

Content, Emojis, and Context: Understanding User Responses to Mobile App Notifications

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Abstract

This study aimed to explore how users perceive and interact with the mobile app notifications which differ in terms of practicableness (content relevance and richness) and visual richness (usage of emojis), and how these responses differ in work and leisure contexts. The study used a qualitative approach, which evaluates four notification prototypes through semi-structured interviews with 16 participants. Each prototype represented a different combination of content and visual design.

The results showed that the practical content was the main driver of perceived usefulness; while visual richness could enhance or diminish user engagement, and it depends on its consistency with the text. Emojis were welcomed when they promoted emotional clarity or appeal but were often viewed as manipulative or distracting when matched with ambiguous content. In addition, participants expressed different preferences depending on the context: during work, they preferred concise, simplified notifications; while during leisure, they are more tolerant to expressive and visually rich formats.

In summary, this study highlights the importance of context-aware and meaning-consistent notification design. And effective notifications should not only convey information but also adapt to the user's current context and expectations. These findings provide unique insights for application designers and contribute to the ongoing discussion around attention-sensitive communication strategies.

Key words: Mobile notification, UX design, Emoji, Contexts

1. Introduction

Notifications have become an integral part of daily life. According to Iqbal and Bailey (2010), notifications are signals created by apps or digital platforms to capture the user's attention and deliver updates, even when the user is not currently interacting with the app. According to Infobip (2024), the notifications can be categorized into four types: mobile app, wearable device, desktop, and web notifications. This study focuses specifically on notifications of mobile applications. Originally, notifications were simple alerts designed to draw attention to certain pieces of information, often carrying a sense of urgency (Goode, 2019). However, with the rise of smartphones and the digital era, notifications have evolved into a key communication tool between apps and users, capable of delivering a wide variety of messages (Shirazi et al., 2014). For example, emergency alerts, financial transaction updates, and health reminders can help prompt users to take immediate action at critical moments (Perri-Moore et al., 2015; Lambropoulos et al., 2021; Cramaekers, 2021)

As mobile technology and internet connectivity have advanced, notifications have become complex, interactive components embedded within digital platforms. Nowadays, the notifications serve not only to alert users to new information, but also to remind them of important tasks, provide real-time updates, and deliver personalized content (Visuri et al., 2019; Infobip, 2024). One of their core functions in the digital environment is to enhance user engagement by encouraging interaction with applications (Infobip, 2024). Research has shown that well-designed notifications could significantly increase user retention and app usage frequency (Pielot et al., 2014). Bell et al. (2023) also confirmed this point, they found that the users who receive notifications are 3.5 times more likely to

open the app within the next hour, demonstrating the powerful role of notifications in driving interaction.

The rapid growth of mobile notifications has significantly exacerbated the problem of information overload. It is estimated that approximately 2.5 EB of new data is generated every day (Fadel et al., 2023), which seriously affects users' attention. As Johnson (2012) metaphorically put it, people's desire for information today is like others' desire for food, leading to what he calls “information obesity”. Unlike users who actively seek information, push notifications frequently interrupt users with unsolicited and often irrelevant content, distracting users and increasing cognitive load. These constant interruptions not only have a negative impact on users but also harm the applications themselves. Chang et al. (2017) found that excessive notifications reduce users' sensitivity to alerts, ultimately weakening their intended effects. Similarly, Ohly and Bastin (2023) also demonstrated that reducing notification-driven interruptions can improve task performance and reduce stress. Pielot and Rello (2017) further confirmed that turning off notifications helped some participants improve their focus and efficiency, but some participants also reported feeling anxious in the absence of expected reminders. In addition to emotional fatigue, notifications could also affect interaction behavior between users with the applications. Wohllebe et al. (2021) found that increasing the frequency of non-personalized notifications led to lower open rates and higher uninstall rates among users. This highlighted that notification overload is not only a user experience issue, but also a strategic risk for app developers. As Stach et al. (2024) pointed out, the notifications have evolved from passive reminders to active shapers of user behavior and sentiment. However, if the notifications keep poorly managed,

particularly in terms of frequency, timing, and content—notifications might provoke a strong backlash from users. Many users mute notifications or abandon apps altogether if they are irrelevant or excessive (Wu et al., 2019; Visuri et al., 2019; Gani et al., 2025). These results highlighted the need for more thoughtful, context-aware notification design.

In the current digital landscape, the design of notifications plays a vital role in shaping user experience. Therefore, it is necessary to explore how different notification designs affect user responses, and how contextual factors (such as when and where users receive notifications) influence their perceptions and responses. As Sutcliffe (2016) pointed out, a product must first attract and engage users and then maintain their interest until its promised value (whether it is utility or fun) is realized. Moreover, the context in which notifications are received significantly affects user perception. Research indicated that user expectations for notifications differ across settings: in work contexts, users prefer task-relevant and practical alerts, whereas in leisure contexts, they are more receptive to social or entertainment-related content (Dora et al., 2020). What is more, content richness and relevance are also very important in notifications. Personalized content tailored to users' traits and contexts are more effective at motivating desired behaviors than generic ones (Jankovič et al., 2022). Additionally, AI-driven personalization has increasingly become a research focus, AI-based notification summary technology could not only reduce user burden but also improve the efficiency of obtaining information (P. Wang et al., 2023).

Based on this background, this study aims to explore how different notification designs influence user behavior and experience, with a particular focus on notification practicableness (content richness and relevance) and visual appeal (emojis). It also

investigates whether users' preferences for these two dimensions vary significantly between work and leisure contexts. By critically analyzing the strengths and limitations of current notification design, this study seeks to offer actionable suggestions for improving notification systems. The key research questions are:

1. How do users perceive and respond to mobile app notifications that vary in practicableness (content richness and relevance) and visual richness (emojis)?
2. To what extent do users' preferences differ from work and leisure conditions in terms of mobile notifications in terms of practicableness (content richness and relevance) and visual richness (emojis)?

Through in-depth interviews, this study seeks to provide theoretical insights and practical recommendations for designing context-sensitive notifications that balance information delivery with user enjoyment, in order to enhance overall user experience and engagement.

2. Theoretical Framework

Whether the design of digital notifications has practicableness (content richness and relevance), which highlights the notification high content richness and relevance) or visual richness (emojis), which conveys notification through expressions, symbols, or aesthetics), it will have a certain degree of impact on user experience and satisfaction. Kim (2022) pointed out that although the interface of notifications and user experience are continuously evolving and improving, they still often disturb users. Kim (2022) also emphasized the importance of optimizing visuals to make notifications more relevant and

personalized, which can increase emotional engagement and satisfaction. Therefore, this paper explores how notifications which emphasize practicableness, and visually appealing notifications impact user experience in different ways, with this impact often being moderated by the context in which they are used. As a result, this study investigates the differences in users' needs for practical and visual notifications in both work and leisure contexts. This research approaches the topic from a few theoretical perspectives, systematically examining the interaction between notification design, user motivation, and the use environment to reveal users' perceptions, reactions, and preferences when faced with different types of push notifications.

2.1 Practical Notice and Visual richness Notice

In this paper, practical notifications mean the content have rich information that are relevant to the users. Hedonic notifications, or visual notifications, refer to messages that include emojis in an emotional or attractive way.

Each smartphone user has their own preferences and settings, which means their interaction with smartphones can vary significantly (Visuri et al., 2019). As a result, relevant push notifications are usually tailored to each user's specific needs and interests, which enhances their effectiveness (Ankur, 2024). For example, Airbnb increased user engagement by 20% by sending reminders related to bookings and personalized travel suggestions (Airbnb Improved User Engagement by 20% Through Personalized Push Notifications - Our Blog, 2024). This shows that highly relevant text notifications can attract users and bring positive results for both the user and the company. Additionally, Li et al. (2023) pointed out that the timing and content relevance of a notification are key factors in triggering an immediate user response. Therefore, high relevance notifications

are effective in attracting user attention and have positive outcomes for both users and companies. Moreover, Pielot et al. (2014) emphasized that the choice of timing and content relevance of notifications plays a decisive role in encouraging user reactions.

To explain the key concepts of this study, the Media Richness Theory (MRT), proposed by Daft and Lengel (1986), provides a valuable framework. According to this theory, different communication channels can present different levels of information richness. And they also proposed that Media richness theory defined media richness as how effectively a medium can convey detailed and context-sensitive information. According to their research, this depends on the speed of interaction, the number and type of cues the medium can carry, the flexibility of the language, and how effectively the media can adapt to individual communication needs. Richer media are more effective in reducing uncertainty and promoting understanding, especially when the information contains ambiguity or emotional nuances (Daft & Lengel, 1986).

The emojis are related to media richness theory (Wang et al., 2023). Emojis serve multiple purposes; they not only convey emotional tone but also enhance the clarity of the message, which help users grasp the notification content more quickly (Jaeger et al., 2018). This matches the idea of media richness theory. Wang et al. (2023) also claimed that emoticons are easier to understand quickly and effectively than plain text. Several research results further support this connection between media richness and user engagement. According to Bahir et al. (2019), notifications containing images or icons tend to achieve a significantly higher response rate compared to standard text-based notifications. Additionally, Novak et al. (2015) also claimed that emojis help human beings quickly interpret emotional intent and facilitate information processing. Also, Schreiner et al. (2019)

illustrated that the way content is presented, especially with rich media elements like videos and images, could greatly improve how engaging the information is, which makes it more likely to trigger emotional responses from users. The study conducted by Schreiner et al. (2019) also highlighted that emotions play a mediating role between content characteristics and user behavior. Furthermore, research has shown that emojis enhance emotional communication, particularly in terms of emotional interpretation (Jaeger et al., 2018; Yan et al., 2024). This is consistent with MRT's core assumption that richer media are more effective in conveying complex and emotionally charged messages.

Finally, rich media could help with vividness and attractiveness. Rich media notifications, such as images and videos, are shown to increase click-through rates because these visual elements are more likely to capture users' attention compared to plain text notifications, thus encouraging interaction (The Rich Push Advantage: How Media Elements Boost Engagement by 25%, n.d.-b). Gavilan et al. (2020) also showed that it could significantly improve the vividness of the image if the image is matched with the text.

Emojis are as important as text message in communication (Hand et al., 2022). On this basis, Tauch & Kanjo, (2016) found that emojis in mobile phone notifications help avoid misunderstandings by conveying emotional polarity; for example, notifications containing multiple emojis have stronger emotional valence than plain text notifications. Hand et al. (2022) asserted that the interaction between message valence and emoji type significantly affects perceived emotionality and clarity. They also mentioned that object emojis are advantageous over inconsistent or ambiguous text-emoji combinations. This is also consistent with the concept of MRT. The media richness theory believes that there

should be a perfect fit between the ambiguity of the communication scene and the richness of the media (Wang et al., 2023; Daft & Lengel, 1986).

2.2 Work or Leisure

Work refers to structured, goal-oriented activities that are usually done to gain income or meet social responsibilities (Van Der Laan et al., 2023). In contrast, leisure refers to activities that people choose freely and do for enjoyment, helping them relax and escape from work-related duties (Iso-Ahola, 1980). These two situations are very different. They not only shape people's attitudes toward certain events but may also influence how users respond to different types of notifications. To be effective, any notification system must first catch the user's attention to some degree (McCrickard et al., 2003). However, the level of attention users give to notifications is not always the same. It changes depending on their current environment and task.

What is more, to better understand why users react differently to notifications in work and leisure situations, the researcher could use the theories of Uses and Gratifications and Cognitive Load. In this case, Cognitive load theory can be used to explain. Cognitive Load Theory (Sweller, 1988) put forward that human beings have limited mental capacity. In work situations, frequent task switching and complex information can increase cognitive load, causing reduced attention and lower efficiency (Sweller, 1988). In addition, Gao et al. (2020) found that when there are too many or inconsistent multimodal elements in a message, it could increase cognitive load and reduce processing fluency. This suggests that although hedonic design can enrich the user experience, if used excessively or imbalanced, it may lead to distractions, frustration, and even reduce usability (Orazi et al., 2023; Youn, 2024). Interruption overload caused by a large number of inappropriate notifications is the

main cause of information overload (Okoshi et al., 2015), and it has been proven that in the workplace, notification interruptions will negatively affect work efficiency (Adamczyk and Bailey, 2004). In work settings, users often face more pressure and need to focus on efficiency. Pejovic and Musolesi (2014) pointed out that notifications that are timely and task-related, such as reminders or updates, are more likely to be accepted. These notifications help reduce cognitive load and improve task performance. Similarly, Böhmer et al. (2011) found that task-focused notifications are seen as less disruptive in work situations, because users mainly care about productivity and avoiding distractions. Iqbal and Bailey (2010) supported this idea by showing that during complex tasks, users are more sensitive to interruptions and view unrelated notifications as annoying. This explains why user reactions to notifications can vary greatly depending on the situation.

To avoid negative reactions such as cognitive overload, Pielot et al. (2014) suggested using context-aware notification strategies. These strategies adjust the content of notifications based on users' current activities and environment, which can help improve acceptance and retention. Nevertheless, Fischer et al. (2010) found that even if a notification comes at the wrong time, users may still accept it if the content matches their personal interests. This shows that content relevance can sometimes be more important than perfect timing.

In terms of the Uses and Gratifications Theory, it highlighted that users actively choose media that fits their needs in a certain context (Katz et al., 1973). Additionally, his theory emphasized that people select media to satisfy their personal needs and motives (Katz et al., 1973). What is more, Stafford et al. (2004) discussed the motivations behind Internet usage, and it confirmed that users use the internet to satisfy their various needs.

Originally developed for traditional media, the Uses and Gratifications Theory remains relevant in digital contexts. Smartphone users actively choose apps and personalize their features, reflecting intentional, need-driven media use (Devrim, 2023).

Meanwhile, Schreiner et al. (2019) illustrated that the way content is presented, especially with rich media elements like videos and images, can greatly increase how engaging the information is, making it more likely to trigger emotional responses from users. The study also highlighted that emotions play a mediating role between content characteristics and user behavior (Schreiner et al., 2019). The richer the media, the stronger the emotional response triggers, which in turn increases the likelihood of behavioral engagement. Likewise, the study on mobile video ads also indicated that rich media content not only captures users' attention and improves memory but also can increase their emotional involvement and desire to interact (Alamäki et al., 2019).

Norman et al. (1995) proposed that user experience theory provides insights for designers to reasonably cope with situational moderators by highlighting overall satisfaction. It focuses on the practical and emotional value that users create for a product or service during use. Norman et al. (1995) advocated the user-centered design concept. In the cross-analysis of different notification situations, it emphasizes the establishment of effective notification according to the variability of situations so that it can meet the task requirements and have the function of emotional arousal at the same time. Bailey and Konstan (2006) further emphasized that by establishing situational consistency, designers can minimize the interference experience caused by information to receivers. By establishing consistency in notification patterns and usage scenarios, designers can make it easier for users to receive information and generate goodwill and a desire for further

interaction.

To sum up, the above theoretical research focusses on the impact of practicableness relevance notice and visual appeal notice on users, as well as users' perceptions and attitudes under different situational factors. Practical notification works by guiding users' actions through obvious words and keywords. The visual richness notification evokes an emotional response through symbols and so on to guide the next action. Situational factors influence the perceived efficiency of the two notification modes.

3. Methodology

3.1 Research Design

3.1.1 Materials

This study aims to explore how different types of notifications affect user interaction, and how people feel about notifications in two different situations: when they are working and when they are relaxing. A qualitative method was used to find out what causes users to give positive or negative feedback when they interact with notifications.

To answer the first research question, the study used in-depth interviews. Before the interview, participants interacted with different types of notifications prototypes. Then, they were asked to talk about their experience. There are four types of notification combinations in this study: (1) high practicableness & high visual richness, (2) high practicableness & low visual richness, (3) low practicableness & low visual richness, (4) low practicableness & high visual richness (See Figure 2). By comparing

these combinations, the study intends to find out which features help improve user satisfaction and willingness to interact with notifications.

All the notifications are related to health information, focusing on preventing users from sitting for long periods. To control the variables in the experiment, the high practical notifications are identical, and the message is: “Reminder: You've been sitting for 60 mins. It's time to take a break. Stand up, stretch your legs, and walk around for 5 mins. Your health depends on it.” The low practical notifications are also the same and say: “You got a notification.” For the visual appeal, the high visual appeal notifications include four emojis: 🧘, 🔔, 🧘, while the low visual appeal notifications do not include any emojis.

The prototype testing was conducted on the researcher’s computer because the researcher cannot guarantee that the software used will not cause privacy issues. To simulate the real use of a phone, the test began with a simulated mobile news reading page. There are two pieces of news. And then, the notifications automatically were shown on the screen after 10 seconds on the news page, the participants chose to click or not click the notification or swipe away the notification. When the participant chose to click, then the phone would navigate to the app page. The whole flow of this prototype is in Figure 3, prototype 1 is used as an example. The news and its sources are in Appendix A, and the pictures used in the prototype design are also cited in Appendix B.

To explore the second research question, the study also used a method called hypothetical scenario-based interview. Therefore, the participants were asked to imagine

they were in a certain situation, such as working or relaxing. Then the participants were asked to share their opinions about the notification in some certain situations. According to Carroll (2000), using scenarios helps the researchers to understand users' real needs because the questions are based on situations from real life. This method might be helpful when it is hard to test the situation in real life, but the researcher still wants to understand how users would react in different contexts.

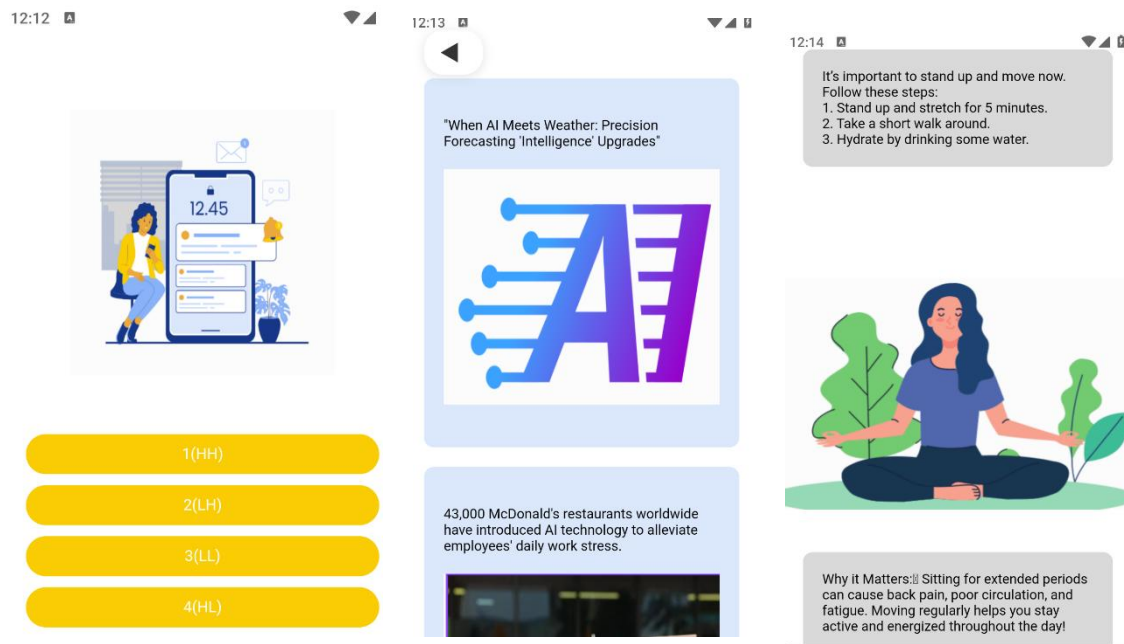


Figure 1: Prototype interface

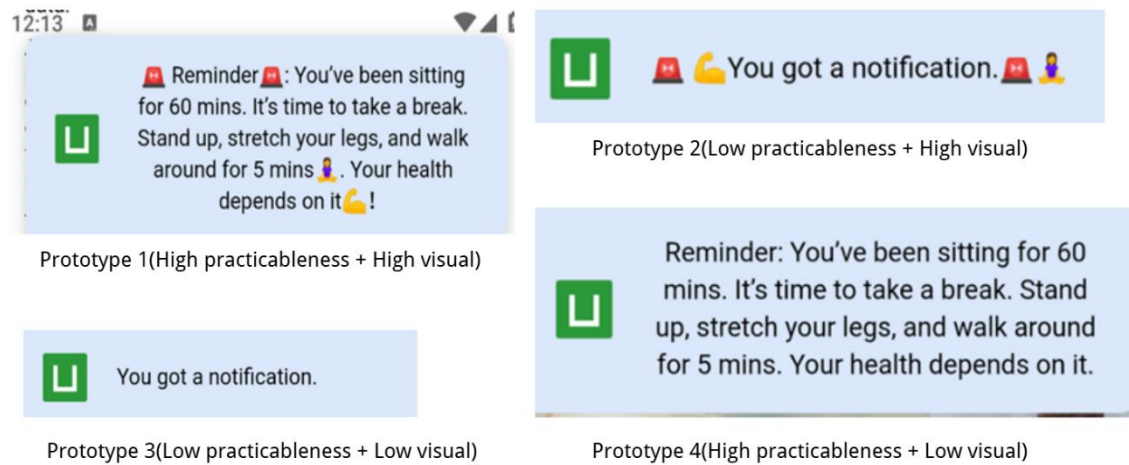


Figure 2: Four notifications

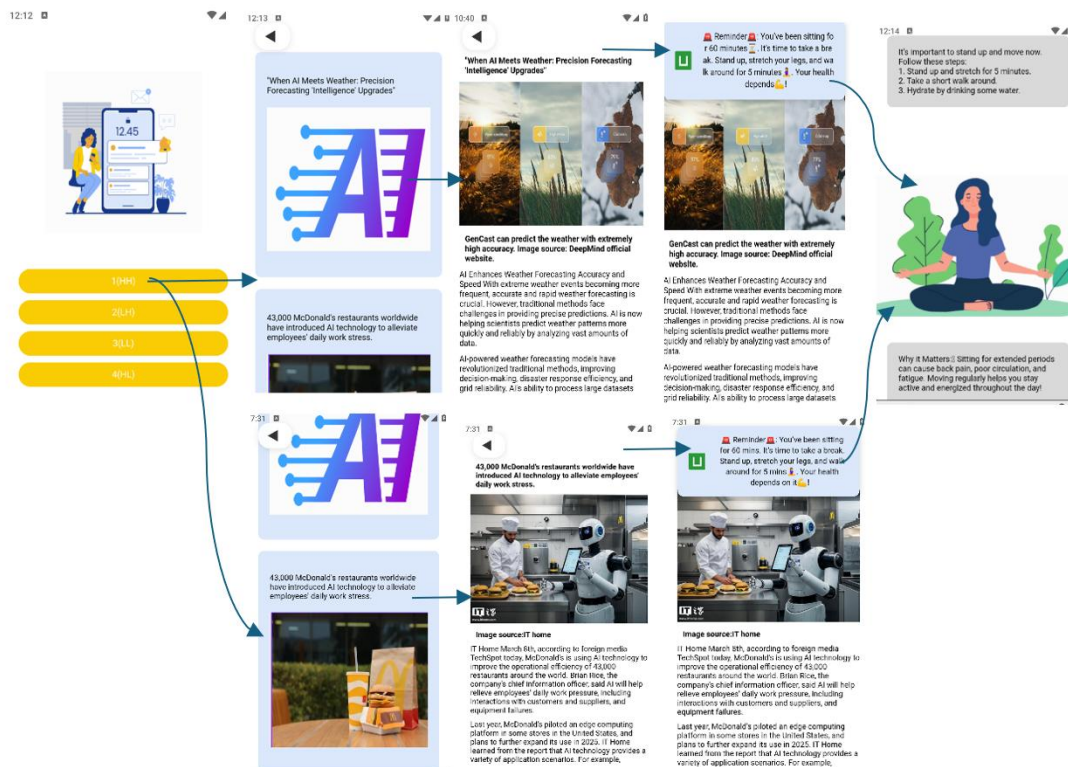


Figure 3: The flow of the prototype (use prototype one as an example)

3.1.2 Procedure

The first part of the experiment was the warming-up stage. In this phase, the

researcher first asked participants for consent to record, and explained any potential risks of the experiment. Afterward, the researcher engaged in informal conversations with the participants to understand how they usually interact with notifications. The researcher asked about the types of notifications participants typically receive, how they deal with them, and their preferences or habits. Additionally, factors that may influence their notification experience, such as frequency, content, or design, were discussed. The goal of this stage is to build a trusting relationship with the participants and gather background information to inform the later stages of testing.

The second stage is prototype testing. In this phase, participants interacted with four different notification prototypes. And then, the participants provided feedback based on their experience with each one. The key focus here is to ensure that participants could truly experience and evaluate the design elements of each prototype, providing comprehensive feedback about their interaction with them. This stage allows the researcher to gather initial reactions from participants, which is crucial for later analysis.

The third stage is the prototype evaluation. In this stage, the researcher worked with the participants to analyze and evaluate the effectiveness of each prototype. Through interviews and discussions, the researcher gained a deeper understanding of which prototype or design elements the participants prefer, exploring their emotional responses and practical assessments. The researcher paid special attention to identifying the factors that most effectively increase user interaction and satisfaction with the notifications. This stage provides valuable insights for determining which design is most preferred by the users.

The fourth stage is the scenario testing. In this phase, the researcher guided participants to imagine themselves in different scenarios, such as being at work or in a leisure setting and ask them to share their preferences and feelings about the notifications based on these scenarios. The goal of this part is to explore how different contexts affect participants' preferences for notification prototypes.

The entire interview process lasted between 45 and 60 minutes, this could ensure that each stage has enough time for detailed discussion while preventing participant fatigue. The specific interview outline can be found in Appendix C.

3.1.2 Participants

A total of 16 participants (13 females and 3 males) were included in this study (See Appendix D). Their ages ranged from 22 to 32 years old, with an average age of about 25.1 years old. All participants were randomly invited, and recruitment was conducted through social media posts, and personal networks. They were mainly composed of master's students and recent graduates. All participants reported frequent use of smartphones and mobile applications. Additionally, they are proficient and fluent in English or Chinese. Also, the interviews were conducted both online and offline, it all depends on the participants' preferences. All interviews were conducted in locations that were familiar and comfortable to the participants, because Hockey (1993) explained that when people think about familiar situations, it becomes easier for them to talk about their experiences, even if those thoughts are usually hard to explain.

3.2 Validity and Reliability

3.2.1 Validity

To ensure the quality and trustworthiness of this study, the researcher followed the

four evaluation criteria proposed by Lincoln et al. (1985): credibility, transferability, dependability, and confirmability.

To improve credibility, the researcher used recordings and notes during the interviews. The researcher not only collected what participants said, but also paid attention to their non-verbal reactions, such as facial expressions and body language. Important concepts like “practicableness” or “visual design” were explained in simple words so that participants could clearly understand the questions and avoid confusion.

This study does not aim for wide generalization, but to ensure the transferability, enough background details and direct quotes from participants are provided so that readers can decide if the results might be useful for other notification designs or app contexts. For example, the researcher explained the interview setting, the types of notifications used, the participants’ background, and how they reacted. This helps other researchers understand if the findings might also apply in their own work.

While, to support confirmability, the researcher kept the research process transparent. And the codes were created in the Atlas.ti. Each research result is supported by direct quotes from participants.

3.2.2 Reliability

In this study, Cohen’s kappa coefficient will be used to ensure consistency and accuracy in the codebooks. The researcher will first randomly select several interview samples from the full dataset and develop a codebook with key factors to be measured: Usefulness, Design, Click Intention, Engagement. The complete codebooks with participants attributions are included in the Appendix E.

Then, an independent second coder will be invited to analyze two of the interview

samples using the same codebook. By comparing the coding results from both coders, the Cohen's kappa value will be calculated to measure the level of agreement between them. This helps confirm the reliability of the coding and supports the trustworthiness of the study results (See Appendix F).

3.3 Pilot test

In order to make sure the feasibility of the research process and the rationality of the interview guideline, the researcher conducted a pilot test before the formal interview. One participant was invited to participate in the test, and the data generated during the test was not included in the final research analysis. This participant's demographic is Female, 27 years old. The pilot interview went smoothly, and the participant completed all the processes and gave positive comments. After the interview, the researcher asked about the difficulty of understanding the questions and the clarity of expression, which aims to find potential improvement points. The participant said that the outline was clear and did not need to be adjusted. It was only suggested that the "reading news" part could be informed in advance before the prototype test to simulate the daily use of mobile phones.

Overall, the pilot feedback showed that the research structure was reasonable, and the process was clear and understandable. The participant did not encounter confusion or obstacles in the process of understanding and answering, which laid a good foundation for the subsequent formal interview.

4. Results

4.1 Overall Ratings across Notification Designs

During the interviews, every participant was told to give a score to four notification designs that differed in practicableness (high vs. low) and visual richness. The four different notification models are: 1. High practicableness + High richness of visual (in the following text will be abbreviated as HP + HV), 2. Low practicableness + High richness of visual (in the following text will be abbreviated as LP + HV), 3. Low practicableness + Low richness of visual (in the following text will be abbreviated as LP +LV), 4. High practicableness + Low richness of content (in the following text will be abbreviated as HP + LV). Meanwhile, the range of ratings is from 1 to 7, with 1 means does not like it at all and 7 means liking it very much. The scores of these notifications' prototypes could show rough notifications' preference pattern.

As shown in Table 1, the “HP + HV” notification prototype received the highest mean score (Mean = 5.19), which could indicate that this combination was more attractive among the 16 participants. Additionally, it was followed by the “LP + HV” condition (Mean = 4.44) and the “HP + LV” condition (Mean = 4.41), with approximately the similar mean ratings. However, the “LP+ LV” notification prototype received the lowest score (Mean = 4.04), which could represent that the participants thought it was the least effective or least attractive among these four prototypes. What also needs to be mentioned is that all the averages are rounded to two decimal places.

	HP+HV	LP+HV	LP+LV	HP+LV	Total
P1	5	4	5	6	20

P2	5	3	4	7	19
P3	4	6	5	4	19
P4	5	3	1	3	12
P5	7	1	3	4	15
P6	5	6	5	4	20
P7	7	5	4	5	21
P8	6	2	5	4	17
P9	3	4	3`	5	15
P10	5	5	4	2	16
P11	6	2	1	5	14
P12	4	5	5.5	6	20.5
P13	4	6	5	3	18
P14	5	6.5	2	3.5	17
P15	7	6.5	5	2	20.5
P16	5	6	5	7	23
Average	5.19	4.44	4.04	4.41	

Table 1: Scores of four notifications

To compare these four different combinations of the notifications' prototype, "HP + HV" and "LP + HV", or "HP + LV" and "LP + LV", it is clear to see that the high practical content scores higher, which might indicate that practical content may be an important aspect in the notification experience. Secondly, in terms of visual richness, by comparing "HP + HV" and "HP + LV", and "LP + HV" and "LP + LV", the researcher found that visual richness also affects the notification experience to a certain extent. Of course, these two factors will interact and jointly affect the overall experience.

Next, the researcher used Codebook to conduct text analysis on the participants' perception and behavioral intentions of each prototype. In order to better elaborate, each prototype will be interpreted from the perspective of positive and negative, and the attributions of each codebook are in the Appendix D.

4.2 High practicableness + High visual richness

4.2.1 Usefulness and Design

Positive

The most frequently mentioned Code in this category “Usefulness” was useful/practical in terms of positive situation, which was mentioned 11 times. Participants said that detailed and relevant notification information would be very useful to them. In addition, “Understandable” and “Clear/Concise” were mentioned 4 times each, and three participants mentioned both at the same time. They stated that notifications that do not have too much irrelevant words and can clearly convey the exact information are often considered easy to understand and concise.

As for the positive design aspects, the most mentioned code was “Attractive/appealing” and “Intuitive/Straightforward”, each of them was mentioned by 9 participants. In addition, the code “Nice combination” and “Cute/Adorable” were mentioned by 8 participants each. And the least mentioned was “Clean/Clear”. Most participants responded positively to the visual design elements (emojis). These elements were often described as “refreshing”, “Cute” or “Personality”. Additionally, the participants also stated that emojis may be more arousing and attract them to read.

Quotes

“And the structure it was written was also really great. It was like First getting your attention and saying why, and then in the end it was like a call to action like stand up and stretch.” – P15, Female, 26 y.o

“Emojis give me a refreshing feeling.” –P7, Female, 24 y.o

“The emojis in the scene allow me to catch my eyes at once.” –P11, Female, 24 y.o

Negative

As for the negative codes of the design, there are “Garish/Gaudy”, “Prolix/Too much” and “Complex”. Among them, “Prolix/Too much” was mentioned the most, with a total of 11 participants mentioned. And among them, P1, P3, P6, and P16 mentioned all these three codes, which might show the underlying connections between the three codes. What is more, many participants expressed dissatisfaction with the overly long and over-designed towards this notification. The excessive usage of emojis and lengthy texts, and the combination of the two might lead to negative evaluations of the design. Additionally, visual complexity is the main reason why users describe the design as “garish” and “Noisy”.

Quote

“Maybe slightly less emojis would be my preference.” -P4, Female, 25 y.o

“I think we shouldn't use too many images to convey information.” -P1, Female, 25 y.o

4.2.2 Engagement

Positive

Positive engagement involves 6 codes, they are “Happy”, “Human touch”, “Energetic”, “Enjoy”, “Supportive”, and “Explanatory”. Among them, “Enjoy” and “Supportive” were mentioned the most with a total of 10 times. Most participants who mentioned “Supportive” also mentioned “Human touch”. Only 1 participant mentioned Energetic. Thus, some of the participants think that this type of notification is pleasant and friendly. In addition, emojis, content, and the combination of the two create a feeling of warmth, support, and positivity. What is more, “Humanized” notifications can make participants feel valued and encouraged.

Quotes

“It felt more personal, and it felt more light and positive.” & “I actually really like the combination of like very explanatory text and the emojis.” -P4, Female, 25 y.o

“Well, the first one has an image and a text, and it is interspersed in the text, which gives me both practical information and emotional transmission, because of those emojis.” -P7, Female, 24 y.o

Negative

There are three codes for negative engagement: “Tension”, “Annoying”, “Overwhelming/Cognition overload”. And the most mentioned one is “Overwhelming/Cognition overload”, which was mentioned by 7 participants. Among them, 5 participants mentioned “Tension” while mentioning overwhelming and cognition overload. Additionally, some of the participants believed that long messages and notifications with emojis would cause pressure and difficulty on their information processing and cognitive processing. This might be reflected in the fact that during the interviews, some participants needed to test the prototype twice before they could finish reading the notification. Also, some participants also claimed that the notification was too long and needed to be read in a very quick speed, which might be the reason for causing tension and annoyance.

Quotes

“It makes me feel a little too much and the overall feeling is that my brain can't handle so much information. If it is given to me at once, I will feel a little too much.” -P12, Female, 28 y.o

“... a bit anxious about it because there's something like a really strong in the way I was like focusing on something at the same time.” -P8, Female, 23 y.o

4.2.3 Interaction intention

Positive

There are three main positive interactions: “Click”, “Do it later”, and “Follow the notification”. 5 participants chose to click, 1 participant chose to click later, and 4 participants chose to follow the notification. The interaction impulse is a combination of content, design, and emotional connection. Some participants claimed that when they perceive the value or emotional connection of the notification, they are willing to take action. Additionally, the participants who chose “Follow the notification” pointed out that because the content is already rich and clearly conveys what it wants to express, so they will not choose to click, they would rather act according to the content of the notification. In addition, P2 indicated that she would click later. Thus, this shows that meaningful participation does not always rely on application interaction.

Quotes

“It is useful to me, I will click it, I will open it.” -P5, Male, 24 y.o

“...I will leave it on the screen, but I will do what it says.” P2, Female, 32 y.o

Negative

“Ignore/Swap away” was chosen by 2 participants; and “No click”, which was chosen by 7 participants. Even if users read the content, they often choose not to interact with the notification. Some of them will ignore it completely, while others claimed that there is no need to click because the message itself is “Completed”. For many participants, the laborious design prevents them from taking further action, or they think that this combination of notifications gives them the feeling and illusion of an

advertisement and therefore feels irrelevant and unimportant.

Quotes

“I may not click it. I may spend time clicking it, because I feel that this notification with an image has perfectly expressed the feeling of the text that he wants to bring to me. Then, maybe through this simple reading, I already understand what this notification wants to tell me, um, I may not click it.” -P7, Female, 24 y.o

4.2.4 Conclusion

Participants’ perception of mobile notifications was shaped by the interaction of four core dimensions: usefulness, design, engagement, and interaction intention. These dimensions do not work separately, but together affect the participants’ positive and negative notification experiences.

In terms of usefulness, notifications were rated highly for conveying relevant information, being concise, and easy to understand (useful, concise, understandable). Participants particularly appreciated this notification has clear goal and were aligned with their personal goals. At the same time, the notification was also clarified by many participants as being too lengthy (Garish/Gaudy, Prolix/too much), and even if the visual design with emoji was acceptable, it was likely to cause negative feelings among participants.

Also, design had a dual effect. On the one hand, the participants responded to designs that adopted intuitive designs positively, and effectively integrated emojis and text, and emojis were used to assist in the transmission of information (Nice Combination). On the other hand, some participants indicated that visual overload (many emojis and lengthy text) might cause cognitive overload and participant rejection

(overwhelming).

In terms of engagement, whether participants are positive or negative is influenced by their overall perception of usability and design. Participants thought that the notification was clear in intent and provided a sense of support (Supportive, Explanatory). However, some participants also experienced psychological discomfort or emotional detachment due to cognitive overload.

In terms of interaction intention, it is directly related to whether the engagement is positive or not. Interactions that present positive results in engagement are usually positive, and vice versa. However, it is worth noting that clicks are not the only indicator of engagement. Some participants reported that they would follow the notification information because the notification content is rich and there is no need to click on the notification. Thus, the improvement might be that the completeness and surface readability of the information may reduce the need for direct interaction.

4.3 Low practicableness + High visual richness

4.3.1 Usefulness and Design

Positive

In terms of positive usefulness, while many participants found the notification visually driven and emotionally expressive, a few participants recognized its practical value in subtle ways. The most frequently mentioned positive code related to usefulness was “Short/clean”, which was mentioned by 9 participants. This could indicate that participants who mentioned this code appreciated concise content. Despite the vague content, participants found the short format to be desirable. Additionally, the participants who

responded positively to usefulness stated that short text was easier to understand, especially compared to longer, content-dense notifications. Despite limited semantic clarity, some participants found the overall intent of the message to be helpful, at least non-intrusive.

Design was one of the most praised aspects of this notification prototype. The most frequently mentioned codes were “Cute” (8 participants). Participants generally appreciated the emojis, and finding them cute, friendly, and eye-catching. Some participants noted that colorful or symbolic designs made notifications more appealing and even increased their willingness to click. What is more, the participant P15 also emphasized that the design was not only visually appealing, but also helped them process notifications faster. She also indicated that the emojis could help convey some information. This was particularly effective when simple visuals were combined with emotionally expressive icons.

Quote

“It is very concise and does not specifically say what happened.” -P7, Female, 24 y.o

“I would prefer a little cute emoji.” -P3, Female, 25 y.o

“For me, the function of this part is very low, but it is matched with a high emotional.

Things make me feel very strange and, well, it gives me emotional value, but I don’t know

what it is. It’s actually a bit subtle.” -P12, Female, 28 y.o

Negative

Although a few participants appreciated its short and emoji-rich appearance, most participants claimed that the prototype is lack of substance and clarity. The most frequently mentioned negative usefulness codes were “Vague/sparse content” by 12 participants, a d and “Redundant” were mentioned by 6 participants, “Unmatched” were by 3 participants,

and "Prolix/too much" was only mentioned by 1 participant. These responses reflected participants' strong dissatisfaction with the text. Some participants felt that the notification looked attractive but did not convey any meaningful content. Some felt that the content was "empty" and lacked specific information or guidance. Additionally, the participants who reported "Redundant" stated that this notification was better not to send.

In terms of design, some participants found that this notification seemed redundant and did not provide any useful information beyond the visual designs. A few participants mentioned (P1, P5, P12) that the text and emojis seemed unmatched, which gave a sense of mismatch. The mismatch between the rich emoji design and the text without substantive content significantly affected the perceived usefulness. For these participants, the notification felt more like an emotional prompt without a purpose, which also seems like trying to be attractive, but unhelpful. Participants P1, P5, P12 claimed that while visual elements such as emojis could attract attention, they often fail to connect to meaningful or useful content. The mismatch between design and information led to confusion and even mistrust. Additionally, three participants (P1, P4, P5) felt that the notification was "Ads-like". Other participants, such as P2 and P12, highlighted the unnecessary emojis for conveying meaningless emotions, which was also the result of the vague text and the mismatch between the text and the emoji, which weakened the credibility of the notification.

Quote

"I think it is very abrupt." -P1, Female, 25 y.o

"And it is equipped with emojis. ...is usually a childish notification or a notification that is irrelevant to me and I don't need it." -P5, Male, 24 y.o

“When it has a lot of designs, but there is no clear message or theme that I want to know, I will feel it is more like an advertisement.” -P1, Female, 25 y.o

“For me and to like, stimulate me to stand up. emotional confused. But nothing really comes out. So it's kind of a burden for me, like I was when I see it. Like uh, kind of subconsciously.” -P2, Female, 32 y.o

4.3.2 Engagement

Positive

Active engagement was driven by three key codes: “Enjoy” (7 participants), “Curiosity” (9 participants), and “Warmth” (6 participants). Participants felt that rich emoji designs were both fun and emotionally stimulating. Many participants described notifications as “creative,” “friendly,” or “cute.” Even when the text was vague, an engaging visual tone and emotional expression sparked curiosity and engagement. Participants frequently associated visual tone with humanizing interactions and felt that even uninformative designs could inspire engagement.

Quote

“I think because the emoji OK, because I like them and it makes more interactive, so click it because of them.” -P6, Female, 22 y.o

“If there are so many words, I feel tired and I think it can't relax me, but the second one has very few words, so I think it can relax me, so I may prefer the second one.” -P14, Female, 25 y.o

Negative

Negative engagement codes included “Annoying,” “Confused,” “Stressful,” and “Anxious”. Among these “Annoying” were the most frequently mentioned, with six people

mentioning it. This is directly related to the vagueness of the text content and the mismatch between the design and the text. P1, P2, and P5 all responded with negative words, so engagement was also negative. Many participants felt that the notifications, while emotional on the surface, which impractical and meaningless. There are also some participants (P2, P12) felt that the notifications were manipulative, abrupt, or visually misleading, especially when the emotional design did not match the specific text. The emotional communication and vague wording of emojis made participants feel disconnected. In addition, some participants noted that although they initially clicked out of curiosity, repeated browsing caused them to lose engagement or feel annoyed.

Quote

“I think it also has too much design, which makes people feel that it looks complicated.”

-P1, Female, 25 y.o

“I will feel a little nervous.” -P7, Female, 24 y.o

4.3.3 Interaction intention

Positive

Positive interactions included “Click” (8 participants) and “Do it later” (1 participant). Many participants were willing to click on the notification because it sparked curiosity, especially when the emoji design created a sense of vagueness or urgency. There are also some participants found the message motivating, while others said they clicked just to clarify ambiguous information. This prototype triggered more active clicks than other prototypes, often because users needed to resolve confusion, instead of emotional appeals, visual creativity or the texts itself. Meanwhile the participant P8 mentioned both Click and Do it later because P8 said she would click, but she should finish what she was doing first.

Quote

“Because it doesn't specify what the content is, I might click on it to find out more about its content.” -P7, Female, 24 y.o

“Maybe I'm gonna check here after I will finish. I was focusing at the moment first.” -P8, Female, 23 y.o

Negative

Negative interactions were coded as “No click,” “Ignore,” and “Depends.” Six participants mentioned they would not click. P9, P10, P11, and P12 said that this needed to be analyzed on case-by-case, some of them thought that the type of app would influence whether they clicked on the notification, and some of them thought that they would refer to their current state and choose to click or not. However, the participant P10 who clicked did not necessarily have a positive evaluation of the notification, but were confused, so this also proved that confusion and curiosity could be forced to be stimulated by the ambiguity of the content. In addition, a key theme was distrust, some participants (P5, P7) expressed suspicion of notifications that looked like promotions or lacked a clear purpose. However, P7 said that he clicked out of curiosity at first, and would not click if the same information was displayed later, so P7 appeared in both the “Click” and “No click” codes.

Quote

“If the content is the same. I might not be very interested and I think it will be a little clickbait and not have any practical content.” -P7, Female, 24 y.o

“I may not click it, because I think at this time, its emojis and text are not very compatible.” -P12, Female, 28 y.o

4.3.4 Conclusion

This prototype received the most polarized feedback. On the one hand, some participants considered its cute, simple, and expressive design attracted strong interest and emotional resonance. On the other hand, some participants felt confusing because it is lack of useful content or clear guidance. In addition, some of the participants also reported that the combination of emojis and vague content made them annoyed and even stressed. In terms of usefulness, the short and easy-to-understand format was praised, but the vagueness and the structure that emphasized emotion over function weakened the perceived value. The design was seen as both an advantage (because it was creatively appealing) and a disadvantage because it did not match the content.

In terms of the interaction, some participants enjoyed the novelty and clicked out of curiosity, while others clicked mainly because the content was vague and they got confused. Or some participants thought the notification was meaningless and refused to interact. This disagreement suggests that emotional design that lacks functional clarity may initially trigger curiosity-driven engagement, but in the long run, it may reduce engagement.

For improvement, the emojis should be matched with clear, simple, and meaningful content so that curiosity is not discouraged by the lack of substance. But how to strike a good balance is still a big challenge.

4.4 Low practicableness + Low visual richness

4.4.1 Usefulness and Design

Positive

Regarding the positive aspects of usefulness, there was only one code, the code

“Understandable”. This code was mentioned by 4 participants. Some of the participants who mentioned this claimed that it was easy to understand because it was just a simple sentence. In terms of design, 10 participants (P4, P5, P6, P7, P8, P9, P10, P12, P15, P16) mentioned “Minimal”, with descriptions such as “simple”, “straightforward”, and “fast processing”. Many participants appreciated the minimalist layout because it was clear and easy to use, especially for receiving notifications in time-sensitive situations. In addition, the code “Normal” was also reflected by 7 participants, who expressed their approval of simple or neutral visual designs that avoid distractions. Although such designs are not outstanding, they are considered fully useful and are less likely to be rejected.

Quote

“I think it's very easy to understand.” -P2, Female, 32 y.o

“I would say that it's very quick. It comes up very quickly. And it's easy to reach as well.”

– P6, Female, 22 y.o

“Its design and everything are quite neutral and very flat, nothing will go wrong, but it is not very outstanding.” – P12, Female, 28 y.o

Negative

The most mentioned negative perception was coded as “Vague” (mentioned by 10 participants), which refers to the lack of specific information in the notification. These participants argued that the content failed to provide real value, calling it “unclear” or “ambiguous.” Related to this was “Hollow” (mentioned by 7 participants), where participants felt that the notification lacked substance or usefulness. Participants who reported that it was hollow also tended to mention “Vague”, with P1, P4, P7, P10, P11, P14,

and P16 all mentioning it. This suggests that vagueness and hollowness complement each other. Among them, P7, P11, and P16 also mentioned “Redundant”.

In terms of design, although minimalist design was praised, some participants thought it lacked human touch. “Impersonal” was mentioned by 5 participants, who thought it was “emotionally distant” or “mechanical”. Some participants further pointed out that the design might cause harm to the app. Therefore, 5 participants (P2, P4, P7, P9, P16) mentioned “Harmful”. Participants who mentioned harmful said that such a design would make them feel disgusted and then take their anger out on the app itself or the app developers (P9), and P2 also mentioned: “If it's keep showing the same thing, it's not only for me. I will ignore the notification, I will start to Ignore the app.”

Quotes

“It does not reveal any useful information, it is empty.” – P7, Female, 24 y.o

“it's the most impersonal and sort of generic” – P4, Female, 25 y.o

“I think the developer does not really care about the users enough.” -P9, Male, 25 y.o

4.4.2 Engagement

Positive

The main driver of engagement was “Curiosity”, mentioned by 7 participants. Many participants said that due to the ambiguity of the message or lack of clarity, they felt curious and clicked to learn more. This was often accompanied by “Click”, which could indicated that curiosity turned into actual user action. Meanwhile, the un-richness of visual and text also enhanced this sense of mystery and increased engagement.

Quote

“I'm curious what the notification is about.” – P2, Female, 32 y.o

“I clicked because it didn’t reveal the content.” – P10, Female, 25 y.o

Negative

Negative engagement mainly has two codes, “Frustrated” and “Confused”, which were mentioned 2 and 4 times respectively. This indicates that the ambiguity of the notification without content and emoji might make participants confused, and the lack of information will make the participants nervous and frustrated (P4, P5). What is more, the code “Confused” also reflects that there is ambiguity in the notification, and the participants (P4, P6, P7, P16) are not sure about the content and the purpose of the notification. However, “Confused” might cause positive interaction intention, and participants may click because they are confused about the intention of the notification.

Quote

“It's like it's the most impersonal and sort of generic and yeah, it it also doesn't give you the actual information. So it's just very fast, like annoying to get a notification like. This I think.” –P4, Female, 25 y.o

4.4.3 Interaction Intention

Positive

The user's intention to interact is mainly driven by curiosity or confusion. The main code here is again "Click" which was mentioned 6 times, and the purpose of the participant's click was to explore the content and intention of the notification. Curiosity was mentioned 7 times. According to the data, the participants who responded to curiosity finally chose to click on the notification, except P1. Moreover, "DO it Later" was mentioned 1 time, which reflects that P15 postponed the intention of interacting with the notification after getting curious.

Quote

“I’m going to click on it. And then discover after.” – P6, Female, 22 y. o

Negative

Non-interaction was still common. “NoClick” was mentioned by 6 participants and “Ignore” was mentioned by 2 participants, indicating that users rejected to interact with the notification, especially if the notification was vague or irrelevant. For some participants, clicking was unnecessary because the message did not convey any urgent or actionable information. Besides, “Depends” was mentioned 4 times, and these participants said whether to click or not depended on whether it was a social media app.

Quote

“The information giving I knew I have a message and I should check it out, but it’s nothing urgent.” – P15, Female, 26 y. o

4.4.4 Conclusion

While participants generally appreciated concise, visually clear information (“Clear”), notifications that were too vague or insufficiently informative were frequently cited as problematic (“Vague”, “Hollow”). Many participants mentioned that notifications that lacked meaningful content were useful. In terms of design, although this notification did not include emojis, its simple and direct layout was praised for its readability (“Minimalist”). However, when the information itself lacked clarity or the tone seemed too bland, some participants thought it seemed impersonal (“Impersonal”), or even confusing or frustrating (“Confused”, “Frustrated”). Moreover, curiosity was also an important factor driving participants to click (“Curious”), especially when the content was hidden. However, this curiosity-based click behavior is often difficult to sustain - once users feel that the

content is too vague or even "manipulated", they tend to lose interest or develop a sense of distrust ("NoClick"). Interestingly, in some cases, it is confusion or mild negative emotions that make users choose to click to view ("Click").

Overall, minimalist visual design is indeed effective in improving readability and stimulating curiosity, but if it lacks meaningful content or fails to relate to the user's current situation, it can easily be seen as irrelevant or even disgusting.

4.5 High practicableness + Low visual richness

4.5.1 Usefulness and Design

Positive

The most frequently mentioned code in positive usefulness was "Useful/practical," cited by 13 participants. Many participants said the notification conveyed valuable and relevant content that they found meaningful in their daily lives. Other frequently mentioned codes included "Efficient" (mentioned by 6 participants), "Related" (mentioned by 6 participants), and "Concise" (mentioned by 6 participants). These codes indicate that participants valued content that was not only useful but also concise and to the point. Furthermore, participant P1 praised the notification for "convey what it was trying to say," or described it as "concise, plain text, and easy to understand" (P3). It is worth noting that some participants also emphasized the richness and sophistication of content (Usefulness_Rich), but only if it adds value and does not cause cognitive overload. This suggests that information density must be carefully balanced with clarity.

In terms of positive design feedback, the most common codes were "Clean layout" and "Attractive", mentioned by 7 and 3 participants respectively. Participants appreciated

the clean layout, clean typography, and structure that supported the core information. Some participants noted that despite the simplicity of the design, it achieved its intended purpose by presenting information clearly and orderly. Even without the heavy use of emojis or bright graphics, participants found that the clear formatting helped direct their attention and made it easier for them to extract meaning from the text. The simple design approach seemed to help readability.

Quotes

“It successfully conveys what it wants to convey.” – P1, Female, 25 y.o

“Because it is useful and helpful, including that its content makes me stretch my hands... it is relatively easy and simple, does not require a lot of effort, and does not require any cost. So I think it is a meaningful notification.” – P11, Female, 24 y.o

“It was simple, just text, easy to understand, and the last sentence your health depends on, it really has, you know.” – P3, Female, 25 y.o

Negative

There are no negative comments regarding usefulness. However, many participants also raised negative comments about the design. The most frequently mentioned negative codes were “Prolix/too much” (mentioned by 10 participants), “Unreadable” (mentioned by 7), and “Rigid” (mentioned by 5). These comments reflected criticisms of the notifications being too long, lacking visual appearance. Four participants (P1, P3, P6, P16) mentioned all three negative design codes, which notes that there is a close underlying connection between lengthiness and poor readability. 9 participants described the notifications as “a rigid piece of text” or “too long to read” and noted that their visual monotony reduced their willingness to engage. Thus, the lack of emojis, or layout diversity

made the information appear lengthy and difficult to understand, which also affected the appeal of the notifications to a certain extent.

Quote

“It's very long, and then, it's a bit boring, that is, I won't. Read it through.” -P10, Female, 25 y.o

“It is very rigid.” -P7, Female, 24 y.o

4.5.2 Engagement

Positive

Participants who responded positively on engagement often described the notification as supportive, persuasive, and friendly. The most frequently mentioned codes were “Persuasive” (mentioned by 5 participants) and “friendly” (mentioned by 4 participants). These responses suggest that despite the lack of visual design of the notification with emojis, the participants (P3, P12) perceived its text and tone as helpful and sincere. Some participants likened it to a reminder from a friend, which helped to contextualize the message in a more understandable way. Interestingly, even without rich design elements like emojis, the language structure and clarity were enough to make the message appear thoughtful or motivational.

Quotes

“It's very persuasive... the text is more persuasive than an emoji than anything.” -P2, Female, 32 y.o

“I still like the text very much. Yes, because it makes me feel that it can really connect with me, yes, it is really helpful to me.” -P16, Male, 25 y.o

Negative

There are three negative engagement codes: “Cold”, “Annoying”, and “Boring”. The most common of these was “Boring”, which was mentioned by 9 participants. A significant number of participants also mentioned “cold” (mentioned 6 times) and “Annoying” (mentioned 5 times). These codes reflect the general lack of emotional connection users had with the notification, mainly due to the bland and rigid presentation of the text, which lacked visual or expressive elements. Participants described the notification as “a stiff piece of text” (P7) and “long and boring” (P10). Many felt that the message lacked humanity and was robotic due to the lack of emoticons or emotional tone. The participant P7 asserted that she felt “very cold” after reading the notification. And this might have a negative impact on the app, with P15 saying that she “might try to ban it” due to the rigid tone. The coldness of the text also led participants to question the intention and value of the message. Some of the participant described it as “like a system notification” or “too robotic”, which reduced the perceived relevance.

Quotes

“Long paragraphs of pure text are more...which makes me feel that I am not being noticed or not at all.” -P7, Female, 24 y.o

“...because it is quite long, and I don't want to finish reading it, so I think it is a relatively useless message.” -P10, Female, 25 y.o

4.5.3 Interaction intention

Positive

There are three types of positive interactions: “Click”, “Follow the notification”, and “Do it later”. The most mentioned one was “Follow the notification”, with 8 participants reporting that they would take action based on the content rather than clicking on the

notification itself. Some of participants (P1, P3, P4, P6, P9, P11) explained that they did not feel the need to interact further because the message itself was clear and contained enough information. Some participants even emphasized that the completeness of the content reduced the need for in-app actions and they were more inclined to respond through actions. Only 3 participants (P2, P12, P16) stated that they would click on the notification.

Quotes

“It gives me the information and also a reminder for me to, you know, walk around and then drink some water or, yeah, stop scrolling the phone.” -P3, Female, 25 y.o

“I will click it, because I feel that it is very closely connected with me, and it will be of great help to me.” -P16, Male, 25 y.o

Negative

Among negative interactions, “not click” was the most common, with 5 participants choosing to ignore the notification completely. Some participants ignored the notification completely, while others felt that clicking on the notification had no added value because the information on the notification interface was already fully displayed (P9).

Quotes

“I would probably try to ban it.” -P15, Female, 26 y.o

“I would say the same as before, like I would just click on it when I have time.” -P13, Female, 24 y.o

4.5.4 Conclusion

The participants’ evaluations of these four dimensions varied, highlighting how even a single notification design can trigger acceptance and resistance, depending on

individual needs and preferences. In terms of usefulness, the participants appreciated the clear and related of the content, especially when the text was concise and directly related to health or well-being. However, for some participants, the length and density of the information were key weaknesses, especially for those who need to read quickly or are sensitive to the amount of text.

Moreover, this notification was considered concise by some participants because it did not include emojis, while others thought it was rigid and boring. The lack of emojis or visual changes made the notification seem bland to many people, which reduce engagement and appeal.

In terms of engagement, a few participants found the notification persuasive or friendly and appreciated the clear intention behind its reminder. However, the majority found it boring or annoying, possibly because it was not enhanced by the visual design. Meanwhile, regarding interaction intention, while some participants noted that they would follow the notification without clicking, most said they would not engage further. This was often because the notification was considered “complete” or the visual part failed to inspire further action. A few participants even said that they ignored the notification due to its unattractive appearance.

Overall, the prototype was recognized for providing relevant and useful content with a clear structure, but it had difficulty maintaining the interest or emotional engagement of participants due to the text-heavy design. To improve, it might need to incorporate a reasonable amount of design while incorporating visual changes and reducing redundancy.

4.6 Work OR Leisure

4.6.1 Work

12 participants mentioned that when receiving notifications during work, clearness and conciseness are important in their responses. Concise notification allows them to extract information quickly and clearly. Meanwhile, P8, P11, and P12 also mentioned that the length of notifications should not be too long. In addition, P10, P11, and P13 clearly stated that long notifications or notifications which contain too many emojis are not suitable in a work environment. They prefer short notifications that can convey the core information immediately.

Quote

“At work, I think it’s best to be concise and clear, and not too long. It’s best not to have too many emojis and too much content like the first one, which I think will bother me. A shorter one is better.” – P10, Female, 25 y.o

“Although I know that this design is intentional, I would rather see concise information during work hours.” – P11, Female, 24 y.o

“Because it does not carry any image, because I may be a more focused person at work. I don’t have any subjective emotional value when I wear it, so, um, the fourth notification is not very fancy, it is more suitable for my state at work, and it will not distract me.”
– P7, Female, 24 y.o

While 9 participants expressed the desire to receive plain text notifications. P5 mentioned that because this format can clearly convey information without further interaction, because they usually have limited attention. In addition, the visual style also affects people's perception of professionalism. P5 said that this notification with

emoticons does not seem formal at work. This shows that the participants also require formal design in notifications while working.

Quote

“If its notification type has an emoji, I think it is not very formal and may not be related to my work. So I don't want to click on it.” – P5, Male, 24 y.o

Interestingly, the participants P3 and P4 had slightly different opinions. While they still value concise, they still hope that some lighthearted emojis may be refreshing during a busy workday, provided the content of the message is relevant.

Quote

“I mean at work I'm usually get stressed all the time, so I would prefer something cute...”

-P3, Female, 25 y.o

“I can imagine that when I'm working...notifications if they are like for something fun or something important, they can say serve as a good escape from work and like a little break.” – P4, Female, 25 y.o

In summary, participants such as P3, P5, P10, P11, and P13 highly favor notifications that are short, useful, and easy to process, especially during work when cognitive load is high. Although some other participants (P4, P9) also hope to receive notifications with emojis and lots of information while working, which can be used as a tool to relax while working.

4.6.2 Leisure

Participants were more tolerant of notifications in a casual or relaxed situation compared to the working environment. They clearly preferred lighthearted, visually rich, and emotionally rich formats. Specifically, P5, P6, P10, P11, and P13 said they were

more receptive to emojis, playful tones, and colorful elements during their breaks or non-work time, which corresponds to the code “Fun.”

Quote

“When I am resting, I can be a little more lively, such as multiple emojis, and it doesn't matter if the tone is a little more relaxed.” – P5, Male, 24 y.o

“But when I am resting, I will have the leisure to see various notifications, including if these notifications are fancy and look good, I will be more likely to click on them.” – P11, Female, 24 y.o

Meanwhile, the participants P2, P3, P7, and P15 mentioned “Efficient”, and P2, P3, P6, P7, P8, P12, and P15 mentioned “Intuitive”, which indicates that even in a casual environment, participants want notifications to be intuitive and to the point, and notifications that are too long or complicated may still cause interruptions or affect the mood negatively during leisure conditions.

Quote

“I really don't want to read anything stressful because it's kind of overwhelming and my brain during the weekend.” – P2, Female, 32 y.o

“Like a notification should be short because they should come to the point.” – P15, Female, 26 y.o

One notable finding is that some participants did not have strong preference when they were relaxing. For example, the participant P1, P6, P13, P14, and P16 asserted that “everything was fine” during their leisure time, and they were more willing to deal with various types of notifications, even those that they would normally ignore during work.

Quote

“And when I'm home, it doesn't matter to be honest.” –P6, Female, 22 y.o

“I don't have any requirements. I think it doesn't matter.” – P14, Female, 25 y.o

However, not all participants liked being interrupted during their leisure time. For example, P4 and P8 noted that notifications, especially irrelevant ones, could still be annoying or distracting, especially when they interfered with enjoyable activities.

Quote

“During my free time, then it's taking away my focus from something fun for something that's probably less fun, so then it's really annoying.” – P4, Female, 24 y.o

“When I'm really relaxing mode. I don't want to see a really long text that I need to process in my head.” – P8, Female, 23 y.o

4.6.3 Conclusion

During work, participants consistently favored notifications that were short, clear, and free from visual distractions. Long texts and excessive emoji use were commonly rejected, as they were seen as disruptive and unprofessional in task-focused settings. In contrast, during leisure time, participants showed greater tolerance for visually rich and emotionally expressive designs, often describing them as fun and engaging. However, even in casual contexts, clarity and simplicity remained important, as overly complex or lengthy notifications could still interrupt relaxation. Notably, individual differences were evident: some participants welcomed playful designs at work or were indifferent during leisure, while others remained sensitive to interruption regardless of context. These findings highlight the need for flexible, context-aware notification strategies that balance clarity, emotional tone, and user expectations.

4.7 Content, Visual, and Context

The researcher also invited 16 participants to rank the importance of three key factors in notifications, namely content, visual design and context, where 1 represents “most important” and 3 represents “least important”, so the lower the average score, the more important it is. From the results, the content and context factors were tied for the most important, with 8 participants ranking them first each; in contrast, visual design was not considered the most important factor by any participant (See Table 2).

Further, the importance of context is obviously dominant in the overall ranking, with an average ranking of 1.44, followed by content, with an average ranking of 1.69, and visual design ranked last with an average ranking of 2.88. This might indicate that participants are more concerned about whether the notification is consistent with their current situation and whether the content of the notification has practical value, rather than its visual appearance.

This result highlights that in the design of mobile notifications, more attention should be paid to the practicality of the content and the appropriateness of the timing of sending, especially in different usage scenarios, users’ sensitivity and acceptance of notifications will change significantly. Although visual elements could increase appeal, they do not constitute the key motivation for clicks and responses in the minds of participants.

Participant	Content	Visual	Context
Participant1	2	3	1
Participant2	2	3	1
Participant3	1	3	2
Participant4	2	3	1

Participant5	1	3	2
Participant6	3	2	1
Participant7	2	3	1
Participant8	1	2	3
Participant9	1	3	2
Participant10	1	3	2
Participant11	2	3	1
Participant12	1	3	2
Participant13	2	3	1
Participant14	3	2	1
Participant15	2	3	1
Participant16	2	3	1

Table 2: Participant Rankings of Content, Visual Design, and Contextual Factors in Mobile Notifications (N=16)

5. Discussion and Conclusion

5.1 Discussion and limitations

The results show that participants' responses to notifications are dependent on the practical content and visual design, and crucially, the degree of harmony between the two. Notifications with high practicableness (e.g., reminders to stretch, long-time sitting) were widely appreciated for their usefulness, goal orientation, and actionability. This was particularly evident in Prototype 1 and Prototype 4, where participants valued clarity, structure, and fit with personal needs. However, content richness alone was not enough to

ensure positive perceptions. For example, Prototype1 produced cognitive overload due to overly lengthy texts and the combination with emojis. On the other hand, notifications with low practicableness (Prototype 2 and Prototype 3) were often perceived as empty or untrustworthy.

Visual richness (emojis) caused mixed reactions. In many cases, emojis were able to enhance user engagement, especially when matched with concise content (Prototype 3). Participants used words such as “cute”, “friendly”, or “motivating” to describe these elements. However, when the emotional tone did not match the practical content or when emojis were overused, the designs were often perceived as “confusing”, “childish”, or “ads-like”. This mismatch between form and meaning is why users don’t interact with notifications.

In addition, curiosity plays a unique role in driving interaction. Participants often click on notifications not because of the information itself, but because of the confusion which might be caused by the ambiguity of the notification content, especially in visually rich but thin content. While this occasionally leads to positive interactions, many participants reported feeling “cheated” or dissatisfied, which suggests that curiosity-based and confusion-based interactions are fragile if not supported by meaningful content. This is likely to be harmful to the application in the long run.

However, several participants such as P1, P9, and P10 also mentioned that the types of applications are an important factor in their perception of notifications. They claimed that social media notifications are more attractive to them cognitively, and other notifications are somewhat irrelevant to them. Global users spend more than two hours a day on platforms such as TikTok, YouTube, and Instagram (De Vor, 2025). And according

to Shirazi et al. (2014), instant messaging notifications are clicked more frequently and quickly than other application notifications, indicating that users have a high degree of attention to social application notifications. Thus, social media's notifications have wider acceptance, and users are more likely to click on the notifications related to the social media. Kanjo et al. (2017) found that users' positive emotion was related to social media message, this is not only because users could feel a sense of belonging but also could enhance their connection with the outside world. Additionally, uses & Gratifications theory also could explain that social media users often turn to platforms not only for information, but to social interaction and maintain relationships (Bowden-Green et al., 2021).

The study also showed that participants' preferences change due to the context they are in. In the working environment, participants preferred notifications that were short, informative, and visually minimal. The prototype with high practicableness and low visual richness (e.g., Prototype 4) were highly consistent with this expectation. Features such as clear, intuitive and low interaction cost were consistently valued. In contrast, emojis were often rejected in work environments because they were unprofessional or distracting, which could cause cognition overload. These findings highlight the importance of aligning notification design with the user's task-focused mental state and suggest that brevity, intuitiveness, and context-aware tone are key to maintaining user acceptance during work.

While in leisure context, the participants were more tolerant of notifications with expressive visuals and a relaxed tone. Notifications with emojis were often described as refreshing and fun. Some participants even welcomed visual overload, viewing it as a

relaxation of cognitive effort. Still, others still preferred concise and clear notifications even when they were casual, indicating that individual differences are still important even in the same context.

To sum up, these findings support the view that context-aware design is critical. Notifications that ignore the user's mental state or daily rhythm might be ignored. In other words, the same notification might be perceived very differently depending on the user's context. For example, a notification that is effective during leisure time may be rejected when focusing on work. Therefore, it is necessary to combine big data algorithms to summarize and predict the user's usage patterns, so that can roughly distinguish what stage the user is in at that time, so as to send different notifications to achieve a positive notification experience.

Nevertheless, although participants were asked to imagine themselves in a work or leisure setting, actual on-site behaviors may differ from responses reported in the interview context, because the contexts and the reactions are all based on the participants' imagination. This could be one of the limitations of this study. Future research could consider conducting field experiments or testing real-time applications to collect more ecologically valid data.

The study has diversified feedback from these 16 participants, so the minority of answers to each question is also obvious. And the most of them are young adults (mean age ≈ 25 years). This limits the generalization of the findings to a wider population, such as older adults and adolescents. According to Caroux et al. (2019), older people may be more sensitive to notifications being intrusive. They also indicated that older users may have a greater need for notifications to be context aware. The sample size was small, with

only 16 participants, which might be biased. What also needs to be mentioned is that, although these four notification prototypes were carefully constructed, they only could represent a limited number of design possibilities. This study did not yet explore the interaction delays and used computer simulators to test hypotheses when interacting with mobile phones, which might have affected participants to some extent. What is more, the exploration of the visual aspect of this study is still relatively limited, mainly focusing on the use of emoji, and not covering more visual design elements, such as dynamic effects, color etc. Nevertheless, the experimental results have preliminarily verified the potential of visual elements in enhancing user engagement. This provides some advice for subsequent research that the discussion on visual design might be expanded to explore more valuable theoretical perspectives and practical significance. And because the prototypes were all created in English, although participants were required to know English during screening, there were almost no native speakers. Thus, reading a large amount of text and emojis (Prototype 1) might cause participants to be more laborious and may be more likely to cause cognitive overload. Moreover, regarding the feedback on work and leisure contexts, the answers were still based on participants' imagination rather than real situations. Although this study has found that different contexts do affect how users respond to notifications, future research could allow users to experience notifications in real usage environments to further restore their actual reactions in daily life.

5.2 Practical implications

And during the interview process, some of the participants gave many new insights into how to achieve a good notification experience. Participant P2 mentioned that visual

richness is not limited to emojis, but it could be dynamic and more intuitive, or even a notification with images as the main part and text as the auxiliary part.

In addition, participant P3 and P12 put forward that notifications can add some additional interactions, not just clickable but can directly operate some simple steps, such as replying to messages and reminding them later. In this case, the users do not need to click on the notification, and they navigate in the application to do the action.

At the same time, participant P6 and P12 both mentioned that the sound of notifications might play an important role, and different sounds may give people different feelings. Participant P12 also mentioned that different applications may have different sounds, and when users are familiar with them, they may be able to judge whether the notification is important or whether they are interested in the application by sound. This may not require users to use visual inspection when they are busy, and can use hearing to distract attention. However, contrary to what P12 said, the literature states that sound or vibration can cause attention distraction (Stothart et al., 2015). Thus, this might just be P12's personal preference. What is more, Whiting and Murdock (2021) also found that people of different ages may have different perceptions of cue sounds, with the effect being more obvious on adolescents around 15 years old, and this effect is accompanied by an increase in heart rate variability.

Furthermore, the participants P9, P15 and others also raised issues regarding the timing and frequency of notifications. They suggested that notifications should not be sent too frequently, as this would make them annoying. Pham et al. (2016) also pointed out that the abuse of push notifications can lead to negative consequences. Adamczyk and Bailey (2004) also found that inappropriate timing—particularly during cognitively

demanding tasks—can negatively impact user experience.

Moreover, the participant P11 also added that notification content and design could be set based on time. For example, the application can send notifications like “Good morning” in the morning; and in the evening, some warm text can pop up to create a resting atmosphere for users. Similarly, P9 also mentioned that it is best to send relevant notifications based on the user’s schedule or time zone, and that specific notifications can be sent on relevant holidays, such as birthdays, Christmas, Thanksgiving, etc.

5.3 Conclusion

This study highlighted the importance of aligning notification design with content relevance, visual elements, and user context. Findings indicated that users respond most positively to notifications that are clear, relevant, and contextually appropriate. While visual elements such as emojis could enhance engagement, their effectiveness depends on consistency with the message and user expectations. Also, both context and content are significantly more influential than visual design. These results indicated the need for adaptive, user-centered notification strategies that consider cognitive state, usage scenarios, and content-visual harmony.

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Appendix A:

Sources of Prototypes:

"When AI Meets Weather: Precision Forecasting 'Intelligence' Upgrades"

GenCast can predict the weather with extremely high accuracy. Image source:
DeepMind official

AI Enhances Weather Forecasting Accuracy and Speed

With extreme weather events becoming more frequent, accurate and rapid weather forecasting is crucial. However, traditional methods face challenges in providing precise predictions. AI is now helping scientists predict weather patterns more quickly and reliably by analyzing vast amounts of data.

AI-powered weather forecasting models have revolutionized traditional methods, improving decision-making, disaster response efficiency, and grid reliability. AI's ability to process large datasets from both historical and real-time sources allows for more accurate predictions.

Traditional weather forecasting relies on complex mathematical models that require significant computational resources, often running on supercomputers. While effective, these models take time and struggle with extreme weather events. AI forecasting provides a breakthrough, offering faster and more accurate results. For example, Google's DeepMind developed the GenCast model, which outperforms traditional models like ECMWF's Integrated Forecasting System (IFS). GenCast predicted 97% of over 1,300 indicators more accurately than ECMWF, and it can generate a 15-day forecast in just 8 minutes.

AI also reduces the computational cost of forecasting. While traditional models can take hours to process, AI models like GenCast can quickly generate results in seconds,

making forecasting more efficient.

Several countries are now adopting AI for weather forecasting. Microsoft released "Aurora," a model that generates global air pollution and weather forecasts in under a minute. NVIDIA launched the CorrDiff model, which improves forecasting precision from 25 kilometers to 2 kilometers, with 22 times faster computation and reduced energy consumption. Huawei's "Pangu Weather Model" has shown competitive accuracy in forecasting both regular and extreme weather events. The ECMWF's AI Weather Forecasting System (AIFS) has also improved forecast speed and reduced energy consumption by 1/1000.

However, AI still faces challenges. While it can provide predictions, it cannot explain the process behind the results. Furthermore, AI excels at predicting large-scale trends but struggles with the detailed daily weather forecasts. Experts suggest combining AI models with traditional numerical forecasting to improve accuracy.

For instance, Japan's RIKEN Institute has developed a system that combines AI and numerical forecasting to predict scattered heavy rainfall, showing how this hybrid approach can enhance forecasting efficiency and reduce computational time.

In conclusion, while AI has made great strides in weather forecasting, combining AI with traditional methods offers the most effective solution for accurate and efficient predictions.

Reporter:Liu Xia

Editor:Zuo Changrui

43,000 McDonald's restaurants worldwide have introduced AI technology to alleviate employees' daily work stress.

IT Home, March 8 – According to a report by foreign media outlet TechSpot today, McDonald's is leveraging AI technology to enhance the operational efficiency of 43,000 restaurants worldwide. The company's Chief Information Officer, Brian Rice, stated that AI will help alleviate employees' daily work pressures, including interactions with customers and suppliers, as well as issues such as equipment malfunctions.

Last year, McDonald's piloted an edge computing platform in some US stores and plans to further expand its use in 2025. IT Home learned from the report that AI technology offers a variety of application scenarios. For example, computer vision can use kitchen cameras to verify order accuracy and ensure customers receive the correct meals, while an AI voice ordering system, jointly tested with IBM last year, helps optimize drive-thru order processes. Additionally, sensors on kitchen equipment can collect real-time data to predict when deep fryers or ice cream machines might fail, allowing for proactive maintenance.

Edge computing can also simplify restaurant management. For instance, a "Generative AI Virtual Manager" can help managers schedule shifts more efficiently.

McDonald's did not disclose how many US stores are currently using this technology.

Gartner analyst Sandip Unni pointed out that McDonald's may encounter resistance when promoting the technology to both franchise and company-operated stores, and deployment costs remain a major challenge.

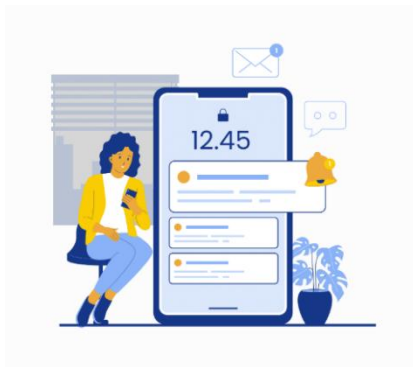
As for whether AI is truly necessary, opinions differ. Some believe that this investment might be better spent on employee training and routine maintenance; if employees perform better in drive-thru ordering and ensuring order accuracy, the need for AI intervention may be reduced.

From Wangyi News

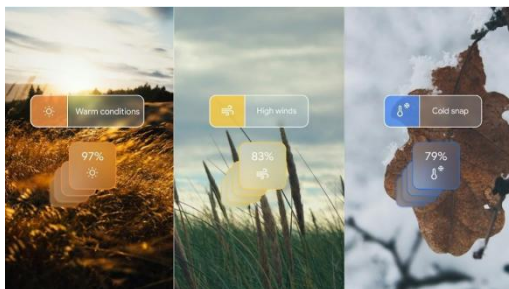
Appendix B:

Images' usage:

The four images below are all downloaded from Canva



This image below is downloaded from DeepMind official



This image below is downloaded from IT home.



Appendix C:

Interview guidelines:

Hi, thank you for joining this interview. I am Yufei Yan, from communication science of University of Twente. This session is part of my bachelor's thesis. The purpose of this study is to explore how people perceive and interact with different mobile notifications.

During the interview, you will be shown four different types of notification designs. After each one, I'll ask you a few questions about your thoughts and feelings. Additionally, I'll also ask you to imagine certain situations, such as being at work or relaxing at home. These situations are only used for testing purposes, there are no right or wrong answers. If at any moment you feel uncomfortable, you are free to pause or cancel the interview.

Please note that the focus of this study is on the notifications themselves—not on the prototype system I use to present them. Therefore, when giving your feedback, try to focus on the content and design of the notifications, rather than the way the prototype works.

This interview will be recorded using both audio and video, but the recordings will only be accessible to me as the researcher. The transcript of the interview will be used for my thesis and shared with University of Twente. No personal information will be passed on to others, and also no personally identifiable information will be included in the thesis. All recordings will be deleted after the thesis is completed.

Before we begin, do you voluntarily agree to take part in this interview, and are you okay with it being recorded? Do you have any questions before we get started?

Interview Guideline:

Warm-up (5 minutes)

Let's begin with a few warm-up questions about your general experience with notifications:

- Can you tell me about the last notification that really caught your attention? What was it about, and how did you respond?
- Do you often check your notifications? Are there moments when you tend to ignore them?
- Are there certain types of notifications you dislike or usually ignore? What kind do you enjoy receiving or are more likely to tap on?
- Have you ever received a notification that really stood out to you? Maybe because the design was special, or the content surprised you?

Prototype Experience & Interview (20 minutes)

Now you will interact with four different notification designs. After each one, I'll ask a few follow-up questions:

- What is your first impression of this notification?
- What do you think of its design—anything you liked or didn't like?
- On a scale from 1 to 7, how much do you like the look of this notification? (1 means not at all, 7 means very much)
- Would you tap on this notification? Why or why not?
- Which part made you want to tap—or not tap—it?
- How did it make you feel?

Comparison & Preference Discussion (15 minutes)

Now let's compare the four notifications:

- Among the four, which one did you like the most? And which one the least?
Why?
- Is there anything in particular that made one stand out to you—positively or negatively?
- It seems like you might prefer notifications that are just text / include emojis—do you know why that is?

Scenario-Based Deep Dive (15 minutes)

Let's move on to imagining some real-life situations:

- Imagine you're at work. Which of the four notifications would you prefer in that context? Why?
(Follow-up: How would you feel if each of the four notifications popped up during work? What would you do and why?)
- Now imagine you're relaxing, maybe at home or during a break. Which notification feels most suitable?
(Follow-up: How would you react to each of the four if they appeared during this moment? And why?)
- Do you think your needs for notifications—like how they look or what they say—are different when you're working versus relaxing?
- Which matters more to you: the content of the notification, or how it looks? Or does it depend on the situation?

Final Thoughts (5 minutes)

- In your opinion, what should apps pay more attention to when sending

notifications? The content? The design? The context you're in? Something else?

- Is there anything we haven't talked about yet that you think is important for a good notification experience?

Appendix D:

Participant demographics

Participant	Gender	Age
Participant1	Female	25
Participant2	Female	32
Participant3	Female	25
Participant4	Female	25
Participant5	Male	24
Participant6	Female	22
Participant7	Female	24
Participant8	Female	23
Participant9	Male	25
Participant10	Female	25
Participant11	Female	24
Participant12	Female	28
Participant13	Female	24
Participant14	Female	25
Participant15	Female	26
Participant16	Male	25

Table: Participants' demographic

Appendix E:

Codebooks and attributions:

P1:

Category	Code	Definition	Example	Frequency
Usefulness	Useful/ practical	The notification serves a clear, functional purpose.	<i>"It is very useful"/ "It has useful information"</i>	P1, P2, P4, P5, P7, P8, P10, P11, P12, P14, P15
	Understandable	The notification is easy to comprehend with minimal cognitive effort.	<i>"It is easy to understand."</i>	P3, P10, P11, P12
	Concise/ clear	The notification is brief and well-structured.	<i>"It is clear"/ "I can see like immediately what it is and then read it"</i>	P3, P5, P10, P11
Nice design	Attractive/ appealing	The visual or interaction design is aesthetically pleasing and engaging.	<i>"It is really eye catching." "It is attractive."</i>	P2, P6, P7, P8, P11, P13, P14, P15, P16
	Intuitive/ straightforward	The design is easy to navigate or understand without instruction.	<i>"I just knew what to do." / "It's really intuitive."</i>	P2, P3, P4, P5, P8, P11, P13, P14, P16
	Nice combination	The design achieves a harmonious balance between different visual and functional elements.	<i>"The texts and emojis go really well together."</i>	P4, P5, P6, P7, P8, P11, P15, P16
	Clean/ clear	The layout is neat, well-organized, and free of visual clutter.	<i>"It's clear to see" / "I like how tidy and clear it is."</i>	P7, P15
	Cute/ adorable	The notification is perceived as endearing or pleasing.	<i>"It looks so cute!" / "I love the little icons—they're really cute."</i>	P2, P4, P5, P7, P9, P11, P15, P16
Positive engagement	Happy	The participant has a feeling of joy or satisfaction.	<i>"It made me feel good." / "It seems positive."</i>	P2, P4, P5, P7, P11, P15, P16
	Human-touch	The participant feels personal or emotionally warm, often mimicking human interaction.	<i>"It feels like a real person is talking to me." / "Very friendly tone."</i>	P4, P5, P6, P7, P8, P10, P11, P15
	Energetic	The participant feels energetic or motivated.	<i>"It gave me a boost." / "It feels energetic."</i>	P2
	Enjoy	The participant expresses a positive emotional response toward the prototype or	<i>"I really enjoyed this." / "It's fun to read."</i>	P2, P4, P5, P7, P8, P10, P11, P14, P15, P16

Positive interaction	Supportive	interaction. The notification offers encouragement or motivation in a way that is emotionally affirming.	<i>"It felt encouraging." / "It seems really want to help me."</i>	P2, P4, P5, P6, P7, P8, P11, P12, P14, P15
	Explanatory	The notification gives the participants a sense of explanation.	<i>"It tells me what to do." / "I understand it better now."</i>	P4, P7, P16
	Click	The notification encourages the user to click.	<i>"I clicked it right away." / "It made me want to open the app."</i>	P5, P12, P14, P15, P16
	Do it later	The participants prefer to check or click the notification later.	<i>"I'd save it for later." / "I don't have time now, but I'll check it later."</i>	P2
	Follow the notification	The notification prompts the user to follow the suggestion.	<i>"I actually did what it told me."</i>	P4, P5, P7, P11, P15

Codebook and Attributes of High practical + High visual richness-positive

Category	Code	Definition	Example	Frequency
Poor design	Garish/gaudy	The visual design is overly bright, flashy, or excessive.	<i>"It looks messy." / "Too many elements/information."</i>	P1, P3, P4, P6, P8, P9, P12, P16
	Prolix/too much	The notification contains too much information.	<i>"The message is too long" / "It is too long, and I don't wanna read it."</i>	P1, P2, P3, P6, P8, P9, P10, P12, P13, P14, P16
	Complex	The design is too complicated or unintuitive, requiring significant effort to understand or use.	<i>"It is hard to read." / "It is too complicated."</i>	P1, P3, P6, P12, P16
Discomfort	Tension	The participant feels stress, anxiety, or a sense of pressure.	<i>"It seems very urgent." / "It seems want to me to do something right now."</i>	P6, P8, P12, P13, P14
	Annoying	The participant feels irritated or frustrated.	<i>"I feel annoying."</i>	P1, P9, P12
	Overwhelming/ Cognition overload	The participant feels cognition overload and overwhelming.	<i>"I feel I cannot process all the information in such a short time."</i>	P1, P6, P8, P9, P12, P13, P14, P16
User Disengagement	Ignored/swap away	The notification is naturally overlooked by the user without their conscious intention.	<i>"I will swap it away." / "I will read a few words and them ignore it."</i>	P10, P13
	No Click	The participant chooses not to interact with or respond to the notification.	<i>"I will not click it."</i>	P1, P3, P4, P5, P7, P8, P9

Codebook and Attributes of High practical + High visual richness-negative

P2:

Category	Code	Definition	Example	Frequency
Positive engagement	Warmth	The participant feels a sense of warmth or being cared.	<i>"I feel I was being cared."</i>	P6, P7, P9, P14, P15, P16
	Curious	The participant feels a sense of interest or curiosity.	<i>"I want to know what it is."</i>	P3, P6, P7, P8, P10, P12, P13, P14, P16
	Enjoy	The participant likes the notification.	<i>"I really like it."</i>	P6, P9, P12, P13, P14, P15, P16
Nice Design	Cute	The notification is perceived as endearing or pleasing.	<i>"It looks so cute!" / "I love the little icons—they're really cute."</i>	P3, P4, P6, P7, P12, P13, P14, P16
	Short/Clean	The notification is perceived as short and clean.	<i>"It is short."</i>	P3, P7, P8, P10, P12, P13, P14, P15, P16
	Subtle	The design evokes nuanced or gentle emotions.	<i>"I feel it is good overall, but a bit strange."</i>	P4, P12
Positive Interaction	Click	The design encourages positive interaction.	<i>"I clicked it right away." / "It made me want to open the app."</i>	P3, P6, P8, P10, P13, P14, P15, P16
	Do it later	The participants prefer to check or click the notification later.	<i>"I'd save it for later."</i>	P8

Codebook and Attributes of Low practical + High visual richness-positive

Category	Code	Definition	Example	Frequency
Poor Content Quality	Redundant	The participant finds some of the design is not necessary.	<i>"I don't think it is necessary." / "Not every notification needs emojis."</i>	P1, P2, P5, P7, P12, P15
	Unmatched	The participant finds the combination of function and visuals incoherent.	<i>"The emojis and the texts are not matched."</i>	P1, P5, P12
	Vague/Sparse Content	The participant finds the notification is too vague.	<i>"I did not get any information in the notification." / "It does not really have some information."</i>	P1, P2, P3, P5, P7, P8, P9, P10, P11, P12, P14, P16
	Prolix/too much	The notification contains excessive or unnecessary information.	<i>"The message is too long" / "It is too long, and I don't wanna read it."</i>	P16
Discomfo	Anxious	The participant feels	<i>"I feel it is</i>	P1, P7, P15

User Disengagement	Perceived Irrelevance	anxiety due to the content.	<i>urgent."/"/ I feels like something bad was happening."</i> <i>"I feel stressed."</i>	
		Stressed The participant experiences stress from the content.		P7, P15
		Confused The participant finds the combination of function and visuals incoherent.	<i>"I don't know what it wants to tell me."</i>	P1, P9, P10, P11, P12
		Annoying The notification causes irritation or frustration.	<i>"I feel annoying."</i>	P1, P2, P4, P5, P9, P12
		Ignored The notification is naturally overlooked by the user without their conscious intention.	<i>"I will swap it away."/"/I will read a few words and them ignore it."</i>	P2, P7
		No Click The participant chooses not to interact with or respond to the notification.	<i>"I will not click it."</i>	P1, P2, P4, P5, P7, P11
		Depends on the app/content Whether the notification is engaging or ignored depends on the specific app's context or content provided.	<i>"I think it depends on the application type."/"/It depends on whether I am free or busy."</i>	P9, P10, P11, P12
		Meaningless emotions The participants feels meaningless emotions or abrupt emotions.	<i>"Not all the notification needs emojis."</i>	P1, P2, P5, P9, P12
		Ads-like The content appears overtly commercialized or similar to an ad.	<i>"I feel like it is a ad."</i>	P1, P4, P5
		Unrelated Interacting with the notification feels it doesn't relate to themselves.	<i>"It seems not related to me."</i>	P1, P2, P4, P5, P8, P12

Codebook and Attributes of Low practical + High visual richness-negative

P3:

Category	Code	Definition	Example	Frequency
Neutral Design	Clear/clean	The notification is conveyed clearly and without ambiguity.	<i>"It's clear what it says."</i>	P1, P2, P3, P5, P6, P10, P15
	Short	The notification is short, doesn't have much information.	<i>"It's quite short."/ / "Not much info."</i>	P1, P5, P6, P7, P8, P10, P12, P13, P14, P16
	Minimalist	The notification is delivered in a simple and unadorned manner.	<i>"It's pretty plain."/ / "Just a basic message."</i>	P4, P5, P6, P7, P8, P9, P10, P12, P15, P16
	Normal	The notification or content is typical and unremarkable, neither	<i>"Nothing special, just normal."</i>	P3, P4, P6, P11, P12, P13, P16

Positive interaction	click	particularly positive nor negative. The notification encourages the user to click or interact directly.	<i>"I clicked it right away." / "It made me want to open the app."</i>	P2, P3, P4, P5, P6, P10
	Do it later	The participants prefer to check or click the notification later.	<i>"I'll look at it later." / "I'm busy now, but I'll check it afterward."</i>	P15
Curiosity	Curious	The notification sparks the user's curiosity or interest, encouraging exploration.	<i>"I want to know more." / "It made me curious."</i>	P1, P2, P4, P5, P6, P10, P15
Usefulness	Understandable	The notification is easy to understand.	<i>"It is easy to understand."</i>	P1, P2, P5, P6

Codebook and Attributes of low practical + low visual richness-positive

Category	Code	Definition	Example	Frequency
Poor Content Quality	Hollow	The notification lacks substantive value.	<i>"It says nothing important." / "There's no real message."</i>	P1, P4, P7, P10, P11, P14, P16
	Vague/Sparse Content	The participant finds the notification is too vague.	<i>"I did not get any information in the notification." / "It does not really have some information."</i>	P1, P4, P5, P6, P7, P10, P11, P12, P14, P16
	Redundant	The participant finds some of the design is not necessary.	<i>"I don't think it is necessary." / "Not every notification needs emojis."</i>	P7, P11, P16
Design Flaw Effect	Harmful	The participant feels like the design might be harmful to the application itself.	<i>"It is not wise to send notification like this."</i>	P2, P4, P7, P9, P16
	Impersonal	The participant feels the design is cold and does not have emotional care.	<i>"So I thought it was a bit like impersonal."</i>	P1, P4, P7, P9, P11
Discomfort	Frustrated	The participant feels frustrated and upset.	<i>"It's annoying." / "This frustrates me."</i>	P4, P5
	Confused	The participant feels confused or uncertain.	<i>"I don't understand what this means." / "It's confusing."</i>	P4, P6, P7, P16
User Disengagement	Ignored	The notification is naturally overlooked by the user without their conscious	<i>"I will swap it away." / "I will read a few words and them ignore it."</i>	P2, P14

No Click	intention. The participant chooses not to interact with or respond to the notification.	<i>"I will not click it."</i>	P1, P4, P11, P13, P14, P16
Depends on the app/content	Whether the notification is engaging or ignored depends on the specific app's context or content provided.	<i>"I think it depends on the application type." / "It depends on whether I am free or busy."</i>	P7, P8, P9, 12

Codebook and Attributes of low practical + High low richness-negative

P4:

Category	Code	Definition	Example	Frequency
Usefulness	Efficient/Straightforward	The notification helps the participant complete tasks quickly and easily.	"I can know the information directly."	P1, P2, P3, P6, P8, P11
	Rich	The notification provides diverse and layered information	"It gives me all the info I need." / "It covers different aspects."	P1, P6, P11
	Related	The content of the notification is highly relevant to the participant's context or needs.	"It's exactly what I care about." / "This is useful for me."	P2, P3, P11, P12, P14, P16
	Useful	The notification helps the participant solve a practical problem.	"It tells me something I need." / "Very practical advice."	P1, P2, P6, P9, P11, P12, P14, P16
	Concise	The notification delivers information in a brief and focused way.	"Not too long, just right."	P1, P2, P3, P4, P8, P11
Nice design	Attractive/appealing	The notification is attractive and appealing.	"It looks really good." / "Very appealing design."	P2, P8, P12
	Clean layout	The design is clear and has clear hierarchy.	"Everything is in the right place." / "Very organized layout."	P1, P3, P4, P5, P8, P13, P15
Positive Engagement	Friendly	The notification is full of care.	"It feels warm." / "Like talking to a person."	P2, P3, P7, P12
	Persuasive	The participant feels a sense of being persuaded.	"It convinced me to check it out." / "I feel motivated to follow it."	P2, P3, P7, P11, P16

Positive interaction	click	The notification encourages the user to click or interact directly.	<i>"I clicked it right away." / "It made me want to open the app."</i>	P2, P12, P16
	Follow notification	The notification prompts the user to follow up or continue in accordance with its suggestion.	<i>"I followed the advice." / "I did what it asked."</i>	P1, P2, P3, P4, P6, P8, P11, P12

Codebook and Attributes of High practical + low visual richness-positive

Category	Code	Definition	Example	Frequency
Poor design	Unreadable	The text or visual elements of the notification are difficult to read.	<i>"I can't read it clearly."</i>	P4, P6, P7, P9, P10, P13
	Prolix/too much	The notification contains excessive or unnecessary information.	<i>"The message is too long" / "It is too long, and I don't wanna read it."</i>	P5, P6, P7, P9, P10, P11, P12, P13, P14, P15
	Rigid	The notification triggers stress, anxiety, or a sense of pressure.	<i>"It makes me feel pressured." / "It's too harsh, makes me anxious."</i>	P5, P7, P10, P13, P15
Discomfort	Cold/Indifferent	The notification lacks warmth or empathy, making the experience feel distant or robotic.	<i>"It feels like a system message, not a real person." / "It's too cold."</i>	P1, P5, P7, P10, P14, P15
	Annoying	The notification causes irritation or frustration.	<i>"I feel annoying."</i>	P4, P5, P6, P7, P11
	Boring	The content is monotonous and dull, failing to sustain the participant's interest.	<i>"It's not interesting." / "I just skip it."</i>	P1, P4, P5, P7, P10, P12, P13, P14
User Disengagement	Ignored	The notification is naturally overlooked by the user without their conscious intention.	<i>"I will swap it away." / "I will read a few words and then ignore it."</i>	P11
	No Click	The participant chooses not to interact with or respond to the notification.	<i>"I will not click it."</i>	P5, P7, P9, P10, P15
	Depends on the app/content	Whether the notification is engaging or ignored depends on the specific app's context or content provided.	<i>"I think it depends on the application type." / "It depends on whether I am free or busy."</i>	P13, P14

Codebook and Attributes of High practical + low visual richness-negative

Work

Category	Code	Definition	Example	Frequency
Conciseness	Concise/ clear	The notification presents information in a highly refined and direct way.	<i>"Very clear to see."</i>	P1, P3, P5, P7, P8, P9, P10, P11, 12, P13, P14, P16
	Minimal	The notification avoids decorative or non-essential visual elements.	<i>"Simple and clean."</i>	P5, P7, P9, P10, P11, P12, P14
Efficiency Tools	Efficient	The notification helps the participant accomplish their goal quickly.	<i>"I know what to do right away."</i>	P1, P2, P3, P4, P5, P7, P11, P12, P13, P14, P16
	Convenient	The notification offers automation or one-click functionality.	<i>"Just one click and it's done." / "Super convenient to act on."</i>	P3, P12
	Interactable	The notification is designed like a practical tool, such as a template.	<i>"Feels like a shortcut or preset I can use." / "It acts like a helper tool."</i>	P1, P2, P3, P4, P8, P11
	Formal	The notification uses language that aligns with professional workplace norms.	<i>"Sounds professional." / "The tone fits work settings well."</i>	P5
Focus Maintenance	Motivational			P3, P4, P13,
	Undistracting	The notification avoids disrupting the participant's focus on core tasks.	<i>"It doesn't interrupt me."</i>	P1, P7, P8, P10, P11, 12
	Text-based	The notification primarily delivers content through clear text.	<i>"Just plain text, easy to read."</i>	P1, P3, P5, P6, P7, P8, P9, P11, P14

Codebook and Attributes of work context

Leisure

Category	Code	Definition	Example	Frequency
No Particular Requirement	No requirement	The participant does not have specific requirements towards the notification.		P1, P5, P6, P13, P14, P16
	Same with work	The participant prefer the same design as when at working condition	<i>"Just like when I'm working."</i>	P9
Nice design	Efficient	The notification can quickly accomplishes the goal	<i>"It helps me get things done quickly." / "I know what to do at once."</i>	P2, P3, P7, P15
	intuitive	The notification can presented as a practical tool (e.g.,	<i>"It works like a ready-to-use tool." / "Very easy to use without</i>	P2, P3, P6, P7, P8, P12, P15

	templates)	<i>thinking.”</i>	
Fun	The notification are interesting for participant to read.	<i>“It’s fun to look at.”</i>	P5, P6, P10, P11, P13
Cute	The notification can add some cute designs	<i>“It’s adorable.”</i>	P5, P6, P7, P10, P11, P13
Undistracting	The notification avoids disrupting the participant’s focus on core tasks.	<i>““It doesn’t interrupt me.”</i>	P2, P3, P4, P8
Text-based	The notification primarily delivers content through clear text.	<i>“Just simple text”</i>	P8

Codebook and Attributes of leisure context

Appendix F:

Cohen’s Kappa result:

Codebook	Cohen’s Kappa
Codebook of high practicableness + high visual richness—positive	0.873
Codebook of high practicableness + high visual richness—negative	0.805
Codebook of low practicableness + high visual richness—positive	0.808
Codebook of low practicableness + high visual richness negative	0.802
Codebook of low practicableness + low visual richness—positive	0.790
Codebook of low practicableness + low visual richness—negative	0.971
Codebook of high practicableness + low visual richness—positive	0.872
Codebook of high practicableness + low visual richness—negative	0.741
Codebook of Work	0.882
Codebook of Leisure	0.924

Table of Cohen’s kappa

Appendix G:

Tool usage:

Tool name	Usage
Java	Coding for the prototype
Leidian Simulator	For installing and running the prototype
ZOOM/Teams	For recording
Atalas.ti	For analyzing the data

Table of Tools usage

Appendix H:

Literature search log:

Date	Database	Search string	Total hits	Remarks
30.03.2025	Google Scholar	"Mobile notification" OR "app notifications"	5050	~16 relevant articles
30.03.2025	Google Scholar	"mobile applications notification mechanisms"	181,000	~11 relevant articles
03.04.2025	Google	"The definition of mobile notification"	2,220,000,000	~ 20 relevant sources
03.04.2025	Google Scholar	"App notification" AND "effects"	886	~15 relevant articles
06.04.2025	Google Scholar	"Personalized notifications" AND "benefits"	777	~12 relevant articles
11.04.2025	Google Scholar	"notification design" AND "UX"	107	~4 relevant articles

11.04.2025	Google Scholar	"notification" AND "cognitive load"	12,200	~4 relevant articles
11.04.2025	Google Scholar	"notification" AND "Work"	1400	~ 5 relevant articles
11.04.2025	Google Scholar	"Work" AND "cognition"	5,000,000	~1 relevant article
11.04.2025	Google Scholar	"Leisure" OR "Free time" OR "Relax" And "Cognition"	850,000	~2 relevant articles
11.04.2025	ScienceDirect	"Media richness theory" AND "emojis"	201	~ 6 relevant articles
12.04.2025	Google Scholar	"Emojis" AND "Effect"	33,400	~ 9 relevant articles
11.06.2025	Google Scholar	"Uses and gratifications" AND "Social media"	39,300	~ 4 relevant articles
11.06.2025	Google Scholar	"Notification sounds" AND "Effect"	614	~ 3 relevant articles
11.06.2025	Google Scholar	"Notification timing" AND "effect"	388	~ 5 relevant articles

AI statement

Grammarly and ChatGPT are used to check for grammatical errors and enhance sentence structure. And DeepL for translate the Chinese version of transcripts. After using these tools, the author thoroughly reviewed and edited the content as needed. Scribbr is used to check the citations.