# Exploring Context-aware Proactive Blocking for Distraction Management

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## Abstract
College students are exposed to smartphone distraction during study-related contexts (e.g., classrooms, self and group studies). This constant distraction may lower their academic performance. In this work, we built a simple context-aware proactive blocking prototype to explore the patterns of focusing contexts, and to evaluate user experiences of proactive blocking for distraction management in study-related contexts for college students. Our preliminary user study shows the positive effects of proactive blocking. We discuss several design implications for context-aware proactive blocking and semi-automated logging for distraction management.

## Author Keywords
Software-based intervention; distraction; commitment device; user interface; context awareness

## ACM Classification Keywords
H.5.m [Information interfaces and presentation (e.g., HCI)]: Miscellaneous.

## Introduction
These days, smartphones are a necessary tool for a more convenient life, and many people habitually use a smartphone. However, smartphone use can cause distractions in the situations where concentration is required (e.g., college

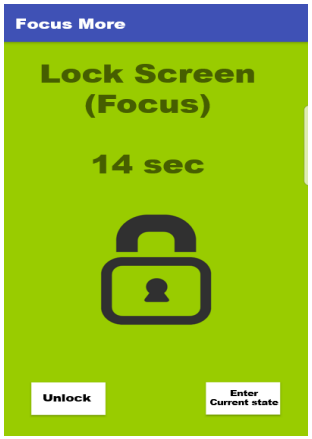


**Figure 1:** Focus mode

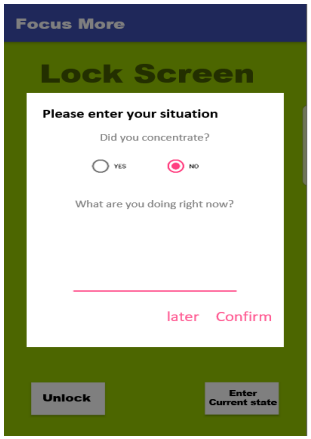


**Figure 2:** Survey

class, personal study), and can lead to the decreased academic performance of college students [2]. Furthermore, the use of smartphones does not end with a short use, and it is more likely to be linked to other uses [1], which can result in prolonged distractions. Therefore, in situations where concentration is required, an intervention to mitigate the use of smartphones is needed.

One of the ways to mitigate the use of smartphones is to use a software-based intervention. In relation to this, a lot of research has been done, and many products have been released in the markets. To mitigate the use of smartphones and help users avoid distraction, blocking notifications or smartphone use is a popular method [5, 4, 3, 6]. According to behavioral psychology, blocking can be viewed as a "*commitment device*", which is a voluntarily imposed restriction to accomplish a personal goal [7].

So far existing blocking methods may be context-aware but reactive. For a given context, users need to initiate a blocking tool to achieve their usage goals [4, 6]. Kim et al. proposed a location-based method that recommends blocking in the user-defined locations (e.g., classrooms [3]). This kind of reactive blocking is limited in that users need to initiate blocking whenever contexts change. Users often forget to activate blocking or may be unwilling to do so in some cases. In this work, we explore the feasibility of context-aware proactive blocking that automatically activates a blocking feature when users need to stay focused. However, automatically detecting such focusing contexts would be challenging. Assuming that focusing contexts most likely happen while users become sedentary (e.g., sitting), as a first step, we developed a simple prototype that locks a user's phone with a lock screen when a user becomes stationary for a least five minutes. This tool allows us to perform experience sampling of their focusing contexts and understand user experiences of proactive blocking under diverse user contexts.

## Exploratory Software Design

Depending on what kinds of situations a user is in, the focusing contexts that the system should consider may differ. For example, Apple's Do Not Disturb (DND) while driving considers a driving context as a focusing context. This mode can be automatically enabled when a device detects a vehicle's motion or is connected to the vehicle's built-in Bluetooth. In our work, we consider various study-related focusing situations that college students engage in. Some of these situations include classrooms, group studies, and self-studying hours. They need to concentrate on their study-related tasks without smartphone distraction. Given that most of such tasks happen in sedentary contexts, we simply assumed that focusing contexts are likely to happen when a user becomes stationary for a certain duration without smartphone usage (say for five minutes). Our intention of this simplistic approach is to capture study-related contexts as many as possible.

We used the lock screen as a blocking interface. The lock screen itself cannot block the use of smartphones but gently allows a user to recognize that they should concentrate on studying whenever they look at it. If a focusing context is detected (i.e., no physical movement, no smartphone usage for five minutes), our prototype displays the lock screen (or the proactive focus mode). The lock screen shows the elapsed time when the focus mode began (See Fig. 1). The user can unlock the lock screen by touching the *unlock button*. Then, our prototype asked the user to select whether he/she currently focused on study-related activities, and to report the purpose of smartphone use (i.e., ESM). The user can ignore it by touching the *later* button (See Fig. 2). The user also can enter his/her current study-related contexts

by touching the *enter current state* button (See Fig. 1).

## Preliminary User Study Setup

We perform a preliminary user study to understand what kinds of focusing contexts exist and how users perceive our proactive blocking feature. We recruited nine students. We held an orientation meeting to instruct how to participate in the test, and how to use the prototype software.

Participants installed the software on their smartphone during the orientation. During focusing contexts, we asked the participants to log on their activities using our tool. A test period was five days (from Monday to Friday). One participant quitted the test for personal reasons, so eight participants finally participated in our study (seven undergraduates; no female; mean age: 21.1).

After the end of the test, we conducted a semi-structured interview. During the interview, we asked about the user experience of the proactive blocking, and we also asked about their focusing contexts such as when/how they concentrate. The interview required between 30 minutes and 40 minutes. Each interviewee was compensated with 20,000 won (approximately 20 USD).

All of the interviews were audio recorded, transcribed, and separated by sentence. We iteratively analyzed the sentences with affinity diagramming. Each sentence was classified with similar themes. This analysis was repeated until all researchers reached a consensus with regard to the final themes.

## Preliminary Results

We report the patterns of students' study-related contexts, and the usefulness and the user experiences of the proactive blocking.

*Patterns of Focusing Contexts*

We identified students' diverse study-related focusing contexts. There were several study-related activities such as class, group, and individual study, and we found that individual study (e.g., working on an assignment, reading a material or paper) was the most common study-related activity. The places where students have been doing individual study most often were the dormitory or the library. We found that students who participated in our test tend to determine the place in which they undertake individual study according to their preferred environment for studying, and we classified students into two type based on where they perform individual study as followings:

*Dormitory type*: The students in this group preferred to study in their dormitory rooms. They set their surroundings to suit themselves for studying. For example, one student said, "*I usually use electronic devices a lot when I study. I have a tablet or laptop connected to a monitor, which allow me to search materials efficiently*"(P6). They liked quiet, unconstrained and comfortable environments for studying.

*Library type*: The students in this group preferred to study in a restrictive environment rather than in an unconstrained and comfortable environment to limit their behaviors (e.g., using a smartphone, sleeping). The students were also motivated to study by observing other students concentrate on studying. The students preferred an environment with a bright light, and a faint noise rather than a very quiet one.

*Usefulness of Proactive Blocking*

Regarding how the prototype has helped students' concentration, students responded that they were able to stay focused on their studies because they often put their smartphone down after looking at the lock screen. Some students responded that they became aware of the purpose of using a smartphone by reporting the purpose of smart-

phone use when they unlock the lock screen and used the smartphone for that purpose. This could prevent unnecessary smartphone use, and it may help to avoid the prolonged distraction. Students also responded that it was useful because they could identify how long and how well they have been concentrated by looking at the elapsed time displayed on the lock screen. Some students said that the prototype would be more useful if they can review their concentration history (e.g., like a timeline). One student said, "*I thought that I should be able to see my history. I want to see how long I have concentrated and rested. It will allow me to see how much I can concentrate on myself.*"(P4).

Our prototype displayed the lock screen. Our participants reported that this was a bit cumbersome when they used their phones with purpose (e.g., searching information), or they needed to react urgently (e.g., urgent contact). However, most of the students responded that the hassle of unlocking and completing a short survey was tolerable. For example, one student said, "*I was not so bothered because I could finish it quickly.*"(P1). They also responded that if the application can accurately infer the concentration situation, it would not matter how the application blocks their smartphone use. One student said, "*I think perfect learning [of focusing contexts] is the most difficult thing. If it is possible, I think not only the lock screen but the other methods can be used because it informs me like this when I study.*"(P7).

*Blocking Contexts Matter*

We identified that user perception was mainly dependent on whether the students were focusing or not. Blocking in study-related contexts can be assumed that the prototype has correctly inferred the situation in which the students are concentrating on study-related activities. Students (6 of 8) responded that they often put their smartphones down due to the lock screen. One student responded, "*When I saw the lock screen, I sometimes turned off the screen of my phone and did what I was doing again. During the test, I felt that the lock screen allow me to realize I'm using the phone unconsciously.*"(P4). When the students turn on a smartphone screen habitually, they felt guilty to realize that they frequently turn on smartphones without any purposes, and students thought that they would stay focused and finish what they were doing. One student said, "*I just thought I'd finish my study and use my smartphone.*"(P2).

The students often felt a sense of achievement and took a break when they found that they focused on studying for a long time by seeing the elapsed time on the lock screen. One student mentioned that "*If it's over an hour, I was proud and considered giving me a break since I studied for over an hour.*"(P8). Students also used their smartphones during studying as needed (e.g., searching for information). Students responded that they felt as a light burden due to the lock screen and survey. One student said, "*When I used my phone for specific purposes such as searching the concept, or I wanted to check the time, the lock screen was a bother.*"(P5).

There are a variety of other non-study related sedentary activities such as breaks and meals. In those situations, our participants felt larger inconvenience due to proactive blocking than in study-related situations. One student responded, "*When I was not using my smartphone unconsciously, or I did not need to concentrate, I felt a bit annoyed to face the lock screen.*"(P5). In contrast, some students also commented that blocking in non-study related contexts was also helpful. They realized that they turned on the smartphones frequently without any purpose, and felt that they had to refrain from using the smartphones. One student said, "*When entering the purpose of smartphone use, I often did not know why I turned on my smartphone. Some-*

*times I realized that I was just using the smartphone without any purposes.*"(P4).

## Implications

Our results provided useful insights into designing context-aware proactive commitment devices for self-regulating smartphone use in study-related contexts for college students.

As illustrated earlier, commitment devices are often used to voluntarily restrict their actions for positive behavioral changes. However, commitment devices are only useful, when they actually self-initiated such restrictions [4]. If people forget to start such restrictions, or their willpower becomes weak, commitment devices are no longer effective. Our proactive blocking mode attempts to solve this limitation of traditional commitment devices by automatically enabling the blocking mode in specific contexts. As a result, proactive blocking obviated the need of self-initiation. Our preliminary study showed that this helped the participants to better regulate their phone use, but it also caused some degree of inconvenience, particularly in non-study contexts. Clearly, our results highlight the usefulness of proactive commitment devices and at the same time, the importance of accurate context-awareness.

Some participants said that if the system can accurately infer the focusing contexts, it would not matter how the system restrains their smartphone use. In this case, the inconvenience was large because proactive blocking was activated in non-study related contexts. Therefore, accurately detecting a situation in which the students concentrate should be the most important consideration when improving the system for all users. It is also important to help users to set the restriction levels according to their environmental preferences (e.g., library vs. dorm).

Note that students used their smartphones for study-related purposes (e.g., searching information or materials) or urgent matters (e.g., responding to requests). The system should support a function that allows students to use their phones temporarily (e.g., allowing five minutes per one hour, permitting white/blacklists). This approach will mitigate students' smartphone use more appropriately than simply restraining smartphone use.

The students wanted to track their concentration history. We can envision the system that supports *semi-automated self-tracking* of focusing contexts. The system can infer focusing contexts for automatic logging. Users can manually edit automatic logging results. If users input labels of focusing contexts, the system can also automatically suggest labels. If we go further from here, we could propose a more elaborated semi-automated self-tracking system that can improve an ability to infer the concentration situations by continuously interacting with the users.

## Conclusion

We designed the simple prototype to explore the feasibility of context-aware proactive blocking that automatically activates the blocking feature when users need to stay focused. We conducted the user study to understand the college students' focusing contexts, and to evaluate the usefulness and user experience of the prototype. Although our prototype is at a very early stage of development, our preliminary user study showed that the prototype was useful for staying focused, and avoiding the distractions when students concentrated on the study-related activities. Finally, we discussed several implications for the context-aware proactive blocking and semi-automated logging system for distraction management.

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