Think Inside the Box: Investigating the Consequences of Everyday Physical Opt-Out Strategies for Mindful Smartphone Use

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ABSTRACT

Absent-minded smartphone use has become a catalyst for digital stress. It is often triggered by the mere presence of the device itself, inciting physical opt-out solutions with potentially severe drawbacks. Consequently, there is a need to explore the design dimensions and entailing limitations of physical opt-out methods, especially for everyday use. Informed through expert interviews and online questionnaires, we designed a proof of concept prototype that creates a physical barrier between users and their smartphones while maintaining ease of access. We evaluated our prototype concept in a two-week in-the-wild study, surfacing known benefits of physical opt-out strategies, such as encouraging reflection and supporting deliberate breaks. Although we reduced absent-minded use for users with a high predisposition, drawbacks such as Fear of Missing Out (FoMO) remain. Our work highlights that finding the appropriate amount of physical separation is essential when designing opt-out strategies for digital wellbeing.

CCS CONCEPTS

• **Human-centered computing** → Smartphones; *Ubiquitous and mobile computing*; **Interaction design**.

KEYWORDS

Physical Opt-Out, Digital Stress, Disengagement, Mindful Smartphone Use, Mindfulness

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1 INTRODUCTION

Smartphones have evolved into multi-functional intelligent devices that are present all the time [15]. This ubiquity makes users feel that they are always connected, leading to digital stress [19, 23]. Applications, such as Forest[1] and Space[2], use digital opt-out methods to help users regain control, yet screen time has continued to rise [26].

Excessive phone use negatively impacts both physical [2, 54] and mental health [14, 42]. A major cause of excess screen time is absent-minded use [37], i.e., phone use without a clear goal, accompanied by loss of autonomy [36]. Phone abstinence and 'digital detox' are ineffective [53] and anxiety inducing [21, 27], while adaptive digital solutions where users retain agency, such as MyTime [24], can fail because compulsive behavior is often triggered by the mere presence of a smartphone [37, 48]. One alternative, which is actively used as a coping strategy by users, is physical opt-out. Physical opt-out is any physical means of preventing phone use, ranging from harsh techniques such as a locked box to simply placing the phone out of sight. However, physical opt-out can lead to adverse effects such as Fear of Missing Out (FoMO) [1] and 'nomophobia' [52]. While physical opt-out can be a tool to combat excessive phone use, it could potentially exacerbate digital stress as associated with digital detox [45, 53]. Consequently, it remains a challenge to design methods that make effective use of physical opt-out while compensating for adverse effects.

In this paper, we investigate physical opt-out as a tool to help users manage their phone use. Rather than drawing from digital detox methods, where the goal is non-use, we instead use physical cues to promote reflection and thus encourage more conscious phone use [38]. We conducted a two-part investigation. First, we identified contexts where absent-minded use is a problem through expert interviews and an online questionnaire. We then deployed a proof-of-concept prototype consisting of a non-locking box with a display in which the users placed their phones at night as a physical friction while maintaining pragmatic features. We deployed the prototype and conducted a two-week in-the-wild study to investigate the experience of using physical opt-out.

Our results show that a physical barrier encourages reflection and significantly reduces absent-minded use for users with a high predisposition. However, the cost of this reduction is increased frustration and compulsive morning phone checking for all users,

[1] https://www.forestapp.cc/
[2] https://findyourphonelifebalance.com/

including those who did not benefit. This work confirms the predicament of designing physical opt-out strategies for digital wellbeing: while our design concept offered benefits for users with a high predisposition for absent-minded use — at a high cost — physical opt-out strategies can be detrimental for users who are not prone to absent-minded use.

2 RELATED WORK

In this chapter, we introduce existing research and recent examples that are relevant to this work. In particular, we analyze digital stress and its association with absent-minded phone use and then introduce examples of both digital and physical opt-out strategies.

2.1 Digital Stress & Absent-minded Phone Use

Excessive phone use has negative implications for physical health, causing poor posture [2] and neck pain [54], and has also been linked to mental health problems, such as depression and anxiety disorders [14, 42]. Modern mobile technologies are commonly designed specifically to be engaging [20] as a consequence of the attention economy [13]. At the same time, users feel that they are constantly connected through technology [23], and this has become an expectation from both social groups and workplaces [40]. Consequently, users feel increasing pressure to appear busy [32] and make themselves available at any time [40]. This feeling of constant connectivity can lead to technology overload, which is linked to increased stress, burnout, anxiety, and depression [43].

Absent-minded phone use occurs when a user engages with their phone without a conscious intention or goal, often leading to more time spent on their phone than they wish [39]. Many smartphone users have reported excessive and habitual use of technology that they later regret or find meaningless [37, 49]. One approach to tackling this excessive use is to use mindfulness principles of intention and purpose [30, 47] to promote more mindful phone use [35]. In this paper, we define mindful use as phone use that is intentional, where the user has full awareness of their actions [30].

To promote more mindful smartphone use, Tran et al. [49] recommend creating meaningful experiences for users and promoting tasks with long-term benefits beyond the immediate moment. Other researchers have proposed gradually reducing support provided by applications so that users gain skills and eventually stop needing the tool [35]. *Dumbphones*[3][4], which are substitute phones that only have basic important features such as calling, are one approach to mindful phone use. They aim to separate the pragmatic aspects of smartphones from the hedonic features. Pragmatic aspects are associated with usefulness and task orientation, while hedonic qualities are related to excitement and joy [22]. Pragmatic and hedonic qualities have been shown to be of differing importance depending on whether the context for use is work or leisure [50]. By reducing the hedonic qualities and maintaining pragmatic qualities, dumbphones aim to reduce the emotional appeal of phones.

Our approach aims to create a physical cue that encourages users to reflect on their smartphone usage each time they consider picking it up. This is in line with calls to increase design for reflection [5] and a trend towards reflection in mindfulness research [46, 49]. Our method, therefore, aims to increase the chances of users interacting mindfully with their phones while also enabling them to maintain agency by not fully preventing them from using their devices.

2.2 Opt-Out Strategies

In response to growing concerns about excessive smartphone use, large corporations have implemented digital wellbeing approaches such as Google Wellbeing[5] and Apple Screentime[6]. App stores are full of wellbeing apps that support users with blockers, timers, or motivational features [41]. Ironically, many wellbeing apps tackle problems created by the very phones to which they are downloaded [29] since the mere presence of a phone has been shown to be disruptive [3, 48]. Prior research has investigated the use of digital frictions, such as creating an empty home screen with apps in folders on secondary screens, to create phones that are less distracting [28]. Although there are many examples investigating digital opt-out methods, Terzimehić et al. [46] found that approaches focusing on the smartphone are not effective in reducing excessive use, but focusing on the real world can have a significant impact.

In contrast to on-device digital opt-out methods, physical opt-out is an under-explored strategy for mindfully managing smartphone use. Researchers have found that users perceive their phones as an extension of themselves [21], and that separation can lead to anxiety [21, 53]. One study prevented users from answering ringing phones during a task, which was shown to interfere with their ability to focus [11]. Another study either removed users' phones completely or forced them to shut them off and put them out of sight, both of which led to increased anxiety depending on their initial level of attachment [8]. Lucero [34] outlines the difficulties and freedoms associated with living without a mobile phone in the modern world where connectivity and constant access to the internet are societal expectations. Commercial products such as phone sleeping bags[7] and Yondr Pouches[8] block signal from phones to create phone-free spaces and promote in-person social interaction. These approaches completely remove phone access from users and are examples of digital detox. In line with Syvertsen [45], we define digital detox as the family of approaches to managing excessive phone use where users are encouraged to completely cut themselves off from their phones for a period of time to 'detox'. Such strategies remove agency and lead to users feeling as though they are missing something [1]. Our approach to physical opt-out is instead to create a temporary physical barrier that acts as a cue for reflection before the user can pick up their phone. We leave agency with the user since they can choose to bypass the barrier and use their phone if they wish. In this paper, we explore physical opt-out as an aid for mindful use rather than a tool for digital abstinence.

3 METHODOLOGY

Related work has identified manifold sources and triggers for digital stress and absent-minded phone usage. Consequently, our initial investigation focused on identifying scenarios that are prone to

[3] https://t3n.de/news/dumbphones-handys-simpel-801028/
[4] https://www.thelightphone.com/
[5] https://wellbeing.google/
[6] https://support.apple.com/en-us/HT208982
[7] https://unplugrevolution.com/product/phone-sleeping-bag/
[8] https://www.overyondr.com/

inducing absent-minded smartphone use. To operationalize this, we formulated a first research question:

RQ1: *How and in which contexts is absent-minded smartphone use perceived to be an issue?*

To investigate this, we first conducted a series of interviews with experts from a range of related fields to identify coping strategies, motivations, and other consequences relating to excessive smartphone use. We also conducted an online questionnaire to find contexts where a general user population identified smartphone use as a problem.

The results confirmed the evidence in the literature identifying bedtime as an important context and physical opt-out as a potential strategy. Consequently, we developed a prototype to tackle the issue of smartphone use at bedtime through physical opt-out and formulated a second research question to guide the prototype evaluation:

RQ2: *How can we make strategic use of physical opt-out to support users in their efforts to more mindfully interact with their smartphones?*

To this end, we designed a prototype box in which users placed their phones at night for one week. In contrast to related work, the prototype strategically employs physical opt-out. In particular, the box did not lock, which theoretically allowed users to access their phones at any time, and pragmatic features were maintained. The participants responded to a reflective questionnaire before using the prototype as a baseline, after using the prototype, and one week after returning the prototype. The prototype incorporated a daily questionnaire each morning and night, and we conducted an exit interview. This study design was chosen to determine both the impact of the prototype compared to baseline, as well as to observe any lasting effects after the prototype usage stopped.

4 INVESTIGATING ABSENT-MINDED SMARTPHONE SCENARIOS

To investigate RQ1, we conducted a series of interviews with experts from both academia and industry and conducted an online questionnaire.

4.1 Participants

Our initial evaluation was a combination of qualitative (interviews) and quantitative (online questionnaire) methods. We, therefore, had two independent recruitment strategies. For the interviews, we recruited $N = 6$ experts (3 female, 3 male) via snowball sampling, including three from academia and three from industry. Table 1 lists the area of expertise for each participant. All interviews were conducted via Zoom and were recorded and transcribed for analysis. Each interview was a one-on-one session with a single researcher and lasted approximately 45 minutes. For the questionnaires, we recruited $N = 71$ participants (41 female, 28 male, 2 diverse) using a university mailing list and social media. The sample was skewed towards a young age, with 81% of the participants below 35 years old.

4.2 Interview Protocol and Survey

The interview protocol was structured as follows: We first asked for demographic information and an elaboration on their area of expertise. We then asked about digital stress in relation to their specific domain. We inquired about trends and challenges to connect insights from their field to more general wellbeing. At the end, we asked them to add their own thoughts and ideas. To analyze the interviews, we followed the pragmatic approach to qualitative analysis [6]. Two researchers initially coded a representative sample of 17% of the material using open coding and then agreed on a coding tree through a discussion. Following this, one researcher coded the remaining material.

Table 1: Overview areas of expertise for the interview participants.

ID	Area of Expertise
E1	A trained psychotherapy practitioner specializing in burnout and anxiety.
E2	A mindfulness entrepreneur, project manager, and yoga teacher.
E3	A researcher studying Virtual Restorative Environments.
E4	An innovation manager for connected technology in smart homes.
E5	A post-doctoral researcher in HCI and psychology studying wellbeing.
E6	A psychologist, professor, and researcher in Human-Machine-Systems.

For the online survey, we asked participants a series of 7-point Likert-scale questions about phone use in three contexts (identified in the expert interviews), as well as general questions about smartphone distraction and whether they've tried to adapt their use with apps and blockers. The interviews were conducted first and were used to create the questions for the survey to investigate whether a wider audience agreed with the contexts identified by the experts. The full list of questions is in the supplementary material.

4.3 Results and Discussion

The following section presents findings from both our expert interviews and online survey and discusses the resulting physical opt-out design implications. The complete survey results are included in the supplementary material.

4.3.1 Physical Opt-Out. Multiple interview participants recommended physical separation as a method to create opportunities to focus and remove the potential for distraction. One participant advised that "*the simplest thing is to put your phone in a different room*" (E6). The same participant also suggested that users often go to more complicated lengths and hide their phones somewhere difficult to reach. Another participant said that users could "*turn it [their phone] around so that it does not distract*" (E2). It is clear from our interview participants that physical opt-out is already an accepted coping strategy to deal with smartphone distraction. One participant commented that physical separation could be "*a trigger for people to reflect*" (E5).

The survey results also indicate that phones are distracting when they are within reach. Approximately half of the respondents found that their smartphone impacted their focus when it is nearby, and

79% reported that they use their phone after going to bed if it is on their nightstand.

Based on these results, physical opt-out methods should be considered as a potential solution so that the phone is out of sight from the user to reduce the opportunity for distraction. This is in line with results in the literature which found that the mere presence of a smartphone triggers a distraction [3, 48].

4.3.2 Fear of Missing Out. Completely separating users from their phones can lead to negative feelings, such as Fear of Missing Out (FoMO). One participant commented that shutting everything off resulted in them missing important information: "*I just turn everything off, which has resulted in me missing important things*" (E6). Participants were worried about missing professional emails as well as messages from their friends. At the same time, participants dislike the fact that phones are ever-present. According to our survey results, 73% found it annoying when people used their smartphones at social gatherings. Ubiquitous mobile devices also blur the boundaries between work and personal life: "*there's no clear distinction as to whether a notification is related to work*" (E6).

FoMO has implications when designing for physical opt-out. If the phone is extremely difficult to access or is fully separated for a long period of time, users can feel stressed and anxious [21, 27]. As a design consideration, physical opt-out methods should therefore be designed to create a temporary sensory (i.e., visual and tactile) separation between users and devices but make it fast and easy for the user to access their device if they choose.

4.3.3 Absent-minded Contexts. Interview participants indicated that **office work** is a crucial scenario since focusing and avoiding distractions is particularly important. Participants in our survey noted that the presence of their phones often distracted them from their primary task, which is in line with previous work [3, 48]. The need to design healthier workplaces is also highlighted in prior research [20]. Work-life balance was also frequently mentioned since ubiquitous smartphone use is a pervasive distraction at work and also allows the workplace to intrude on personal lives [12].

In-person group social situations were also mentioned as an important context. Technology can be used to connect us and bring us closer together, but overuse was noted as a detractor from social interactions. This is again supported by literature that shows that phone presence decreases conversation satisfaction [3].

Smartphone use near **bedtime** was highlighted as problematic by the experts and confirmed by the survey. Survey participants reported being highly likely to access their phone during the night, and approximately half perceived that their phone impacts their sleep. The interview participants also frequently emphasized the need for intentional breaks from technology. The literature also indicates that phone use in bed impacts sleep duration and effectiveness [10], leads to increased fatigue [17], and suggests that avoiding phone use at night correlates with better sleep duration [4]. Commercial solutions such as Do Not Disturb mode on both iOS[9] and Android[10] can limit notifications during sleep, but the mere presence of the device can be enough to trigger use [48]. The remainder of this paper explores the **bedtime** use context since it is strongly supported by both our study and the literature.

5 PHYSICAL PROTOTYPE TO MANAGE BEDTIME PHONE USE

Based on our initial investigation and prior work, we developed a prototype to tackle absent-minded smartphone use at bedtime. In this section, we address RQ2 through the development and evaluation of a prototype box we created to act as a physical barrier for smartphones at night.

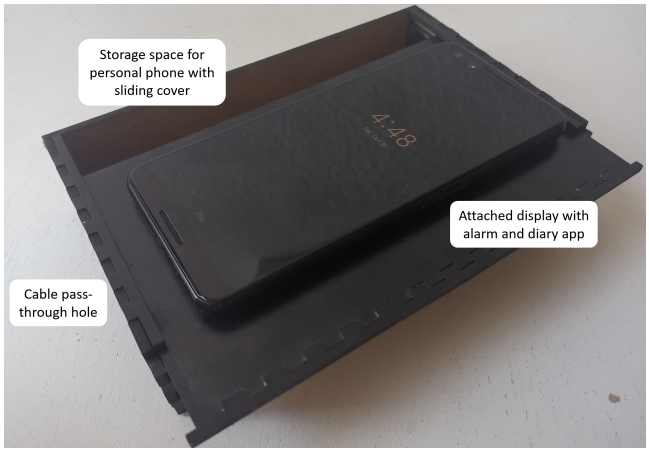


Figure 1: The proof-of-concept prototype, consisting of a laser cut box with a sliding cover, charging cable hole, and a display on top where users can set alarms.

5.1 Designing for Strategic Use of Physical Opt-Out

We incorporated the following design considerations when creating the prototype:

Create a physical barrier between the user and the phone.
Our interviews highlighted that physically separating users from their phones can help avoid distraction since the mere presence of the device can be disruptive [3, 48]. Consequently, the prototype is a simple box where a user puts their phone. The box, shown in Figure 1, was laser cut from wood and press fit together. The top portion slides shut to physically and visibly separate the phone from the user. The box shape was inspired by the shape of typical alarm clocks to naturally fit into the bedtime routine. The shape is also partially inspired by *Snow White's Coffin*, a rectangular radio with a glass cover by Dieter Rams on display in the Museum of Modern Art[11]. Although there are some commercial solutions providing physical separation[12], most prior work has focused on digital solutions [41].

[9]https://support.apple.com/en-us/HT204321
[10]https://support.google.com/android/answer/9069335?hl=en&ref_topic=7651002

[11]https://www.moma.org/collection/works/2649
[12]Phone sleeping bags: https://unplugrevolution.com/product/phone-sleeping-bag/ & Yondr: https://www.overyondr.com/

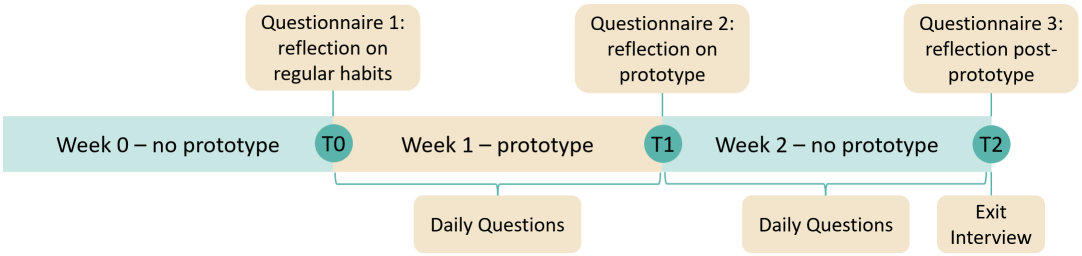


Figure 2: Procedure of the prototype evaluation. Participants use the prototype for one week (Week1), complete questionnaires at times T0-T2, respond to daily questions in Weeks 1 and 2, and complete an exit interview at time T2.

Table 2: Overview of the daily questions asked each morning and night.

Time	ID	Question
Morning	M01	I felt the urge to use my phone tonight.
Morning	M02	I was worried that something is going on that I needed to track.
Morning	M03	My first impulse after waking up was to check the phone.
Night	N01	Today I have used my phone without a goal in mind.
Night	N02	I feel restless and frustrated when putting my phone away.
Night	N03	I preferred using my smartphone rather than spend time with others.

Maintain ease of access.
Our participants also highlighted the potential for FoMO when phones are completely inaccessible, which is supported by the literature [8, 21, 53]. We, therefore, designed the box without a lock — the phone can be accessed by sliding open the box at any time. The box is therefore intended to act as a physical reminder rather than an actual physical cage. This is in contrast to 'digital detox' strategies and more aligned with adaptive approaches such as MyTime [24].

Enable practical features.
In line with prior work identifying hedonic qualities as exciting [22], we separated pragmatic bedtime phone features. A hole was cut in the box for a charging cable, and we mounted a separate phone to the top that only had an alarm app and our daily questions. Users could set an alarm and answer study questions without spending extra time on their own phones, where they could be distracted by other features. This approach is unique relative to commercial physical opt-out solutions that block out all features.

5.2 Study Design

We employed a mixed-method evaluation of the effectiveness of our prototype in fostering reflection and reducing absent-minded phone usage. We conducted an initial questionnaire to understand the characteristics of our study population, such as whether they had a high predisposition for absent-minded use. Afterward, we deployed the prototype for one week and evaluated whether users reflected on their phone usage. To investigate whether users demonstrated lasting changes after discontinuing the use of the box, we inquired about their phone usage one week after the experiment. A detailed overview of the study timeline is shown in Figure 2 and elaborated in the following.

5.2.1 Procedure. The participants completed questionnaires at three stages: before using the prototype (T0), after using the prototype for one week (T1), and one week after returning the prototype (T2). The timeline is shown in Figure 2.

5.2.2 Measures & Analysis. The Smartphone Use Questionnaire: Absent-minded (SUQ-A) [39] was asked at each time point (T0, T1, and T2). The SUQ-A evaluates absent-minded smartphone use and has strong correlations relative to other smartphone use scales [16]. The first questionnaire additionally asked for demographic information. The results of the SUQ-A were tested for significance using paired t-tests with Bonferroni corrections.

The participants also completed three Likert-scale questions each morning and evening, shown in Table 2. The daily questions were answered directly on the prototype via a custom app. Finally, we conducted a 20-minute semi-structured exit interview with each participant. All of the interviews were conducted by Author 2 and were recorded and transcribed for analysis. To analyze the interviews, three authors coded a representative sample of 20% of the material using open coding. Following this, the authors agreed on a coding tree and one author coded the remaining material. This process is in line with Blandford et al. [6].

5.2.3 Participants. We recruited $N = 10$ (6 female, 4 male) participants[13] aged 24-32 years ($M = 27\,y$) to take part in a two-week study through a university mailing list. Participants were compensated 10€/hour (35€ total) for their time, and the only participation criterion was the ownership of a smartphone. There was an equal distribution of students and employed participants. The participants had a bimodal distribution in their absent-minded use as measured by their initial SUQ-A responses (see leftmost violin in Figure 3a). This indicates that our study population is evenly split

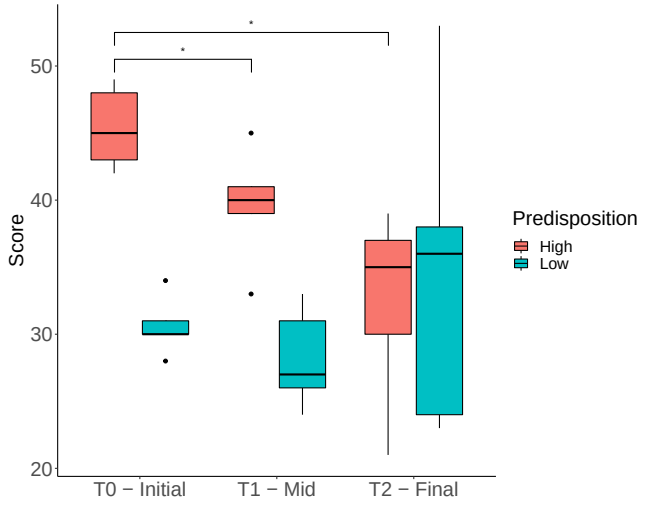
[13]This is a meaningful sample size for our formative evaluation [25], able to uncover flaws and benefits of the design concept.

between high and low predisposition to absent-minded phone use. As a result, we split the sample based on the bi-modal distribution. Half the study population was in each group.

5.3 Results

This section presents outcomes from the prototype questionnaires, daily questions, and exit interviews.

(a) A violin plot of the SUQ-A results measuring absent-minded phone use. The initial (T0) responses show a clear bi-modal distribution.



(b) The SUQ-A results split based on the initial (T0) scores. The high predisposition group has a significant decrease from T0, while the low predisposition group shows no significant change.

Figure 3: Absent-minded phone use results from the SUQ-A. Users with a high predisposition showed a significant decrease from their initial scores.

5.3.1 Questionnaires. The results of the SUQ-A are shown in Figure 3. A lower score indicates less absent-minded use. The results for the participants split by their predisposition towards absent-minded use are shown in Figure 3b. Participants with high initial absent-minded use showed a significant decrease both with the prototype ($t(4) = 3.64$, $p = 0.02$) and one week later ($t(4) = 4.51$, $p = 0.01$) compared to their initial scores. Participants with low initial SUQ-A scores saw no significant change in either time frame ($t(4) = 1.5$, $p = 0.2$; $t(4) = -0.88$, $p = 0.43$).

5.3.2 Daily Questions. Figure 4 shows the distribution of responses for each question divided into 'During' (the week with the prototype), and 'Post' (the week after returning the prototype).

The results of M01, N02, and N03 showed no significant difference across the two weeks for both groups of participants ($p > 0.05$). One important takeaway is that users overwhelmingly did not feel compelled to take their phones out of the box at night (M01). Questions M02 (FoMO — $t(34) = 2.38$, $p < 0.05$ for Low; $t(34)=3.70$, $p < 0.001$ for High), M03 (frustration — $t(34) = 3.1$, $p < 0.05$ for Low; $t(34) = 2.59$, $p < 0.01$ for High), and N01 (morning use — $t(34) = 4.68$, $p < 0.001$ for Low; $t(34) = 3.79$, $p < 0.001$ for High), on the other hand, were all significantly higher with the prototype compared to one week later.

5.3.3 Exit Interview. We identified two important themes in the interview responses - PERSISTENT REFLECTION and OUT OF SIGHT OUT OF MIND. The following section will present each theme with supporting evidence.

PERSISTENT REFLECTION: Participants frequently commented on the impact of the prototype on their perception of their own phone use. One participant (U6) elaborated on the routine and physical process of interacting with the box, claiming that it was a useful prompt to encourage them to leave their phone alone at night:

> *... such a good anchor really, for putting the mobile away for the evening, switching on flight mode, putting the mobile into the box, filling out...your app, and getting it out again in the morning.* (U6)

Another participant highlighted that the ritual and physical barrier meant that they were unlikely to take their phone out of the prototype once their phone was in for the night:

> *And I guess it felt more like I'm officially putting my phone away for the night, I'm not going to pull it out again once I've done the questionnaire and put it in the box.* (U8)

Participants also mentioned that they were more aware of their phone use throughout the day. The nightly prompt to reflect on their usage led to a lasting increased awareness. One participant (U3) commented that they questioned their intention each time they looked at their phone:

> *Am I looking at the cellphone now because I want to see, for example, who has written or I have seen someone write to me?... Or do I look at the cellphone just out of boredom?* (U3)

OUT OF SIGHT, OUT OF MIND: The aim of our prototype was to assist users in resisting absent-minded phone use before bed. In the interviews, we discovered that the box was also useful in the morning. Participants noted that they were less likely to start using their phones immediately upon waking up. One participant (U1) commented that they often left the phone in the box during their

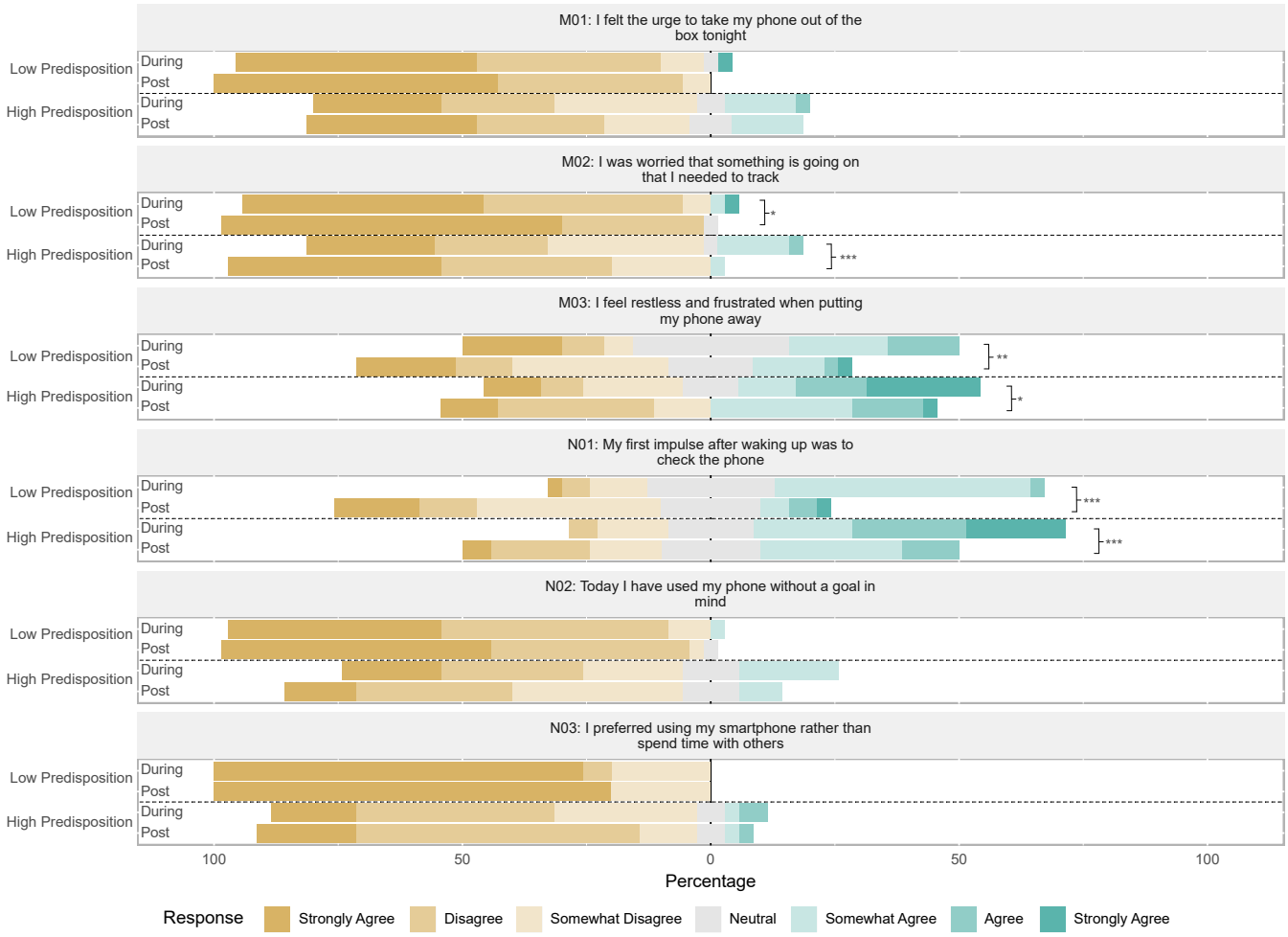


Figure 4: Results from the daily questions asked each morning (M01-03) and night (N01-03). The results are split based on predisposition for absent-minded use and divided into Week 1 (During) and Week 2 (Post).

whole morning routine and only took it out when they left for work:

> *And with the box I left it there for an hour and I just checked it before I went out for work. So that was kind of very nice to have the morning not using the phone* (U1)

Another participant (U5) explained this behavior by saying that the prototype acted as an extra step between them and their phone. This extra step reminded them that they had the option to do other tasks before checking their phone:

> *This step in between, that was the only difference that made clear to me: I could theoretically do something else before picking up my cellphone* (U5)

Our prototype does not have a locking mechanism; it is simply a box in which the user can place their phone. Some participants noted that the small physical friction was enough to create a psychological barrier:

> *I don't even have to close it very tight, it was enough that the cellphone is in the box. But it felt somehow out of reach* (U6)

While participants reacted positively to the physical barrier, they did not often mention that they made use of the pragmatic features included in the box. Several participants continued to use the alarm on their own phones although it was inside the box: "*I really like the alarm sound that I have from my phone so I wanted to keep it [...] Too much of a habit I guess.* (U7).

6 DISCUSSION

Our study aimed to identify scenarios where absent-minded smartphone use is an issue and subsequently explore strategic physical opt-out as a means of promoting mindful use. In Section 4.3.3 we

identified three contexts where absent-minded smartphone use is problematic (RQ1), namely office work, in-person social situations, and bedtime. Our prototype implementation then focused on bedtime phone use, which will be the focus of the discussion. We will first discuss our findings regarding implementing strategic physical opt-out strategies (RQ2), then identify the implications of our work for digital wellbeing and discuss limitations to our study.

6.1 High Risk, High Reward: Challenges of Strategic Physical Opt-Out

Physical cues allow for reflection.
The results of our study show that physical opt-out methods can be an effective way for users to manage absent-minded smartphone use, even without a locking mechanism. Our prototype theoretically allowed users to access their phones at any time, but users with a high predisposition for absent-minded use still showed a significant reduction according to the SUQ-A (see Figure 3b). These results demonstrate that **harsh locking mechanisms are not required for physical opt-out to be effective, but rather a physical friction is enough**.

Prior work has shown that questions [18, 31] and journaling [9] can trigger reflection, so the daily questions may have contributed to the reflection effect. However, the participants mentioned in the interviews (Section 5.3.3) that the physical box was a cue to reflect on their phone use both at bedtime and throughout the day. This is supported by research in tangible interfaces, which have been leveraged to increase reflection [33]. Research has also shown that *availability to be observed* is a key driver for reflection that favors physical artifacts over digital ones [51]. Consequently, technology designers should **consider incorporating physical cues for reflection, so long as they consider the subsequent frustration**.

There is no one-size-fits-all physical opt-out.
Although users with a high predisposition for absent-minded use saw a significant benefit from using the prototype (Figure 3b), it came at a high cost. Both groups of users reported high levels of frustration and compulsive morning phone checking while using the prototype (see Figure 4). This frustration confirms previous work reporting that phone separation induces anxiety in users [8, 21, 53]. Our results, therefore, indicate that **even a non-locking box is enough separation to create negative feelings for users**.

We hypothesized that incorporating pragmatic features into the prototype, such as a clock and an alarm, would help ease potential frustrations since users would have access to the most important features. However, some users still set alarms on their own phones within the box and rarely mentioned these pragmatic features as having either a positive or negative effect. As such, we see that physical barriers create frustration for users even when they still have access to useful features. This follows past work showing that users feel that their own phone is an extension of themselves [21], which cannot simply be replaced through pragmatic features.

Our participants also had a range of subjective preferences regarding how much of a barrier is needed to be effective. One user commented that they "*don't even have to close it very tight, it was enough that the cellphone is in the box*" (U6), while another commented that they would prefer to "*have to do something to make it open*" (U7). It would be very simple to adapt our current prototype to these varied user needs by adding an electronic lock controlled by the display phone mounted on top. Each step that stands between the user and their phone is an opportunity for them to ask themselves why they are picking up their phone and reflect on their intentions [44]. However, it may also cause frustration or anxiety and should be balanced carefully. Based on our results, this balance is different for different users, so a physical opt-out system should be adaptable to individual user needs. In particular, the **benefits of physical opt-out are only relevant for users with a high predisposition for absent-minded use**, so they must decide whether regaining control of their smartphone use is worth the frustration.

6.2 Opportunities for Digital Wellbeing

We envision physical opt-out solutions as one piece of a complete web of technologies that create a robust ecosystem for digital wellbeing. Research has shown that technology ecosystems are more robust and effective than individual solutions on their own [7]. In an ecosystem approach, designers could combine both physical and digital opt-out methods, leveraging the best of both approaches. Digital methods could reduce smartphone functionality to only practical features at opportune times, while physical methods can be used when intense focus or intentional breaks are required. As such, physical opt-out serves as a physical cue, as discussed previously, while digital methods would allow for a straightforward but adaptable separation. We could use app usage data from digital tracking services to automatically determine their predisposition for absent-minded use. We could then implement physical opt-out only for those users identified as having a high predisposition who will benefit. For users with a low predisposition, adaptive digital opt-out could be implemented without physical opt-out. There is an opportunity for further research in this area to find the most effective method of balancing opt-out methods to support users in engaging with their phones more mindfully while maintaining autonomy, as suggested in previous research [36].

Research has shown that hedonic aspects of technology are emotionally connected and engaging [22], particularly in leisure contexts [50]. Consequently, our design for physical opt-out deliberately separated practical and hedonic features of smartphones. The aim of this design decision was for users to see their phones less often, addressing the issue that the mere presence of a phone is distracting [3, 48]. We did not explicitly evaluate the effectiveness of this design decision, so the principle should be further explored in future work.

6.3 Limitations and Opportunities for Future Work

Our evaluation called for participants to use the prototype in their homes for one week to provide opportunities to interact with the prototype multiple times and reduce some novelty effects. It remains to be investigated if long-term use can significantly impact sleep habits. A longitudinal study evaluating long-term sleep effects is out of the scope of this paper. Rather, our work provides an initial glimpse into how to design for strategic physical opt-out and how users experience this method. Consequently, there are opportunities for multiple future studies. Firstly, does continuous use of

physical opt-out improve sleep duration and efficiency? Secondly, we hypothesize that a physical barrier could have a lasting effect on the user, and therefore continuous use may not be necessary.

We identified several requirements in the design of our prototype, particularly to create a physical barrier without completely preventing access and enabling practical features. The box design with a sliding access door and a top-mounted screen satisfies all of these requirements, but we did not investigate other form factors or access mechanisms. Our design was inspired by the shape of typical alarm clocks, but it is entirely possible that other metaphors may be more naturally incorporated into bedtime rituals and therefore improve performance. For example, phone storage could be incorporated into a pillow or a bedside table. It may be interesting for future research to investigate the role of form factor and access method in the effectiveness and usability of sleep-related phone overuse.

Another limitation is that we only explored the bedtime scenario with our prototype. In our initial interviews and questionnaires, we also identified office work and in-person group social situations as important contexts. Thus, there is an opportunity for future work to evaluate whether our findings generalize to the other contexts we identified.

7 CONCLUSION

This paper presents a two-part study exploring physical opt-out as a means of improving mindful interactions with smartphones. We first conducted a series of expert interviews and an online questionnaire to explore requirements and contexts in which absent-minded smartphone use is an issue. Based on these, we designed a proof-of-concept prototype for bedtime phone use, implementing a design concept that — while creating a physical barrier — still maintains ease of access to the smartphone. We subsequently evaluated this concept in a two-week study focused on bedtime smartphone usage. Our results show that physical opt-out has the potential to be an effective strategy for users with a high predisposition towards absent-minded use. However, users with a low predisposition did not see any benefit, and both groups experienced increased frustration. When deployed strategically, physical opt-out methods have the potential to create opportunities for reflection and empower users who are struggling with excessive smartphone use to interact with their phones in a more mindful way.

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