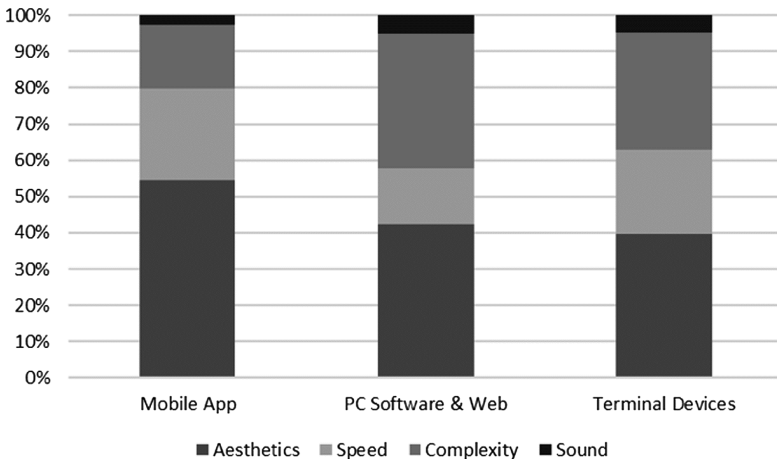


Fig. 7. Product features mentioned when using different types of product.

Interaction Results. Although there is no significant difference between these interaction results across different types of product, participants paid attention to different

results when interacting with different types of product as Fig. 8 shows. For example, participants often got annoyed by the pop-up windows on computers, while they were impatient when not getting quick responses from their mobile apps.

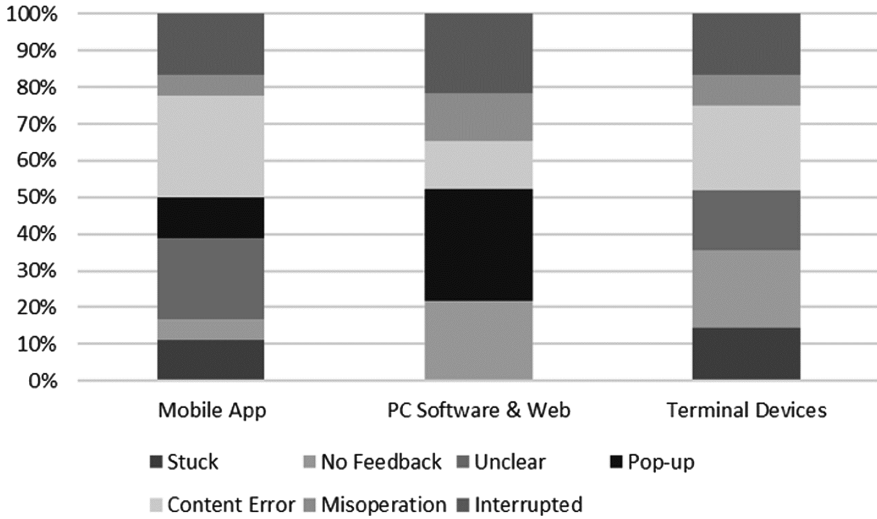


Fig. 8. Different results mentioned when interacting with a different product.

Users' Feedback. With different results of interaction, participants chose different ways to go on. Figure 9 shows that participants often re-interacted and overcome the difficulties. Participants waited and ignored more when using terminal devices as they were not

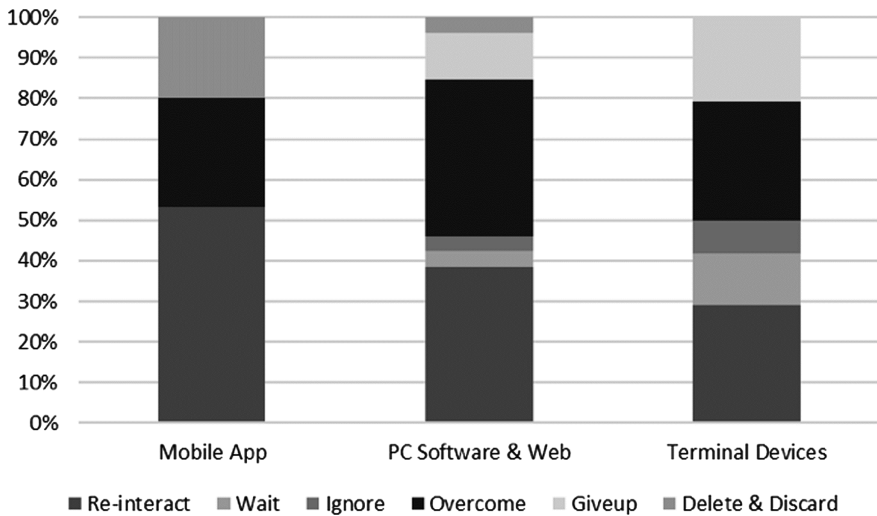


Fig. 9. User's feedback on different types of product.

familiar with them. When the interaction failed, participants often deleted the mobile applications while giving up on terminal devices. It seems that participants had less patience on mobile devices. Meanwhile, there were fewer ways for participants to find help to solve their problems on terminal devices, so giving up seemed to be the only choice.

4.6 User Expectations

After open coding, quantitative analysis, and data display, we found that users tend to have very different emotional tendencies when using mobile phones and computers. Participants seemed to be more “tolerant” to mobile phones, but the use of computers can easily trigger negative emotions. We speculate that this might be caused by user’s expectations. In daily life, mobile phones are used more frequently than computers, so participants are more familiar with the possible interaction results on mobile phones, which might trigger less negative emotions, and vice versa.

We found that users are more prone to emotional volatility when they mentioned, “stability” and “predictability”. For example, Participant 15 mentioned, “*The interaction process was very painful, mainly due to poor stability, the site collapsed constantly.*” (Record-1505) When system behavior was unpredictable, the expectation of the user was difficult to satisfy. We further categorized user expectations into the following three categories (Table 2).

Table 2. Three different types of user expectation.

Record ID	Type	Record
3303	Desire	(Describing a popular game on mobile phone...) After the purchase, the game showed that this was the 10th hero I own, generating a relatively cool interface for sharing with my friends. Then I got the best of the best (MVP) with a new hero in the game and the game immediately gave me an MVP trophy interface and praised me so much that I felt very fulfilled
1808	Previous experience	(Talking about a new change on Samsung’s mobile phone...) I did not know when they started in this way. I found Samsung’s mobile phone’s confirmation button moved from the left to the right. As the confirmation key was on the left, when the small window with “confirm” and “cancel” button popped up, my finger unconsciously presses the left button to confirm. I’m happy about it, because I think such kind of design is in line with my formal experience
3302	Basic needs	(Describing a system bug...) After the system did not respond, I clicked the confirm button. There was no prompt of the error, so I thought the network connection had a problem. I had been waiting and then tried several times with no responses. Finally, after sending the transaction code four more times, I entered the correct transaction code to complete the transaction

There seemed to be a close connection between user expectation and their emotional experiences. This needs further investigation.

5 Conclusion

In this paper, we report differences in users' emotions, product features, interaction results, and users' feedbacks when users interact with different types of digital products. These results provide an exploratory understanding of the relationships between product types and other factors and could make a contribution to cross-platform designers. Furthermore, using a general guideline to interaction design for the different type of products might not be a good idea. This study also suggests that another factor, users' expectation, might have a strong impact when we were measuring user experience in different types of interaction process, and this needs further investigation.

From the results, we confirm that digital products evoke both negative and positive emotions. We find that different types of digital product stimulate different emotional experience. Users were less "disappointed" when they interact with mobile apps. Users were often "surprised" when using a terminal device. We also find users' different experience on product features. Users mentioned "aesthetics" more with mobile devices than with terminal devices. Users cared more about task complexity and chose to overcome the problem they have met when using a personal computer. Results also show that users' feedback differed markedly when they interact with different types of product which confirms previous research. Moreover, users tend to take different actions to interaction results. For example, users were more likely to quit their task on terminal devices than on mobile devices. We speculate that the differences in emotional experiences may have something to do with users' expectations with the products. Olsson's framework [22] that contextualizes layers of expectations into desires, experience-based assumptions, social and societal norms, and must-be expectations may help to understand the connection. This needs further investigation.

Limitations of this research lie in the homogeneity of our participants since they were recruited from the same curriculum with a similar background. In the future, we could expand the span of participants' backgrounds. Future research could also examine the relationship between user behavior, expected/anticipated result of the behavior, and users' emotional experiences.

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