“I Want It to Do More Than Deliver”: Users’ Desires for Intelligent Notification Systems

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Prior work on mobile notifications primarily investigates specific features introduced by researchers, observing how users interact with them and evaluating their effectiveness in supporting notification delivery and management. Less is known about what features and capabilities users themselves desire from future intelligent notification systems (FINS). We conducted interviews and design workshops to understand these desires. Our findings reveal that participants envisioned FINS as proactive agents extending beyond passive notification delivery. They wanted FINS to manage attention by surfacing actionable takeaways and progressively disclosing notification details, assist follow-up actions, and associate notifications with related ones and relevant external context. Participants also imagined FINS evolving into adaptive companions that infer personal context to anticipate needs, reinforce self-defined goals to support personal development, and connect users with relevant trends beyond their followed sources. Finally, participants desired distributing notification awareness through co-present contacts and objects embedded in routines to time and contextualize delivery.

CCS Concepts: • **Human-centered computing** → **Empirical studies in HCI**; *User studies*.

Additional Key Words and Phrases: Design Workshop; Notifications System; Elicitation; User Experience

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1 Introduction

Smartphones’ notification systems are a pivotal information source in modern life, providing their users with a constant influx of updates, messages, and alerts [80, 98]. These systems have evolved to play a variety of roles, from facilitating communication to managing daily tasks [56], and smartphone users tend to rely on them for task and time management [16]. On the negative side, however, continuous streams of notifications often lead to overload [25, 75, 94]. They can

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strain users' cognitive capacities [1, 5], disrupt their time-management efforts [45, 75], and in some cases negatively impact their overall well-being [50].

Many researchers have explored strategies for mitigating these adverse effects, and some have prototyped functions to support notification management. An important subset of such work has focused on making notifications less disruptive by optimizing when and how they are delivered. Such mechanisms include delivering alerts at "opportune moments" between tasks or during periods of low cognitive load [34, 69, 71], delivering notifications via users' preferred devices [26, 60, 85, 92, 96], batching notifications to reduce the frequency of interruptions [36], and supporting users in anticipating notifications via custom alerts [15]. Another stream of research provides features designed to help users manage their notifications, such as snoozing [93] or pinning notifications [57] for later review, reordering critical information to maintain visibility within a large stack of alerts [56, 57], and using text summaries [21] or ambient visualizations [41] to facilitate quick assessment of notification content and relative importance.

However, while prior work has proposed a wide range of mechanisms for mitigating notification-related problems, more recent efforts have largely focused on designing and evaluating solutions for already identified challenges. Comparatively less attention has been devoted to revisiting which notification-related breakdowns contemporary smartphone users still perceive as most problematic in everyday life. As notification ecosystems, mobile practices, and users' experiences with intelligent systems continue to evolve, some longstanding challenges may persist, change in form, or reveal unmet needs that existing approaches have not fully addressed. At the same time, increasing exposure to intelligent assistants and AI-powered systems may also shape how users imagine future notification systems supporting their daily lives. If certain notification-related challenges remain salient despite years of prior work, this may suggest opportunities to explore broader forms of support beyond the mechanisms currently emphasized in notification research. However, it remains unclear how users now envision future intelligent notification systems supporting notification interaction and related everyday practices, or what broader forms of support they expect such systems to provide. To address this gap, we ask:

RQ: What kind of features and capabilities do users desire in future intelligent notification systems?

To answer this research question, we conducted a two-stage qualitative study consisting of semi-structured interviews followed by design workshops. In Stage 1, we interviewed 13 smartphone users to identify the notification-related breakdowns and unmet needs they continue to experience in everyday life. By asking participants to describe ideal notification interactions, we prompted reflection on the underlying pain points, tasks, and forms of support they hoped future intelligent notification systems (hereafter referred to as *FINS*) could address. These insights were then distilled into a set of core "missions" that grounded Stage 2.

In Stage 2, we conducted five design workshops with 21 additional participants and one returning Stage 1 participant. Using the missions as prompts, participants envisioned how FINS could accomplish these tasks in practice. Through participants' envisioned interactions and services, we explored both the kinds of support users desired from FINS and the forms through which they expected such support to be provided and experienced, thereby uncovering broader expectations for the roles FINS could play in everyday life.

This paper makes three main contributions to notification research by articulating the broader roles and forms of support users envision for FINS across everyday notification interactions:

- It shows that users envision FINS extending beyond passive notification delivery toward proactive support for notification-related tasks, including surfacing actionable takeaways,

progressively disclosing details, supporting follow-up actions, and connecting notifications with related information and external context.
- It reveals that users further envision FINS evolving beyond notification management into adaptive personal assistants that infer personal context, reinforce self-defined goals and values, and connect users with relevant trends, opportunities, and communities beyond followed information sources.
- It demonstrates that users also envision notification awareness extending beyond smartphones themselves, through leveraging trusted co-present people and everyday objects to route, contextualize, and spatially embed notification delivery within users' routines and environments.

2 Background of Mobile Notification Research

Early notification research focused primarily on reducing the negative impacts of interruptions. Prior work showed that notifications can impair task performance, increase errors, and affect users' emotional state [1, 5, 43, 77]. Notifications can also create resumption costs when users return to interrupted tasks, and may affect nearby people in shared social contexts [27, 34, 54, 84]. These concerns motivated efforts to predict users' interruptibility and withhold alerts at inopportune moments [37, 71, 86]. Together, these findings cast notifications predominantly as sources of disruption and stress [73, 98, 101], with audible alerts linked to inattention and hyperactivity symptoms [50]. In response, research has explored solutions, including quieter modes in socially sensitive contexts [18, 33, 49], delivering notifications at opportune moments such as workflow breakpoints [45, 69], and batching notifications to reduce interruption frequency and stress [36].

Despite these documented challenges, notifications are integral to how users stay informed about new events, messages, and tasks [18, 46]. Research has shown that alerts are particularly valued when users anticipate specific information [18, 46], and that varying alerts help users infer incoming content and decide whether to attend to it [17]. Users are typically highly attentive to notifications, engaging with them even when devices are muted [18] and often within minutes of arrival [28, 73]. Recent work further situates this attentiveness within broader checking habits, as many smartphone interactions are self-initiated rather than driven by alerts [42].

This understanding has shifted the research focus from minimizing disruption [43] toward identifying when users are receptive to engaging with notifications [2, 70]. Researchers have developed models to predict opportune moments based on attention levels, engagement patterns, and contextual factors [2, 67, 70, 72]. Related work has examined receptive states and contexts such as waiting [11], free time [23], on-the-go learning [29], scheduled activities [31], and social or workplace settings [13]. This focus has resulted in a more nuanced view of notification interaction as a multi-stage process, moving from the initial alert, to glancing, to reading, and finally to acting on notifications [85, 87, 88]. Prior studies have used this model to examine how users attend to alerts [18], decide whether to read content [63, 76], and act on notifications [52, 53]. For notifications demanding cognitive effort, users often prefer to engage only when they are prepared to follow through [52, 100], and this decision can also be shaped by social pressures, such as not wanting a sender to know a message has been read [24]. Chang et al. [16] further identified 12 triggers or motives associated with various notification timings and types.

The focus on user receptivity has also highlighted how notification characteristics shape attention and response. Prior work has shown that receptivity is influenced by perceived interest, relevance, actionability, and the sender-recipient relationship [35, 51, 62, 63]. This line of work has also motivated systems that infer notification preferences from user interaction, context, and content importance [59, 89]. Research has further examined the frequency of different notification types and users' attitudes toward them [63, 76, 80, 95]. For instance, users deem few notification types both important and time-sensitive [95]. Yet, while smartphone users often prefer notifications from communication apps or particular people and events [56, 80, 93], notification preferences remain highly diverse across individuals [55, 56, 80]. This diversity has motivated studies that infer preferences from engagement metrics [59], support explicit labeling or preference feedback [82, 89], and examine rule-based customization for notification presentation [4, 15, 41].

Beyond examining when users are receptive and what kinds of notifications they attend to, notification research has expanded to multi-device contexts, spanning phones, computers, and wearables. In-situ studies have documented how users distribute notification interactions across devices [14, 85, 92, 96], while other work has explored routing notifications to appropriate devices based on user context [26, 60] and delivering notifications in immersive environments such as virtual reality [20, 44, 79]. Research has further explored notification delivery through channels beyond conventional screen-based delivery. One line of work has investigated body-proximate channels, such as rings [78], under-clothing wearables [8], and on-finger cues [12], showing how modality and body location shape notification experience. Another line of work studies smart-home and everyday-object notification interactions, showing that suitable delivery locations depend on factors such as urgency, proximity, and disruption [68, 90, 91].

Building on insights into when, what, and where notifications should surface, researchers have also examined how users manage notifications after they arrive. For example, prior work has found that notification attendance and response time vary by notification type, presentation style, and sender relationship [63, 76]. Weber et al. [94] further identified distinct patterns of notification drawer management. These understandings have informed explorations of specific management features, such as rule-based deferrals [4, 93], user-assigned alerts [15], ordering and pinning [56, 57], and notification summaries or ambient visualizations for quick assessment [21, 41]. Several of these works also show users' interest in processing related notifications together, such as by grouping them by source or topic [21, 56, 57] or synthesizing interaction histories in summaries [21]. Additionally, visualizing notification engagement over time has been shown to help users reflect on their usage [97], and therefore support personalization and management of their notifications [47].

While such work can reveal needs that extend beyond the feature in question, there has been less direct focus on what users themselves envision as the broader support an intelligent notification system should provide. As a result, what users desire across the full experience of receiving, understanding, managing, and acting on notifications remains less well understood. We address this gap through a two-stage qualitative study that develops a user-grounded understanding of what support people envision and desire from FINS.

3 Stage 1: Understanding Users' Notification Needs and Challenges

To answer our research question, we conducted a two-stage qualitative study, illustrated in Figure 1. Stage 1 used semi-structured interviews to examine the breakdowns participants experienced with current notification systems and the needs reflected in those breakdowns. Stage 2 then used design workshops to explore how participants envisioned FINS support and interactions.

Prior notification research has identified a broad range of challenges associated with everyday notification use, while more recent work has primarily focused on designing and evaluating mechanisms intended to mitigate these issues. In comparison, less attention has been devoted to re-examining which notification-related breakdowns contemporary smartphone users continue to perceive as most problematic in their everyday experiences. As notification ecosystems, mobile practices, and users' experiences with intelligent systems continue to evolve, it remains important to understand which challenges users still find most salient and in need of support. To ground our design workshops in problems that participants could meaningfully relate to, we therefore conducted exploratory interviews to identify the notification-related breakdowns and unmet

Table 1. Participant Profiles for Stage 1 Interviews

ID	Age & Gender	Occupation	Primary Device Currently in Use	Mobile OS	Daily Notification Count on Primary Phone
P01	33 F	Marketing	Smartphone & Computer	Android	>60
P02	25 M	Student	Smartphone & Computer	iOS	31–60
P03	18 M	Student	Smartphone	Android	<10
P04	26 F	Medical	Smartphone & Computer & Tablet & Smartwatch	iOS	31–60
P05	22 F	Student	Smartphone & Computer & Smartwatch	iOS	31–60
P06	34 M	Finance	Smartphone	Android	31–60
P07	20 F	Student	Smartphone & Computer	Android	>60
P08	23 F	Manufacturing	Smartphone & Computer & Smartwatch	iOS	>60
P09	37 M	Freelancer	Smartphone & Computer	Android	31–60
P10	33 F	Art & Design	Smartphone	Android	31–60
P11	30 F	Edu. & Comm.	Smartphone	iOS	31–60
P12	35 F	Art & Design	Smartphone	iOS	11–30
P13	27 M	IT	Smartphone	iOS	11–30

needs that users continue to experience in present-day notification interaction. These findings subsequently informed the design missions used in Stage 2's workshops.

3.1 Stage 1 Recruitment and Participants

We recruited participants through public social media communities, including Facebook groups and local discussion boards, to reach a broad range of everyday smartphone users. Interested individuals completed a screening questionnaire about their notification usage patterns, smartphone operating system, and demographics. To capture perceived notification burden, we also asked participants to estimate their daily notification volume. We selected 13 participants (5 male, 8 female, aged 18–37, M = 27.9, SD = 6.18) to ensure diversity in OS platforms and perceived notification volume, and each was compensated with approximately US$13. Detailed demographics are shown in Table 1.

3.2 Stage 1 Study Procedure

Prior to the interview, participants were asked to create three conceptual sketches or written descriptions of ideal notification interactions they wished existed. Informed by prior work [18, 85, 87, 88], we framed these artifacts not as proposed solutions, but as *probes* to elicit the breakdowns participants experienced and the needs behind their imagined interactions.

The study was conducted either in person (n = 2) or remotely via video conferencing (n = 11), lasting 90–120 minutes. All sessions were video-recorded with consent, transcribed verbatim, and manually reviewed for accuracy. As new insights about their ideal interaction models emerged during the interviews, participants were encouraged to annotate or update their sketches, using physical prints and pen for in-person sessions and shared collaborative documents for remote sessions.

We began by asking participants to walk us through their envisioned ideal interactions, focusing on the breakdowns and underlying needs that motivated these ideas. Rather than treating these artifacts as concrete solutions or emphasizing implementation details, we used them as prompts to guide discussion of the situations, pain points, and needs behind participants' imagined interactions.

During and after the discussion on their ideal interactions, we broadened the conversation to participants' current notification practices and the breakdowns they encountered in everyday use. Guided by touchpoints of notification interaction identified in prior literature—namely *notification alerts* [18, 87, 88], *browsing interfaces* [36, 41], *content presentation* [21, 56, 57], and *cross-device* *interactions* [14, 85, 92, 96]—we explored whether participants experienced breakdowns or unmet needs in these areas, while remaining open to issues beyond these categories.

3.3 Stage 1 Data Analysis

We applied inductive thematic analysis [9] to the interview transcripts to identify recurring breakdowns, unmet needs, and tensions in participants' current notification experiences. As part of this process, preliminary open coding was conducted alongside data collection to monitor whether new interviews introduced substantially new codes or categories. After two successive interviews did not introduce new categories, we stopped recruitment, resulting in 13 interviews completed within two weeks. We then continued the full analysis over three months, with weekly team meetings to discuss and refine the codebook. We used open coding in Atlas.ti[1]. To help ensure analytical rigor, each transcript was independently coded by at least two members of the research team. Codes were then compared, discussed, and refined through constant comparison [38, 39] across participants.

As themes emerged, we organized related codes into higher-level categories that reflected both specific pain points (e.g., handling overload, difficulty of preserving important messages) and broader tensions (e.g., the trade-off between responsiveness and disruption). Throughout this process, we revisited the transcripts to ensure that emerging themes were grounded in the data.

3.4 Stage 1 Findings

Our analysis surfaced four broad categories of recurring pain points and unmet needs that existing notification systems did not adequately support. We label these findings as F1–F4 below, and later refer to them when describing how Stage 1 informed the Stage 2 workshop tasks.

3.4.1 F1: Information Overload and the Fear of Missing Critical Alerts. The most prevalent challenge was the sheer volume of notification content, which made notifications burdensome to handle and made it difficult for participants to find information that deserved attention. This overload came from lengthy notifications extending *"beyond the screen"* (P02), as well as high notification volumes that mixed critical and unnecessary information, such as irrelevant recommendations from social or shopping platforms (P06). Important updates could therefore be buried when users only had short breaks to check their phones (P12). Yet participants were often hesitant to reduce this overload because they feared missing critical updates. For example, muting a source could lead them to repeatedly check the app manually for new messages (P08).

3.4.2 F2: The Cost of Handling Unwanted and Ill-Timed Interruptions. Participants also struggled to protect their focus from unwanted or poorly timed interruptions. Sounds, vibrations, and illuminated screens could disrupt ongoing activities, such as reading, where a notification could *"make you lose your place, and your concentration suddenly disappears"* (P13). Participants were especially frustrated when the interruption came from low-value alerts, such as advertisements (P02). Frustration also arose when useful notifications arrived at unsuitable moments, such as work messages late at night (P06) or discount coupons during study sessions (P01), drawing participants into interactions that clashed with their contexts and intentions.

3.4.3 F3: Difficulty of Extracting Key Information from Overly Detailed or Vague Notifications. Even when notification volume was manageable, participants reported that individual notifications could require disproportionate effort to interpret. Some notifications buried key details in excessive context, such as a financial alert where the participant only wanted to know the extent of a stock's drop but had to parse through broader market news (P06). Others were too vague to support quick

[1] https://atlasti.com/

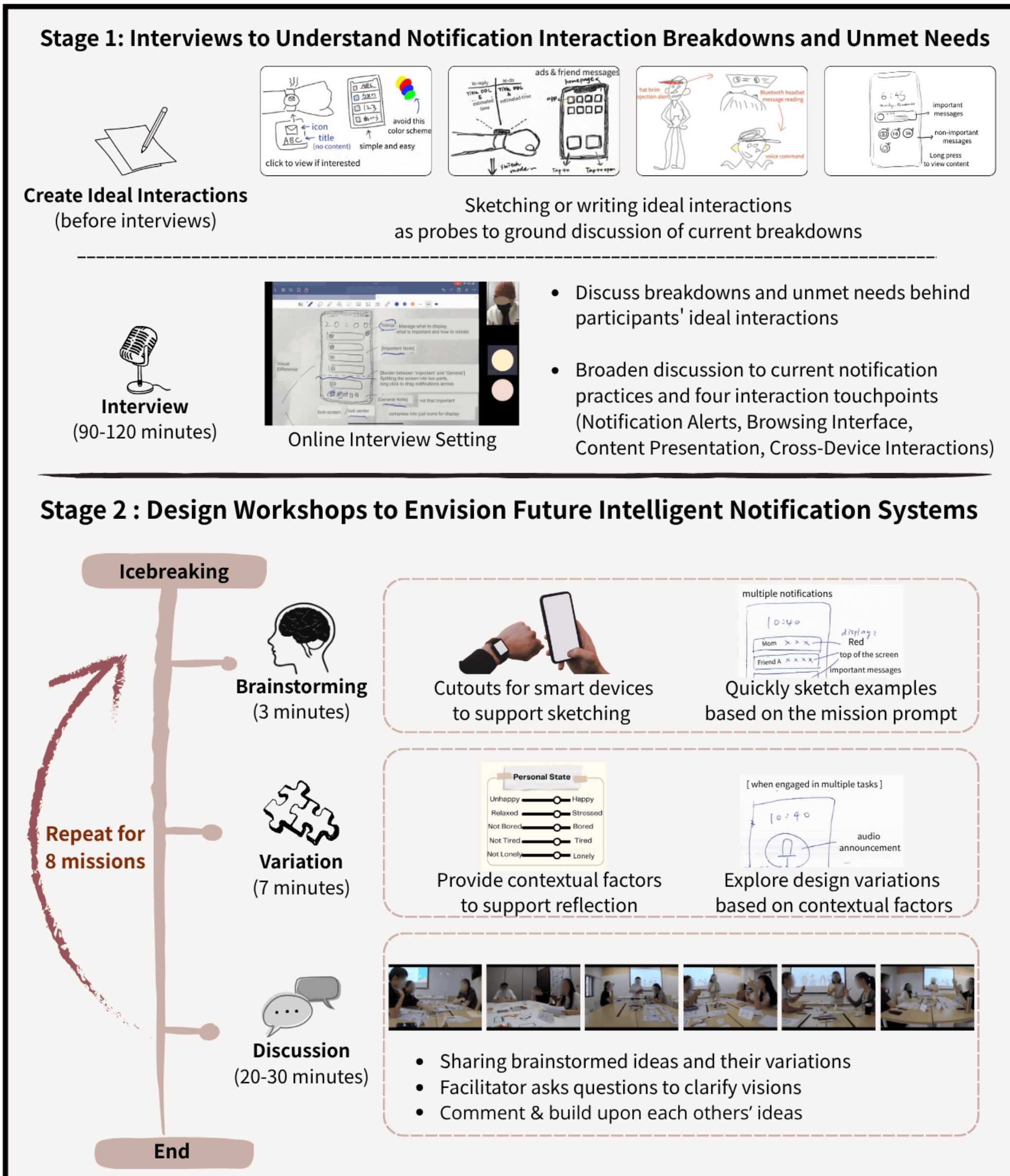


Figure 1. Diagram of the Two-Stage Study Procedures

judgment, such as posts that only stated that *"Somebody posted,"* forcing participants to *"click through two more layers"* before deciding whether the content was worth attention (P11).

3.4.4 F4: Inadequate Support for Task Reminders and Deferred Follow-Up. Participants often encountered notifications that conveyed valuable information or required action, but they could not engage with them immediately because they were busy, in an inappropriate context, or lacked time.

Table 2. Participant Profiles for Stage 2 Design Workshops

ID	Age & Gender	Occupation	Primary Device Currently in Use	Mobile OS	Daily Notifications on Primary Phone	Workshop # - Group
P14	25 F	Student	Smartphone & Computer	iOS	11–30	1-B
P15	36 F	Marketing	Smartphone & Computer	iOS	>60	1-B
P16	37 M	Freelancer	Smartphone & Computer	Android	31–60	1-B
P17	24 F	Student	Smartphone & Computer	Android	31–60	1-B
P18	26 F	IT	Smartphone & Computer	iOS	11–30	1-A
P19	34 F	IT	Smartphone & Computer	iOS	11–30	1-A
P20	27 F	Art & Design	Smartphone	Android	11–30	1-A
P21	30 M	Student	Smartphone & Computer & Smartwatch	iOS	31–60	2-A
P22	24 F	Art & Design	Smartphone & Computer	iOS	11–30	2-A
P23	26 F	Edu. & Comm.	Smartphone & Computer & Tablet	iOS	>60	2-A
P24	23 F	Art & Design	Smartphone	iOS	31–60	2-B
P25	21 M	Student	Smartphone & Computer	Android	<10	2-B
P26	35 M	IT	Smartphone & Smartwatch	Android	>60	3-A
P27	29 F	Student	Smartphone & Computer	Android	>60	3-A
P28	26 F	Student	Smartphone & Computer	iOS	11–30	3-B
P29	19 F	Student	Smartphone & Computer	Android	11–30	3-B
P30	21 M	Student	Smartphone & Computer & Tablet	iOS	11–30	4
P31	38 F	IT & Student	Smartphone & Computer & Smartwatch	iOS	11–30	4
P32	24 F	Marketing & Student	Smartphone & Computer	iOS	>60	4
P33	20 F	Student	Smartphone & Computer & Tablet	iOS	<10	5
P34	25 F	Art & Design	Smartphone & Computer & Tablet	iOS	11–30	5
P35	34 M	IT	Smartphone & Smartwatch	Android	31–60	5

Existing systems provided limited support for remembering or deferring these tasks, so participants had to rely on makeshift strategies, such as keeping notifications unread or visible in the drawer. P09 explained that he would keep important notifications because he might need to read them *"a second or third time,"* while P13 described the notification center as an *"intermediate point"* where critical items should remain until they could be properly handled.

4 Stage 2: Design Workshop

Stage 1 identified recurring pain points and unmet needs in participants' everyday notification experiences. Building on these insights, together with prior literature, we designed a set of workshop tasks intended to prompt participants to envision how FINS could support them. We iteratively refined and pilot-tested these tasks before finalizing them as eight design "missions," which participants were asked to imagine FINS addressing.

4.1 Stage 2 Recruitment and Participants

For Stage 2, we recruited through public online channels in our study context, including Facebook groups and local discussion boards. We used the same screening questionnaire as in Stage 1 to collect demographic information and basic notification-usage measures. In total, 22 people participated in the design workshops, including 16 females and 6 male participants, ranging in age from 19 to 38 (M = 27.5, SD = 5.82). Participation in both stages was optional. One participant (P16) chose to do so, which we considered acceptable given the different formats and focus of each stage and the approximately five-month interval between them. Most participants used smartphones and computers as their primary notification devices, and four also used smartwatches. Each participant received approximately US$26 in compensation. We concluded the data collection after five workshops as we observed thematic saturation, where subsequent workshops were no longer yielding significantly new design patterns. Further participant details are provided in Table 2.

4.2 From Pilot Workshops to Eight Design Missions

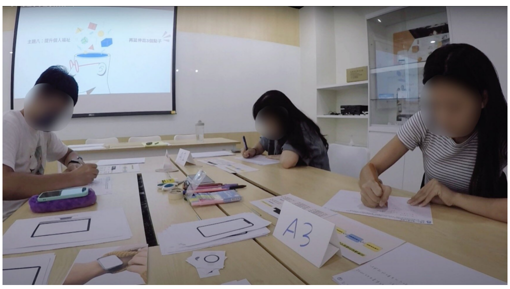
To determine the final workshop tasks, we iteratively refined our design prompts. Initially, drawing on the pain points identified in Stage 1 and prior notification literature [85, 87], we structured the workshops around a four-stage notification-interaction framework: noticing, glancing, reading, and acting. Participants were introduced to these stages alongside corresponding notification-related breakdowns and asked to envision how FINS could support them across each stage. To evaluate this framing and explore alternative ways of structuring participants' design thinking, we conducted two pilot workshops with eight volunteers each, none of whom participated in Stage 1 or the main Stage 2 workshops.

However, pilot participants often found the stage-based framing fragmented and struggled to relate the stages to their real-world needs. Some viewed certain stages as irrelevant to their everyday experiences, while others found it difficult to propose concrete or aspirational designs without a clearer purpose. Through participants' reflections and our observations, we found that participants engaged more readily when design discussions were anchored around concrete goals—namely, what they wanted FINS to accomplish. This framing enabled participants to think more concretely about what kinds of support and interactions FINS should provide. Consequently, we adopted a *mission-oriented* framing for the main workshops, using missions as prompts to structure discussion and encourage participants to consider broader forms of support FINS could provide.

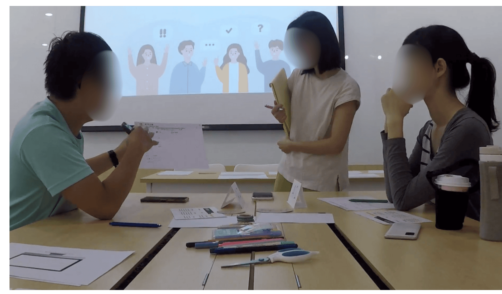
Specifically, we grounded a set of services and support needs in the Stage 1 findings and complemented them with relevant prior literature that addressed similar notification-related breakdowns. Using both sources gave us greater confidence that these missions reflected needs that are not only well-established in prior research, but also continue to resonate with users' present-day experiences. We organized these into seven functional missions (Missions 1–7). In addition to functional needs, our Stage 1 interviews also surfaced concerns around notification-related stress and well-being. This motivated the inclusion of Mission 8 ("Well-being"), which was designed to explore how FINS might support users' mental health beyond task management. Ultimately, this process resulted in eight design missions, listed below with the Stage 1 finding(s) that grounded each mission and the related work it echoes.

- **Mission 1: Minimizing Disturbances and Distractions.** Reducing notification-related interruptions during specific moments and in certain contexts. Grounded in *F2*; echoes [1, 5, 18, 43, 69].
- **Mission 2: Preventing Critical Notifications from Being Missed.** Ensuring that crucial notifications are promptly noticed and addressed. Grounded in *F1*; echoes [15, 56, 57, 95].
- **Mission 3: Quick Notification Comprehension.** Supporting users to rapidly extract key information from notifications. Grounded in *F3*; echoes [21, 41].
- **Mission 4: Determining a Priority Order.** Helping users prioritize notifications to focus their attention and engagement. Grounded in *F1* and *F3*; echoes [56, 57, 94, 95].
- **Mission 5: Scheduling When to Read or Engage.** Identifying opportune moments for users to interact with their notifications. Grounded in *F2* and *F4*; echoes [11, 45, 69, 74, 100].
- **Mission 6: Reminding Users about Important Tasks.** Creating effective reminder mechanisms for critical tasks amidst the high volume of notifications. Grounded in *F4* and *F1*; echoes [4, 16, 57, 93].
- **Mission 7: Exploring Worthwhile Recommended Content.** Developing strategies for presenting or recommending content that aligns with users' interests. Grounded in *F1* and *F2*; echoes [20, 21, 55, 63, 80].

- **Mission 8: Leveraging Notifications for Well-Being.** Exploring how notifications could be used to positively impact users' physical and mental health. Grounded in the broader burden across *F1–F4*; echoes [6, 7, 22, 58, 99].

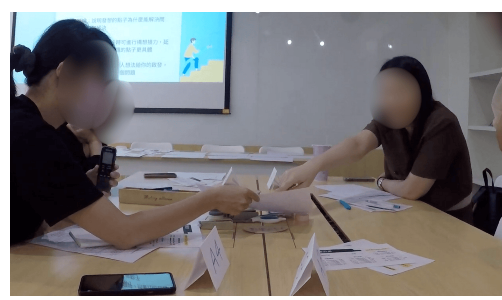


(a) For each mission, the first two segments involved participants sketching brainstormed ideas and their variations based on the current mission's prompt and contextual factors.



(b) During each mission's discussion segment, each participant (the person on the left in this photo) takes turns in sharing their sketches and thoughts.

(c) The workshop facilitator (the person standing in this photo) may ask follow-up questions to clarify the participants' ideas.



(d) Other participants then comment on these proposed ideas or build on each other's thoughts to improve these initial ideas.

Figure 2. Scenes of design workshop settings from workshop recordings. Cutouts of blank-screen smart devices are placed on the table, where participants can freely use them in their sketches.

4.3 Stage 2 Workshop Procedure

The five design workshops were structured around the eight notification-interaction missions identified in Section 4.2. The missions were presented in a fixed order to ensure a logical flow from "filtering" (Missions 1–2) to "engagement" (Missions 3–7) and finally "well-being" (Mission 8). The workshops' goal was not to co-design a complete system, but to explore a diverse range of user needs, scenarios, and design possibilities grounded in participants' lived experiences.

Each workshop lasted between 4.5 and 5 hours. To mitigate participant fatigue and sustain high levels of cognitive engagement throughout the intensive workshop, we divided the workshop into two blocks. A 20-minute intermission was scheduled after Mission 4, during which refreshments were provided to help participants recharge halfway through the workshop.

Each workshop included one or two facilitators and at least two, but not more than four participants. We began with participants giving consent, followed by an ice-breaking activity where they introduced themselves. Prior to the main tasks, facilitators conducted a 20-minute tutorial on brainstorming techniques. We provided classic examples of existing notification solutions and demonstrated how to extend them into novel variations. This warm-up helped participants understand how open-ended their ideas could be before moving into the mission-specific workshop tasks. Facilitators then outlined the eight missions, as illustrated in Figure 2, with each mission explored through three timed segments:

Segment 1: Rapid Brainstorming (three minutes). Each participant began by individually reflecting on the mission prompt. We provided illustrative scenario prompts (e.g., *"Imagine you are in a deep focus state..."*) to spark their ideation. To assist with visualization, we provided printed cutouts of smartphones, smartwatches, and laptops with blank screens that allowed participants to sketch their imagined interfaces and/or interaction sequences. This initial segment was designed to tap into participants' intuitive desires and needs grounded in lived experience, without the constraints of either group dynamics or technical-feasibility doubts.

Segment 2: Generating Variations (seven minutes). After sketching a core concept, participants were asked to expand on it by creating at least three contextual variations. Our prompts encouraged them to think about how their design might function differently depending on contextual factors such as their current activity (e.g., working, commuting, relaxing) [61, 62, 64], personal or emotional state (e.g., stressed, focused, tired) [64, 74, 102], social context (e.g., alone vs. in a meeting) [32, 83], content type (e.g., media, task, message) [63, 80], and the identity of the notification sender (e.g., a close contact, a service, or a bot) [51, 63, 102]. This segment helped participants reflect on how well their ideas would work across diverse real-world scenarios and propose nuanced requirements.

Segment 3: Discussion (20-30 minutes). Workshop participants then took turns presenting their sketches and design variations to the group. Using their sketches as visual anchors, each described the needs their idea aimed to address and the associated FINS behaviors that they desired. Facilitators asked follow-up questions to clarify the reasoning behind each idea, how the interaction should adapt to different contexts, and how the FINS' responses to user preferences or behavior might change over time. Participants were also encouraged to comment on one another's ideas, relate them to their own experiences, and suggest refinements. The discussions often led to deeper elaboration of initially vague ideas and revealed shared patterns of frustration or aspiration, which helped us identify common design directions across participants.

4.4 Stage 2 Data Analysis

All workshops were video-recorded and were manually transcribed verbatim, with AI assistance followed by manual correction. We adopted an iterative approach to qualitative analysis, aided by Atlas.ti[2]. Data analysis was again conducted concurrently with data collection, which enabled ongoing reflection and allowed us to ensure the diversity of participant perspectives. This method also allowed us to refine our recruitment strategy as needed, ensuring balanced representation across usage patterns and demographic backgrounds.

The coding process followed an inductive approach grounded in open coding. The missions structured ideation during the workshops, but we did not treat them as fixed analysis categories. Instead, we coded participants' sketches and discussion across all missions to capture cross-cutting expectations for support from FINS. To minimize moderator bias, the second and third authors began by independently coding transcripts from workshops they did not moderate. Their initial codes were intended to capture a broad range of user-identified needs, ideas, and frustrations. The research team met twice monthly to discuss emergent codes, resolve discrepancies, and collaboratively refine the codebook through constant comparison. As coding progressed, we grouped related codes

[2]https://atlasti.com/

into higher-level categories through axial coding [81], which were then clustered into the final themes [9] that reflected recurring expectations and desired functionalities.

While our analysis was primarily bottom-up, our interpretation was also informed by existing literature and by what emerging AI-powered notification systems can plausibly support. This helped us recognize patterns related to automation, personalization, contextual adaptation, and user agency that, while not yet widely deployed in real systems, were prominent in participants' articulated preferences for future ones.

5 Stage 2 Design Workshop Findings: Users' Desires for Future Intelligent Notification Systems

Our analysis of the design workshops shows that participants wanted FINS to go beyond delivering and organizing alerts to offer broader support for personal information and task management. Many participants described FINS as proactive assistants that extend into everyday activities. In the sections below, we report these expectations and desired features, including capabilities that extend beyond what today's notification systems typically support.

5.1 Users Wanted Future Intelligent Notification Systems to Adapt Notification Presentation through Implicit Learning from User Behavior and Explicit Feedback

Workshop participants wanted FINS to adapt over time by learning from their ongoing notification interactions. They expected such adaptation to reduce repetitive handling and make notifications that mattered more visible. A key part of this vision was *implicit learning*, where FINS would interpret routine behaviors such as opening, previewing, ignoring, or swiping away notifications as preference signals. Participants often compared this learning to how social media platforms tailor content through engagement metrics. As P21 explained:

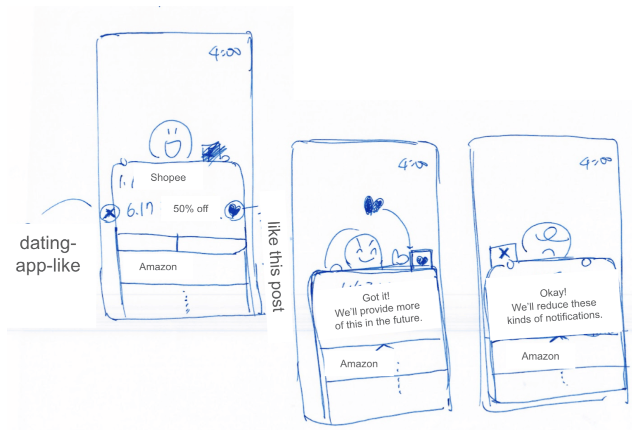
> *When I see this kind of ad, my first reaction is to swipe it away without opening it—just pull down and swipe away, pull down and swipe away. I hope the system can figure out that I'm not interested in this kind of ad. Otherwise, having to swipe every time is honestly really annoying.*

Several participants hoped that FINS could combine multiple behavioral indicators to capture their preferences and degree of interest more precisely. For example, P35 proposed that

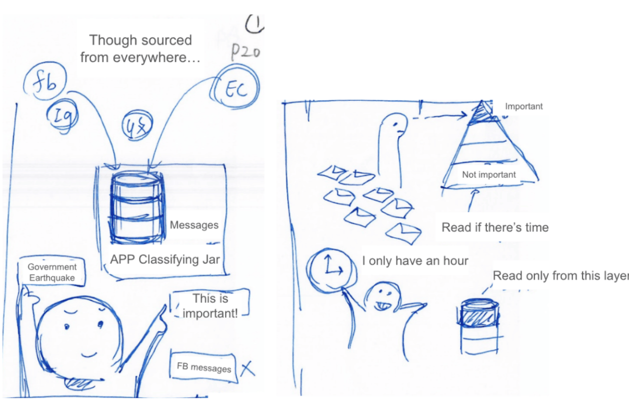
> *the system should record how many times the user opens the app through a notification, and also keep track of how often they preview it and for how long. Then it could use those factors to decide whether to bump it up. Another factor would be how often the user just swipes it away, or how many days it goes untouched [...]. Combining those, the system could figure out what to push up or down over time. That way, the stuff that's actually important to you naturally floats to the top.*

These comments suggest that participants expected FINS to infer interest and disinterest from repeated interaction patterns, rather than requiring repeated manual handling of the same kinds of notifications.

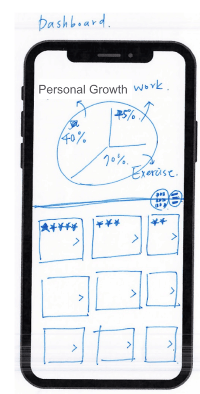
Complementing this expectation was a desire for *explicit mechanisms* through which users could directly communicate preferences. While participants appreciated that implicit learning could reduce the need for extra effort beyond routine interactions, they worried that FINS might learn ineffectively, such as by misinterpreting their actions and adapting in unwanted ways. They therefore proposed lightweight feedback controls that could fit into notification handling, allowing them to easily reinforce or correct FINS' understanding of their preferences without leaving the notification interaction flow, such as through simple like/dislike buttons. As P29 explained:



(a) P20 suggested lightweight mechanisms similar to dating apps, where users could explicitly provide like/dislike feedback on presented notifications.



(b) With FINS that effectively adapt to user feedback, P20 imagined a "notification jar" that, when time to handle notifications is limited, surfaces the most important items first while leaving less relevant ones deeper in the jar for later review.



(c) P18 proposed a dashboard to visualize implicitly learned preferences and highlight the notifications most worthy of attention.

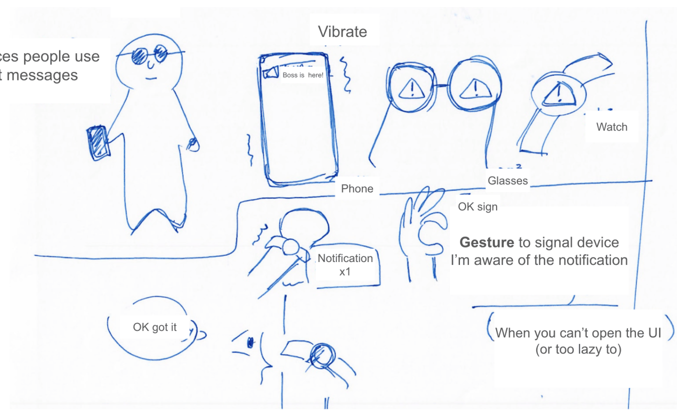
Figure 3. Sketches illustrating participants' desires for adaptive FINS that learn user preferences.

> *Say a news notification pops up and it's a type of news you like. There could be a button on the right where you can press to say you like it. Then the system would show you more of that type of news in the future. If it's a comic and you don't like it, you could press a button on the left to say you don't like it, so it stops recommending that type of comic.*

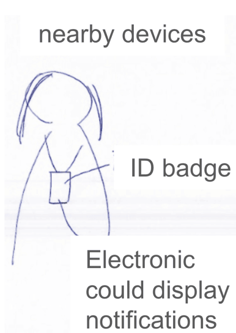
Other participants imagined dedicated training interactions outside the notification flow. P20, for instance, suggested that *"swiping left or right could be like Tinder, for 'like' or 'dislike.' [...] If you swipe 'dislike,' it would say, 'OK, we will reduce messages like this,' similar to how Facebook does when you unfollow something,"* as illustrated in Figure 3a.

Participants expected effective learning from behavior and feedback to help FINS prioritize notifications according to their needs. P21 imagined a *"notification jar"* (Figure 3b) that presents only the most relevant notifications at the top when time is limited. P18 similarly proposed a dashboard (Figure 3c) that visualizes interaction patterns, such as *"more than 70% [of interacted* *notifications] are about exercising or 40% are about personal growth,"* and uses these insights to highlight *"notifications marked with more stars"* as deserving greater attention.

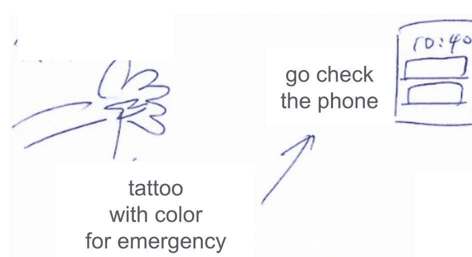
Together, these suggestions reflect a desire for FINS that adapt to users' habits and preferences over time through lightweight, low-effort interactions rather than cumbersome configuration.



(a) P20 envisioned that when a critical notification arrives, FINS should evaluate all available devices and objects and route the alert via the most suitable channels to maximize awareness. She also suggested quick gestures to dismiss the signal, especially when users cannot immediately access notification interfaces.



(b) P32 proposed using her work badge as an indicator for potentially important notifications, reasoning that it is almost always with her in workplace settings.



(c) Extending the idea in Figure 4b, P32 imagined bodily augmentation—such as a tattoo that changes color—to prompt her to check her phone when urgent notifications arrive.

Figure 4. Participants' sketches of how FINS could extend notification delivery and enhance awareness of critical notifications.

5.2 Users Imagined Distributed Notification Awareness through Objects and Trusted People

Some participants wanted FINS to extend notification awareness beyond their smartphones into their physical environment. While the idea of enhancing notification awareness often touched on amplifying existing devices' signals, such as by transforming urgent notifications into phone calls (P31) or delivering them via electric pulses (P27), a more notable theme involved leveraging nearby objects and people to support or distribute awareness of important incoming information.

5.2.1 Extending Notification Delivery through Physical and Social Channels. Instead of relying solely on smartphones, which are often not immediately accessible, participants imagined FINS to route alerts through everyday objects that users are more consistently in contact with. These objects could act as peripheral indicators to draw attention to the primary device. For instance, P32 described how her work badge—an item she always wears—could serve as a more reliable conduit for notifications than her phone (Figure 4b):

> *It's always hanging on me when I'm working. Unlike my phone, which is heavy and only needed if I plan to do a lot of things, the badge is always there. So if it vibrated or lit up, I'd definitely notice.*

She extended this idea further, imagining a form of bodily augmentation that could visually signal urgency (Figure 4c): *"If I had a tattoo on my hand, and an urgent notification came, it could turn red or something."*

In addition to leveraging the most consistently present objects, P20 suggested that FINS should explore all possible devices and objects (Figure 4a) and choose channels that increase the chance of noticing critical notifications—thereby minimizing the chance of missing them—for instance, *"show[ing] an alert announcement like my phone is hacked [...], or pop[ping] out a 'Warning' signal on my glasses."* Recognizing that such alerts might appear through objects in the surrounding environment—and often in the presence of other people—she also suggested using gestures to dismiss these signals, in order to *"prevent bothering those nearby"* when notification interfaces are not immediately accessible.

Alongside non-phone objects, participants also envisioned leveraging nearby people as intermediaries for missed notifications, particularly in situations where their own attention was likely to lapse. In loud or socially distracting environments such as nightclubs or cafés, they imagined important notifications being rerouted to trusted individuals if left unattended for too long. P25 suggested that FINS would *"let people around you who are less likely to be distracted in that place receive the notification, and then they can notify you."* Similarly, P26 emphasized the value of colleagues as notification relays: *"Like your colleague next to you could tell you the boss tagged you on LINE, if you didn't see it."* He elaborated on this by pointing to the regularity of physical co-location in daily life: *"When a person's lifestyle is stable, they tend to be around the same group of people. [...] If I'm with those people, they could also be notified. When you don't notice, your friends could tell you."*

5.2.2 Embedding Notification Relevance in Spatial Routines and Object Interactions. Participants envisioned FINS that not only distributed information across the physical environment, but also leveraged users' habitual interactions with surrounding objects to deliver context-relevant reminders. In this view, notification delivery becomes spatially embedded, with certain objects surfacing only the most relevant information depending on users' routines and immediate context.

Rather than constantly pushing notifications, participants suggested embedding reminders into objects they naturally encounter during daily routines. For example, P25 described placing a small calendar-like display near the shoe cabinet she interacts with every morning before leaving home, which would surface only location-relevant and time-sensitive reminders:

> *You'd only see the things you need to do before leaving on that calendar by the door. [...] Having different places for different notifications makes me feel more comfortable and avoids fatigue.*

Her emphasis was not simply on location, but on pre-existing routines of spatial attention—this object is not just visible; it is encountered with specific mental readiness. Thus, rather than issuing global alerts, FINS could tactically place information where users' attention is already primed.

Participants also discussed leveraging different surfaces of a single object to assign meaning. For instance, P24 imagined using the back of her phone to show only persistent task-related content. This face is less frequently interacted with, and therefore ideal for low-interruption awareness. Its visibility becomes meaningful only in specific handling contexts—such as when the phone is picked up or turned over—embedding the notification in a micro-spatial routine:

> *Usually when we're working, we don't want to be disturbed [...] what if the to-do list could be displayed on the back of the phone? It would just be the to-do list, with no other unrelated notifications shown there.*

In both cases, the participants are not merely redistributing content—they are assigning attentional roles to objects or surfaces based on their spatial relationship to future actions. These interfaces mark activities or situations, and serve as effective channels for filtering what matters at that moment.

Together, these perspectives describe an expanded role for FINS that emphasizes spatial intentionality. Rather than constantly competing for attention, notifications could surface on the right object, at the right place and moment, when users are most ready to act.

5.3 Users Preferred Actionable Takeaways and Progressive Disclosure

Stage 2 participants wanted FINS to do more than relay information—it should structure notifications so the most important cues are immediately clear. Frustrated by missing critical tasks buried within verbose or cluttered notifications, they envisioned a two-tiered content model: concise, actionable takeaways for rapid comprehension, followed by progressively disclosed details when needed. Participants viewed this layered structure as essential for managing attention and reducing the risk of overlooking important information.

5.3.1 Providing Actionable Takeaways to Guide Next Steps. Many participants expressed a desire that FINS should do more than summarize: i.e., they should interpret messages, with the aim of surfacing the specific action or intent that is most relevant to the user. This capability was seen as essential for quickly determining whether a notification required attention and what the user needed to do. As P19 noted, *"I don't just want to receive the content, I want to process it quickly. [...] I want to know, 'What is my next step?'"*

Some participants emphasized that such interpretation would depend both on users' contexts and on their personal preferences. In some cases, simply knowing the category of a notification was deemed sufficient. In others, however, FINS would need to highlight a required response or deadline. For example, a notification from a telecommunications company might be considered irrelevant if it comprises a promotion, but crucial if it concerns a service issue. As P29 explained:

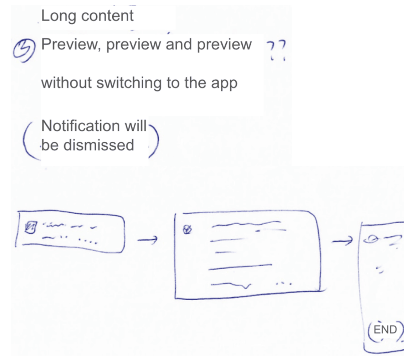
> *Take [company], for instance. Sometimes you have to read the text to figure out if it's a promotion or a system message. It would be much more convenient if it could just say up front: this is a promotion, or this is a reminder that your data or phone bill is running low.*

Similarly, P25, who followed several bloggers, noted that only minimal information was needed to make a decision about whether to engage further:

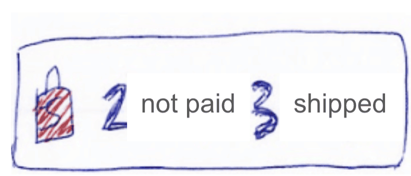
> *The information I want to know early doesn't need to be complete. [...] I just need to know the title or the outline; I don't need the full information to decide whether to read his article. Overly large content can be uncomfortable; it can be important but incomplete.*

Additionally, several participants suggested aggregating takeaways from notifications with similar intents to support batch processing. This was seen as especially useful for task-oriented notifications, as it could provide a quick overview of the status of multiple items at once. For example, P34 explained (Figure 5c): *"I want to see how many [e-commerce products] are unpaid or shipped. [...] I order a lot of things for my company, but sometimes forget to re-check their statuses."*

(a) P18 preferred FINS that could proactively deliver takeaways through conversational interactions, reading out core messages on smartphones or smartwatches to reduce the need for users to seek information themselves.



(b) When notification content is lengthy or when its real intent is hidden within the corresponding application, P34 proposed an interface that progressively discloses content at different levels of detail. This design both prevents overload and reveals the notification's essence without requiring deeper interaction.



(c) P34 noted that many similar notifications may share the same takeaway message. He therefore suggested grouping them together as an initial layer, before progressively disclosing individual details.

Figure 5. Participants' sketches representing actionable takeaways and progressive disclosure.

A number of participants also imagined various modalities for receiving such core messages. Some, like P18, envisioned conversational interactions where they could ask questions and receive direct answers (Figure 5a):

> *What if I could just ask, 'What is my boss looking for me for today?' and it could tell me directly, 'Nothing, you're done for the day.'*

Beyond wanting to understand messages, many participants expected FINS to facilitate subsequent action. One form of such support that they wanted was providing suggested next steps. For example, P14 told us:

> *It could suggest that I need to reply by a certain time, and even better, if the message requires answering questions or planning, it could prepare suggestions A, B, and C for me. [...] Besides just reminding me of the time, it's best if it also tells me how to do it, giving me options.*

Some preferred lightweight interactions that let users instruct FINS to carry out the next step on their behalf, enabling it to further relieve their efforts in executing follow-up actions. For example, P30 described: *"Say my mom asks if I'm coming home for dinner. The system could generate two options: YES or NO. I just tap YES right from the notification without opening the app or typing a reply."* Several participants also described more proactive support, wanting FINS to *autonomously* perform routine, time-sensitive actions on their behalf to avoid missed opportunities. P31 mentioned some tasks that *"the system could just handle it for me—like paying a bill when it's due, or grabbing concert tickets when the time comes. That way I don't risk missing the message or forgetting to act."*

In short, participants desired support from FINS that not only interpreted what content mattered, but also minimized the friction of acting upon that interpretation—whether through recommended actions or autonomous execution.

5.3.2 Progressively Disclosing Details to Manage Attention. While participants valued upfront clarity, they also wanted the ability to access further information—when they chose to do so. This expectation about progressive disclosure reflected an attention-management strategy: they did not want to be confronted with details unless/until they were ready to engage.

(a) Displaying only the presence of incoming notifications—without content—through the "frosted-glass" display during predefined periods when users feel unreceptive to notifications.

(b) Initially displaying only the sender or source of a notification, with additional details progressively revealed when the user is ready to engage.

Figure 6. P20's "frosted-glass" interfaces for previewing notifications while deferring full disclosure.

Some participants told us they appreciated having an initial high-level notification preview that would later expand into more specific content. For example, P25 described this prior experience as desirable:

> *When I check my phone at six or seven in the morning [...] it might just remind me, "You have several new emails in your Gmail inbox," letting me know roughly that there are a few important emails. Then, as I'm getting ready, I can have a general idea of what I need to handle today.*

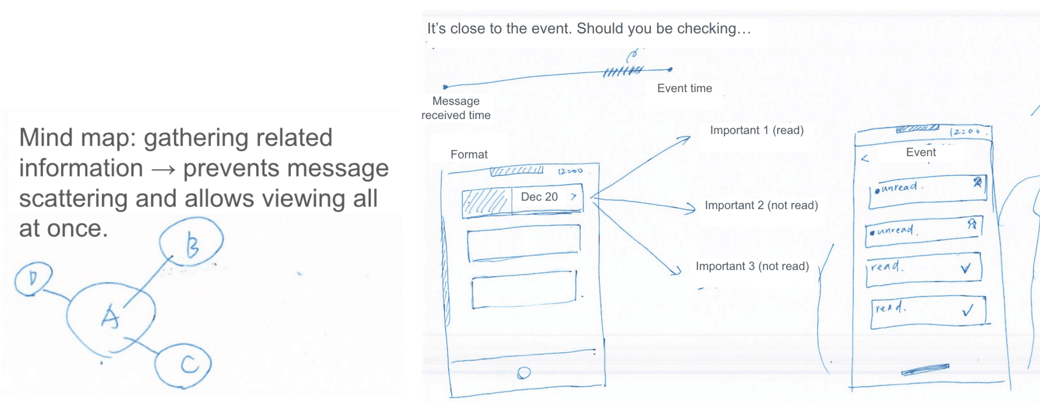
P20 offered a more metaphorical framing of progressive disclosure, describing an interface overlay that would keep details hidden when she felt unreceptive to notifications (Figure 6a), while allowing her to reveal more information when ready to engage (Figure 6b):

> *The frosted glass [in my sketches] means the thing exists, but you can have a delay [...] It's not like "I don't know," it's more like "I know, but I choose to wait a moment to look at it." [...] Seeing the full work message after hours [...] you can't stop, you can't let go of that sense of responsibility. I want to know it's there, but just block out the details.*

Through these and other such examples, participants expressed a desire to maintain ambient awareness of new content without experiencing immediate pressure to act, highlighting how progressive disclosure can help balance awareness with control over their attention.

5.4 Users Desired Support for Linking Related Notifications and Relevant External Context

Various participants emphasized that notifications should not be treated as isolated items. To improve processing efficiency, they wished FINS could proactively present and indicate connections, both among related notifications and between notifications and relevant external information.



(a) Illustrating the concept of how linking related notifications could help reduce cognitive load.

(b) An example of linking notifications associated with an event, combining both unattended notifications and those already known to supplement information when managing related activities.

Figure 7. P18's sketches of FINS that support linking associated notifications to improve efficiency in managing multiple related messages.

These connections were viewed as beneficial in two main respects. First, they could streamline the handling of multiple related notifications, saving participants from repeatedly switching contexts to piece together the full picture. Several interviewees described frustration when topically or temporally related notifications were scattered across different apps or buried in various parts of the notification stack. They hoped FINS could *proactively* link such items, reducing the need to manually locate and revisit each message, thereby creating a smoother and more cohesive interaction flow. P18 illustrated this concept in Figure 7a, and reasoned:

> *If I'm reading notification A and A and B are related, B could be put on a read-later list. [...] That way, I can finish off promotions A, B, C, D at once, without searching for them in individual apps.*

She further imagined scattered communications related to an upcoming job interview being consolidated into a single reminder (Fig. 7b):

> *I imagine a pop-up would appear, telling me, 'Hey, this event [an interview] is coming up, do you need to review certain messages?' [...] It would group the three emails it sent me. Whether I've read them or not, it would remind me to look at them again.*

Second, participants wanted associations that connected notifications to external knowledge, helping situate individual messages within a broader context. They viewed such associations as both time-saving and cognitively supportive, as FINS could proactively gather information users would otherwise search for themselves. For example, P26 hoped that FINS would proactively associate a camping-related message with the weather forecast, because *"for camping, weather is really important."* Such contextualization was also viewed as critical when notifications were ambiguous or unfamiliar. P31 reflected on receiving a health-related message and imagined FINS that could *"look up related information, so if I'm worried [...] I can read further to confirm that this is a normal situation and I don't need to worry."*

Some participants even imagined FINS extending notifications into task suggestions that mirrored how a message could trigger related ideas in their own thinking. As P34 described: *"It reminds me to pay for a train ticket, and that makes me think, 'Oh, I also need to book a hotel room.' It would be great to immediately write down these little things."*

5.5 Users Envisioned Agent-Like Future Intelligent Notification Systems that Personalize, Coach, and Connect

Finally, participants envisioned notification support taking on broader, assistant-like roles that actively help shape their lives and goals. Specifically, they imagined FINS that could: 1) infer personal context to deliver information aligned with their immediate needs and activities; 2) reinforce self-defined goals and values through personalized prompts; and 3) explore societal and community trends to connect them with relevant information, opportunities, and communities.

5.5.1 Using Information from Notifications as Signals to Anticipate and Proactively Support Broader User Needs. Participants envisioned FINS personalizing information by inferring users' immediate states and long-term profiles from notification streams, digital traces, and interaction histories. By leveraging this broader contextual information, they believed FINS could develop a more holistic understanding of users and better tailor support to their situational needs and activities.

For example, participants wanted FINS to infer users' immediate states to determine which kinds of notifications they would be receptive to. P21 suggested that his typing patterns could reflect his mood, which in turn would provide a clue about what notifications he might want to see:

> *If the system detects that the words I've been typing recently are more gloomy, busy, or irritable, it could make corresponding adjustments [...] Some people, when they're feeling down, want to see more positive news [...] while others might want fewer notifications.*

He also noted that FINS could use other incoming notifications to infer a user's status, such as their financial state, and adjust the content it promotes accordingly: *"If the system sees frequent, large deposits from my salary notifications [...] it can infer that I'm financially well-off recently, so it could show ads for cars or houses [...] turning money into the shape of things you like."* As P21's examples illustrate, users' desire for FINS that knows their status was prompted by a need not only for relevant content, but for support for their situational well-being.

Beyond responding to immediate events, many participants imagined FINS acting as proactive assistants that infer broader needs and opportunities from notification streams. Rather than treating notifications as isolated information, they wanted FINS to synthesize these signals with contextual data to provide insights, reminders, and suggestions beyond notification management.

For instance, participants suggested that recurring notification patterns could reveal users' long-term interests and roles. P25 explained that frequent game-installation updates would signal that he is primarily a gamer, enabling FINS to recommend more relevant gaming content: *"If my computer has over ten games installed, you'll know it's probably not for office work, but for gaming. So you can present more gaming-related information."* Similarly, P21 noted that a person's profession—often reflected in their notifications—could guide FINS in suggesting targeted resources, such as prompting a social-media manager with notifications about creativity-related tools or books.

Participants also highlighted that notifications often stem from interpersonal exchanges, making them a valuable resource for socially aware assistance. They envisioned FINS recognizing communication patterns and offering timely relational reminders. As P14 described, *"It could pop up some 'tips,' like important dates I've had with this person or things I need to remember about them [...] For some professions like PR or marketing, this information would be very important."* In this way, participants saw FINS as supporting the maintenance of personal and professional relationships.

Finally, participants imagined FINS combining notification streams with contextual data such as schedules to anticipate related needs. Since notifications often signal ongoing activities—like events, purchases, or deadlines—they wanted FINS to connect them to broader life tasks. P14 illustrated: *"If it already knows from your calendar that you're going to [a city], it could integrate other information and remind you, 'Oh, you can also buy this [Father's Day gift] in [that city].'"* Here, FINS was envisioned as a proactive assistant that links notifications to larger goals and responsibilities.

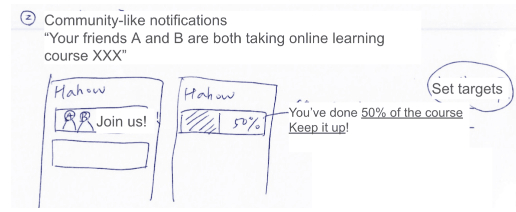
5.5.2 Reinforcing Personal Goals Through Proactive Reminders. Participants imagined FINS evolving beyond reminding them of externally triggered events, such as appointments or messages, to acting as a coach that reinforces internally defined goals and values. For example, P23 described an intervention at moments of distraction: *"For example, when I open Netflix to start watching a video, it could remind me, 'Hey, what are your goals? Have you done them today? Did you exercise?'"*

Participants further noted that such reminders could be more effective if FINS contextualized personal data to strengthen prompts. P27 imagined an emotionally resonant reminder tied to a photo: *"It could show a precious photo to make you suddenly say, 'Wow, I really miss my mom,' and then you make the call."* P29 envisioned linking logged behaviors with external information, for instance: *"It could analyze that you ate McDonald's today, and then pop up a health news story [...] or recommend exercise videos."* Participants also suggested mechanisms for sustaining goal pursuit, including uplifting messages, cumulative progress feedback (e.g., *"You've listened to TED Talks for X hours this month"* (P35)), and visual progress indicators. Others envisioned more playful strategies, such as P32's idea of a gamified virtual pet whose growth depends on maintaining healthy routines (Figure 8c).

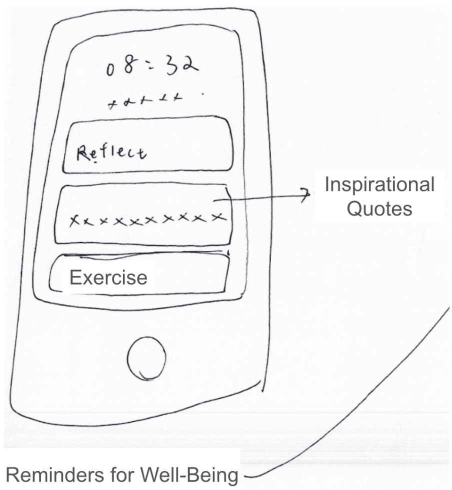
Together, these accounts show how participants envisioned personalized and tailored prompts as essential supports for sustaining goal pursuit, aligning FINS and themselves with their broader aspirational values.

5.5.3 Connecting Users to Relevant Community and Societal Trends Beyond Followed Sources. Finally, participants saw FINS extending beyond relaying information from existing apps to proactively scouting the wider world and surfacing relevant societal or community trends they might otherwise miss.

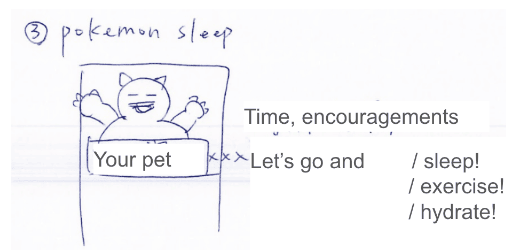
To maintain awareness of the wider world, participants expected FINS to notify them of major events, even those outside their usual interests. As P25 noted, *"These are major events that everyone should probably know about."* Similarly, P27 did not want to be left unaware simply because such events fell outside her existing notification streams: *"I don't want a situation where a major world event happens [...] but because it's not what I typically follow, nothing pops up and it leaves me completely unaware of it."*



(b) P32, drawing on the case of an online course, imagined FINS leveraging personal context from app interactions, using progress tracking and peer pressure to encourage users in accomplishing their intended actions.



(a) P28 envisioned reminders that support multiple aspects of well-being, such as prompting exercise for physical health, encouraging daily reflections for mental health, and motivating users with inspirational quotes.



(c) To further support users in pursuing personal goals, P32 proposed gamifying the process with a virtual pet that reinforces habits by prompting actions and rewarding each completed step with new interactions and pet evolutions.

Figure 8. Participants' desired ways for FINS to actively encourage actions that align with personal goals and support well-being.

Beyond broad societal awareness, participants hoped FINS could surface relevant insights from communities and sources they did not yet follow. This was often framed as drawing on the activities of experts or advanced peers within relevant fields. P25, who was learning programming, explained how this could bridge a "resource gap":

> *There are things I don't know about and haven't explored, but maybe those from top universities have access to certain resources [...] Their social media algorithms would have push notifications for these, and I hope I could receive them too.*

Participants also saw community-sourced content as a tool for fulfilling social needs. P27 explained how FINS could help her connect with different age groups by understanding their interests: *"I was tutoring a while ago, but I had no idea what elementary and middle school students are into. [...] This way, I could know, for example, what celebrities they're watching."* She further noted that knowing what others were *not* seeing could also help introduce novel conversation topics: *"If they haven't been paying attention to it, and I bring it up, they'll find it a novel topic for conversation."*

Collectively, these roles—anticipating users' needs from notification patterns, coaching through proactive reminders, and surfacing trends beyond existing sources—portray FINS not simply as information managers, but as proactive partners that support users' daily activities and long-term aspirations.

6 Discussion

To inform the design of future intelligent notification systems (FINS), our study investigated what kinds of support users expect such systems to provide in everyday life. Through a two-stage qualitative study, we first revisited the notification-related breakdowns and unmet needs that contemporary smartphone users continue to experience, and then used these findings to ground design workshops exploring how users envision FINS addressing these challenges.

Stage 1 revealed that smartphone users continue to experience notification challenges long documented in prior research, including unwanted interruptions [5, 36, 43, 69], missed important information [56, 57, 80, 95], difficulties quickly understanding notification content [21, 41, 63], and problems managing deferred follow-up tasks [16, 57, 93]. The persistence of these concerns is notable given extensive prior efforts to address them. One possible explanation is that some proposed mechanisms have not yet been integrated into widely used notification systems, limiting their impact on everyday practice. Yet another possibility is that existing approaches may not fully address the broader needs of everyday notification interaction as it continues to evolve, amid increasing information volume, app diversity, and user expectations for more intelligent forms of support. If so, supporting notification interaction may require not only refining existing mechanisms, but also understanding what broader forms of support users now expect future intelligent notification systems to provide in everyday life.

Building on these persistent breakdowns, Stage 2 explored how participants envisioned FINS supporting these familiar notification challenges and what broader forms of support such systems might provide in everyday life. Across the workshops, participants envisioned FINS extending beyond existing notification-management functions toward more proactive, personalized, and assistant-like roles that support notification-related tasks, everyday activities, personal goals, and decision making. In the following sections, we discuss these expectations and their implications for designing future intelligent notification systems.

6.1 Making Notifications Actionable, Layered, and Connected

Across the design workshops, participants consistently envisioned FINS as doing more than passively delivering notifications. Instead, they imagined *notification agents* that help users interpret, prioritize, and act upon notification-related tasks more effectively by organizing important information, supporting timely action, and revealing meaningful relationships across fragmented notifications.

Stage 1 participants frequently described notifications as difficult to manage when messages were too verbose to assess quickly or too ambiguous to interpret without accessing them. To address this, workshop participants envisioned FINS generating concise and actionable takeaways that explicitly communicate why a notification matters and whether it requires attention or follow-up. While prior work has shown that notification overviews and summaries can support rapid assessment of content and importance [21, 41], our findings suggest that participants viewed such summaries not as the endpoint of notification interaction, but as the first layer of a broader interaction model based on progressive disclosure.

This layered interaction model also reflects Stage 1 participants' concerns about being unintentionally drawn into engagement at inappropriate moments. Prior notification research has focused on identifying opportune moments for interruption and engagement [52, 67, 72, 100]. Our findings extend this perspective by suggesting that users may also desire control over *depth of engagement*. Participants wanted to remain aware of notifications while selectively delaying access to richer content until they were cognitively or situationally ready to engage further. In this sense, progressive disclosure functioned not only as a presentation technique, but also as an attention-management strategy that helps users balance awareness with control over engagement.

Participants' expectations also extended from comprehension to action. While prior work has shown that overviews can reduce the effort required to understand complex notifications [21, 41], our findings reveal a further expectation that participants wanted FINS to reduce the effort required to respond. They suggested mechanisms such as quick-reply generation and autonomous execution, which could reduce the need to switch apps or manually handle follow-up steps. These envisioned capabilities suggest that FINS may function not only as interpreters of notification content, but also as facilitators of action that bridge awareness and response.

Another recurring expectation was that FINS should identify connections among related notifications and support users in processing them together. Participants described situations in which messages about the same topic or event were scattered across time or across different apps. Current notification systems often treat these notifications as isolated units, leaving users to track these relationships and revisit messages one by one. This concern builds on prior work showing that users prefer to batch-process notifications with similar characteristics, such as source or topic, to reduce context switching [21, 36, 56, 57]. Our findings extend this idea by showing that participants wanted FINS not only to group similar notifications, but also to link related notifications into sequences or re-surface earlier ones when they became relevant. In this view, notifications are not only individual items to be cleared, but also parts of ongoing activities that unfold over time.

Beyond linking notifications to one another, participants also wanted FINS to connect notifications with relevant information beyond what they had already received. Recent work has shown the value of synthesizing past interaction histories into notification summaries to provide context [21]. Our findings extend this by showing that participants also wanted FINS to bring in external information, such as weather forecasts, schedules, or background details, when such information would help them contextualize a message. These associations could reduce uncertainty and save users the effort of searching for information themselves. In this way, participants envisioned FINS as a source of interpretive support that helps users understand how a notification fits into their plans and ongoing activities.

From a design perspective, these findings suggest that FINS should support a path from awareness to action. This requires systems to identify what a notification means, reveal information at an appropriate level of detail, connect related messages, and provide relevant context when users need it. At the same time, such FINS must balance initiative with user control, especially when moving from presenting information to suggesting or performing actions.

6.2 Embedding Notification Awareness in Everyday Routines through Objects and Social Channels

While participants often framed FINS as organizers of incoming content, they also imagined FINS that distribute notification awareness across people and places they come across in everyday routines. This finding responds to the broader ubicomp scope of notification design by showing how participants wanted FINS to use everyday objects and trusted people beyond mobile devices to help them notice important information at appropriate moments.

Prior work on smart-home notifications has examined how factors such as urgency, proximity, and disruption influence where notifications should be displayed, including on smartphones, nearby objects, and environmental displays [68, 90, 91]. Our participants extended this line of thinking from selecting suitable display locations to embedding notification awareness in objects they already encounter at predictable moments in their routines, such as work badges, shoe cabinets, and the backs of their phones. They treated these objects not only as passive display surfaces, but also as meaningful points in everyday activity where notification information could be signaled, delayed, or contextualized. For example, a calendar display near a door could serve as a morning reminder hub, while the back of a phone could act as a low-interruption space for persistent tasks. These examples suggest that notification awareness can be distributed across familiar routines and touchpoints beyond smartphone screens.

Participants also extended distributed awareness to social arrangements. They imagined that FINS could temporarily involve family members, friends, colleagues, or other trusted people nearby who are better positioned to receive and relay critical information. This vision of social delegation resonates with prior work in mobile assessment, where invited peers increased the number of answered questionnaires without reducing response quality [19]. In our study, participants applied a related logic to attention management by treating trusted contacts as intermediaries for important notifications when they themselves were unlikely to notice them. These ideas suggest that participants saw attention as something that could sometimes be shared with trusted people nearby. FINS could therefore coordinate not only where information appears, but also who may help relay it when the user is unavailable.

6.3 Reimagining Future Intelligent Notification Systems as Adaptive Personal Assistants

Finally, participants did not envision FINS merely as tools for delivering, organizing, or presenting notifications. Instead, they imagined FINS as partners that learn from users' situations, interests, and goals, and evolve alongside them. This expectation shifts the role of FINS from passive notification management toward adaptive personal assistance in everyday life.

Participants expected FINS to learn implicitly from their behaviors and notification histories to surface the most relevant notifications over time. At the same time, they wanted lightweight explicit-feedback mechanisms to correct FINS when it got things wrong. This aligns with prior work showing the value of implicit behavioral data [55, 62, 67], explicit labeling [55, 57, 82, 89], and rule-based customization [4, 15, 41, 59, 82] for notification personalization. Our study extends this literature by showing that participants envisioned FINS not only as systems that tailor notification presentation, but also as adaptive personal assistants that use notification content and interaction patterns to infer users' immediate states, long-term interests and goals, relationships, and broader activities. From this perspective, notification streams were not seen only as isolated items to be managed, but also as signals from which FINS could derive insights, reminders, and suggestions for daily life. This perspective highlights an expanded role for FINS, moving from mechanisms for personalization toward adaptive personal assistants capable of offering proactive services that notification research has less explored.

Importantly, participants also articulated expectations that pushed beyond adaptive personalization of presenting received notifications, envisioning FINS that act proactively to help them grow and remain aligned with their goals and values. This expectation resonates with prior work on microlearning systems that deliver productivity-enhancing content during idle moments [29], but participants imagined a broader scope of support. They described FINS that would not only boost short-term productivity, but also reinforce long-term aspirations, such as prompting healthier behaviors, supporting focus, encouraging relational actions like reconnecting with family, and informing them of opportunities aligned with evolving interests. These opportunities might include community trends, expert-recommended resources, or upcoming events relevant to their goals, even when they fell outside participants' existing subscriptions or awareness. In doing so, FINS could reduce the burden of manually monitoring multiple sources while also helping users discover novel opportunities that support both their personal and professional growth.

One reason participants may have likened FINS to personal assistants is the role notifications already play in mobile interaction. As a central hub for incoming information across apps and services, notification systems bring together interpersonal messages, work communications, subscribed content, service updates, and other incoming information. This makes notifications a rich basis from which a system could infer what users are involved in, what they care about, and what they may need support with. At the same time, notifications are frequent touchpoints on mobile devices, with prior work showing that people often check them within minutes of arrival [28, 73]. They also serve as a primary channel through which mobile devices initiate interaction with users. By combining broad informational coverage with close ties to everyday routines, notifications occupy a role that may naturally support assistant-like services. Designers may therefore benefit from reconceptualizing FINS not only as tools for managing attention, but also as assistants for delivering personalized services grounded in everyday life.

6.4 Design Implications for Future Intelligent Notification Systems

Based on our findings, we outline design directions for FINS.

First, we suggest FINS support follow-up actions by extracting actionable takeaways from notification content, building on prior work on task extraction from emails [40, 65, 66, 103] and work communications [3, 30]. FINS could also autonomously handle notification-related tasks, building on recent work on agents that act on smartphones by reading the user's screen [104]. For repeated actions in similar contexts, FINS could learn from users' past manual responses to notifications and suggest or automate follow-up steps, while unfamiliar or higher-risk actions would still require explicit approval.

Second, we suggest FINS associate related notifications across applications and retrieve context when notification content is insufficient. FINS could extract features from notifications known to influence engagement, such as senders, source applications, topics, keywords, and events [63, 80, 89], and use shared features to connect notifications about the same task, event, or conversation. The same features could also help detect when a notification refers to unfamiliar people, topics, events, or terms, or when it lacks information needed to complete a task, prompting FINS to retrieve relevant information from the user's other applications or online sources.

Third, we suggest FINS use displays or indicators embedded in everyday objects that users encounter at predictable moments. These channels could help users notice important information when phone-based alerts are less suitable. Systems could also support social delegation by allowing users, with prior agreement, to route selected urgent notifications to trusted contacts who are often co-located, while marking these notifications as delegated and allowing contacts to control when they receive them.

Fourth, we suggest FINS learn about users and their goals through notification streams to infer what users are currently dealing with and what goals they may want support for. Recent advances in large language models make such inference increasingly plausible [10, 48], but systems should combine these inferences with direct user feedback [82]. This feedback could help users correct or reject goal-oriented support when it is inaccurate, intrusive, or likely to add to notification fatigue.

Finally, one way to support the assistant-like role of FINS is to represent users' notification context as a knowledge graph that connects people, topics, tasks, and goals. Rather than treating notifications as separate items, such a graph could preserve how a new notification relates to prior messages, past actions, and ongoing plans. These relationships could help FINS decide which details are most relevant for takeaway generation, what background information should be shown immediately or deferred for progressive disclosure, and which prior notifications or external sources should be retrieved for context. Aggregating such knowledge across users could also help identify relevant community trends. However, future work should examine how to maintain these representations while respecting privacy and users' control over what FINS can learn from their notifications and interactions.

6.5 Study Limitations

This study has several limitations. First, our qualitative approach based on interviews, workshops, and sketching does not allow us to quantify how prevalent particular user desires are, nor to measure the impact of our notification-interaction missions or design suggestions. Second, we did not evaluate the practical applicability or acceptability of the proposed design directions in real-world use. Our use of predefined missions and contextual prompts may also have shaped participants' responses. The workshop framing may have foregrounded instrumental goals and may not fully reflect the full range of user priorities in everyday life. The design dimensions associated with our eight missions should therefore be viewed as non-exhaustive. Third, although we incorporated multi-device scenarios, participants largely centered on mobile phones. Future research should further examine how these design directions extend to broader multi-device contexts. Finally, our sample was young, predominantly female, and drawn from the researchers' home country, which may limit generalizability. Our recruitment relied on online channels, which may have introduced younger and more digitally engaged participants and made our findings more reflective of younger smartphone users. Future research should integrate quantitative methods, expand to multi-device environments, and include a more diverse participant pool to provide a more comprehensive understanding of user needs and preferences for FINS.

7 Conclusion

Through semi-structured interviews and design workshops, we examined what users desire from FINS. Our findings suggest a shift from notification systems as passive alert managers to proactive agents that support users' attention, actions, and longer-term goals. Participants envisioned FINS as agents that surface actionable takeaways with progressive disclosure, assist follow-up actions, and link related notifications with relevant external context. They also described FINS as adaptive companions that infer personal context to align needs, reinforce self-defined goals, and connect users with relevant community and societal trends beyond their followed sources. Finally, participants wanted notification awareness distributed beyond devices via co-present contacts and objects embedded in routines to better time and contextualize delivery. Together, these desires broaden the design space for FINS toward proactive partners meaningfully integrated into the routines and aspirations of everyday life.

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