App Limits Bar: A Progress of App Limits for Overcoming Smartphone Overuse

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Abstract
Smartphone overuse has many negative effects on human beings. The function App Limits in our phones, which belongs to behavior reinforcement strategies for overcoming problematic smartphone overuse, constrains users by shutting them completely out of an app after a certain period of time. While it has effectiveness to some extent, lacking procedural detection of problematic behavior always brings about anxiety and depression for users. We proposed App Limits Bar (ALB) to progress the traditional App Limits, aiming to mitigate the negative feelings about using App Limits and enhance users’ abilities to manage their time on addictive apps. Meanwhile, we took a three-phase user study to answer whether ALB helps users be more content with using the app limits function and whether ALB performs better than traditional App Limits in terms of reducing usage time and open times on addictive apps. Future work will study the best shape of the edge screen for visualization when the front screen faces us.

Author Keywords
Smartphone Overuse Strategies; Mobile App Addiction; App Limits

Introduction
Excessive and problematic use of smartphones, also referred to as smartphone addiction, has potentially harmful
effects. Research indicates that musculoskeletal impair-
ment [1], poor academic performance [11], anxiety and de-
pression [9] as well as poor sleep quality [4] are all negative
consequences of smartphone overuse. In recent years,
some smartphones allow users to set limited usage time
to apps (e.g., Huawei Digital Balance and Iphone App Lim-
its) in order to overcome smartphone addiction. Findings
from prior works indicate that smartphone use is reduced
as a result of apps regulating use [3]. Nevertheless, notifi-
cation prompt informing users of remaining time only at the
last few minutes may frustrate users if they wasted previ-
ous limited time on meaningless contexts of that app. That’s
because it is obviously late at this moment for them to take
action to change their behaviors. Take WeChat as an ex-
ample, meaninglessly browsing friends’ updates without
consciousness occupies a lot during no notification period.
Therefore, with the arrival of notification implying that only
5 minutes are left for use, users might feel regretted about
their previous improper use of this app and feel anxious
about being refused to receive and deal with a more im-
portant subsequent message from this app. To solve the
mental pressure issue on using the existing app limits func-
tion and to change their problematic use of addictive apps,
we propose App Limits Bar (ALB) to upgrade the traditional
App Limits.

App Limits Bar (ALB) is designed to progress the function
App Limits in our mobile phones. ALB can present usage
time or remaining time for use during the whole using pro-
cess, which helps users manage their limited use time bet-
ter. Meanwhile, we propose to have the left edge of the
phone to be a display screen for ALB considering the lim-
ited screen of smartphones. In addition, signals represent-
ing compulsive open times in the using process are also
visualized as Ding et al. [7] proved that compulsive open
time is also a good indicator of app addiction.

Related Work

There are three [3] categories of corrective measures for
problematic smartphone overuse: information-enhancing
strategies, capacity-enhancing strategies and behavior re-
inforcement strategies. The proposed ALB belongs to the
mixture of the latter two strategies.

Several information-enhancing strategies include direct
warnings [2], documentaries and public campaigns empha-
sizing the severity and risk of problematic smartphone use
[5] and educational programs and guidelines for the young
[6]. The limitation of information-enhancing strategies is that
it probably won’t influence those who have already fully in-
formed about the negative effects of smartphone overuse
[10]. In addition, it is difficult for users to quit their addictive
behavior voluntarily only via information-enhancing strate-
gies [3].

Behavior reinforcement strategies refrain users from
accessing smartphone after a certain period of time or by
making smartphone use more difficult (e.g., [6]). The ex-
isting function App Limits is designed based on this logic.
While it does restrict smartphone overuse to some extent,
App Limits still contains a few imperfections. For instance,
lacking procedural detection causes inappropriate manage-
ment of available usage time, and thus brings about regrets
and depression. Inspired by the logic of capacity-enhancing
strategies which aims at reinforcing self-disciplinary and
rational management abilities [10], tools are supposed to
build in features that timely detect the problematic behavior
[12] for users to make adjustments. Our proposed App Limit
Bar applies that.

In terms of progress bar design, we apply Harrison et al.’s
visually augmented progress bar [8] that makes processes
appear 11% faster visually, prompting users to feel urgent
in the last several minutes for quick preparation of withdrawing themselves from the current app.

In addition, similar work that Wang et al. [13] conducted compared point-of-choice prompt with the always-on progress bar on PC for sedentary behavior change, which has a reference influence on our study design.

Prototype
In order to test the feasibility of our App Limits Bar (ALB), we built a prototype device using the following components:

1) An Iphone 11 or other IOS smartphone devices that contain App Limits function.
2) A piece of external, curved and multi-touch screen connected with the phone. The display screen is modified to half-terete shape, whose radius is 2 millimeters long, and is matched with the left edge of the phone (see Figure 1).

Progress Bar
To achieve ALB function, we are required to develop a progress bar on this external and multi-touch screen, which includes the following functions:

1) Record the usage time and open time of the addictive apps. A green bar is designed for recording the usage time while a blue bar is for the left time. The default setting is that the green bar is on the blue one (see Figure 2). Meanwhile, a designed imaginary line is visualization of the open time (see Figure 2 (middle)).
2) A visually augmented bar (see Figure 2 (right)) is to be displayed when the last 10 minutes left.
3) A horizontal black bar will be displayed when users slide down the screen versus the bar will be canceled when users slide up (see Figure 4 and Figure 5).
4) To set blue bar is on the green bar, tap twice on the blue bar and vice versa.

Study
This user study is designed to test the effect of ALB. We are intended to answer the following questions by this study:

1) Dose ALB make users reduce the usage time and open times cost on addictive apps compared with no limits and traditional App Limits?
2) Dose ALB reduce the frequency of choosing "no limits today" compared with the traditional App Limits?
3) Do users have more positive feelings about using ALB than traditional App Limits?

Question 1 & 2 are designed to explain whether users manage their limited usage time better than using traditional
Figure 3: Gesture that evokes touch on the left edge screen.

App Limits. Question 3 is designed to figure out whether ALB reduces negative feelings about using app limits function for users.

Participant Selection
We recruited 12 participants aged 18 to 22 who were college students. Of these participants, half were male and half were female to avoid gender bias. All of them have experienced using App Limits on their phones in order to reduce the time spent on addictive apps.

Tutorials of How to use ALB
Before using ALB, we were required to assist participants to get familiar with all the ALB functions:

• Show participants how to set a limited usage time for a certain app using IOS App Limits function.
• Open the limited app and browser it for a while. We need to explain that the green bar represents the usage time and the blue bar shows the left time. Meanwhile, participants are supposed to be taught that in order to display a countdown, they need to hold the phone sideways, making the left edge screen upward (see Figure 3), and then tap the blue bar twice. If they want to recover to show the usage time, hold the phone as mentioned before and tap the green bar twice. In addition, participants should be informed that once they open the app, there will be an imaginary line in the position of the usage time progress bar.
• Participants can make the progress bar time from zero instead of continuous accumulation by holding the phone sideways, making the left edge screen upward, and then sliding down on the edge screen with a figure to set a horizontal black bar (see Figure 4). In terms of recovery, slide up to delete the latest bar (see Figure 5).
• When the blue bar remains last 10 minutes, this 10-minute part will be full of all the edge screen and display final countdown (see Figure 2 (Right)). The pure blue bar will become a visually augmented bar.
to make users feel urgent. In the end, the point-of-choice prompt will display on the whole screen to inform users that the available usage time is over. Participants can choose either “OK” or “no limits today”. If it is “no limits today”, participants will be allowed to use this app with no time limits for the rest of the day.

Figure 5: Slide up to delete the latest horizontal black bar.

Study Design
In order to answer the research questions above, we ran the study in three phases, which cost three weeks in total:

The first phase is to help participants figure out which apps they are addicted to. We provided an Iphone 11 for each participant and took away their own phones for six days (week 1 from Monday to Saturday). Each participant had downloaded their commonly-used apps on the provided phones ahead of the experiment. During the first phase (week 1 from Monday to Saturday), they used this new phone without any limit. Usage time and open time frequency per day for each app were recorded in the built-in settings of their Iphone. When the first phase was over, each participant was required to review their usage time per day for each app and chose several addictive apps for themselves on the following Sunday.

Finding the specific addictive apps for each participant, phase two and phase three are designed to compare the effect of ALB with the traditional app limit function.

As a preparation for the second phase, participants were asked to use the built-in App Limit function to restrict all the addictive apps they selected in the first phase during the following six days (week 2 from Monday to Saturday). While the participants can set time for each addictive app according to their own will, the restricted time per day for each addictive app should be less than the maximum daily usage time of that app in the first phase. Usage time per day, open time frequency per day, and how many times they choose “no limits today” in these six days were recorded. What needs to be emphasized is that participants cannot be informed that they are going to be recorded the chosen frequency of “no limits today” in the experimental days.

Prior to the last phase, we assisted all the participants to get familiar with ALB (see Tutorials of How to use ALB) on Sunday of week 2. In the last phase (week 3 from Monday to Saturday), each participant were asked to use the ALB to restrict all the addictive apps (NOTE. The restricted usage time and apps were the same as the second phase). Usage time per day, open time frequency per day, and how many times they choose “no limits today” in these six days were also recorded. In addition, that we are going to record the chosen frequency of “no limits today” in these six days cannot be known by participants either.

On the last Sunday, each participant was interviewed by us, answering the following questions:

1) Do you feel less frustrated and anxious when the limited time is up during phase three compared with phase two? (Yes or No)
2) Do you think the App Limits Bar helps you reduce meaningless usage time on addictive apps compared with the traditional App Limits function? (Yes or No)

3) Do you think your management and self-regulation abilities on app addiction have improved during phase three compared with phase two? (Yes or No)

Data Collection and Processing
For each participant, we drew the line chart of usage time per day of each app distributed in the six days from three phases for the convenience of comparison. Open times per day for each app were made the same statistics as the usage time. The chosen frequencies of "no limits today" from three phases were also compared. In addition, we also did statistics on the answers to each interview question.

Limitation
For our design, we mainly focused on ALB’s effectiveness. Therefore, edge screen design has not been well explored. Further work will research whether the half-terete edge screen is able to display ALB best when the front screen faces us compared with other possible shape design on the edge screen.

REFERENCES
[1] Abdullah M. Alsalameh, Mohammad Harisi, Muath A. Alduayji, Abdullah Almutham, and Farid M. Mahmood. 2019. Evaluating the relationship between smartphone addiction/overuse and musculoskeletal pain among medical students at Qassim University. Journal of Family Medicine and Primary Care 8 (2019), 2953 – 2959.

[2] S. Barnes, A. Pressey, and E. Scornavacca. 2019. Mobile ubiquity: Understanding the relationship between cognitive absorption, smartphone addiction and social network services. Comput. Hum. Behav. 90 (2019), 246–258.

[3] Peter André Busch and S. McCarthy. 2020. Antecedents and consequences of problematic smartphone use: A systematic literature review of an emerging research area. Computers in Human Behavior (2020), 106414.

[4] A. Chang, D. Aeschbach, J. Duffy, and C. Czeisler. 2014. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. Proceedings of the National Academy of Sciences 112 (2014), 1232 – 1237.

[5] B. Chen, F. Liu, S. Ding, X. Ying, L. Wang, and Yufeng Wen. 2017. Gender differences in factors associated with smartphone addiction: a cross-sectional study among medical college students. BMC Psychiatry 17 (2017).

[6] Kyung-Seu Cho and J. Lee. 2017. Influence of smartphone addiction proneness of young children on problematic behaviors and emotional intelligence: Mediating self-assessment effects of parents using smartphones. Comput. Hum. Behav. 66 (2017), 303–311.

[7] Xiang Ding, J. Xu, G. Chen, and Chenren Xu. 2016. Beyond Smartphone Overuse: Identifying Addictive Mobile Apps. In CHI EA ’16.

[8] C. Harrison, Z. Yeo, and S. Hudson. 2010. Faster progress bars: manipulating perceived duration with visual augmentations. In CHI.
[9] Joshua Harwood, J. Dooley, A. Scott, and R. Joiner. 2014. Constantly connected - The effects of smart-devices on mental health. Comput. Hum. Behav. 34 (2014), 267–272.

[10] Hyeokkoo Eric Kwon, Hyunji So, S. Han, and Wonseok Oh. 2016. Excessive Dependence on Mobile Social Apps: A Rational Addiction Perspective. Inf. Syst. Res. 27 (2016), 919–939.

[11] A. Lepp, J. Barkley, and Aryn C. Karpinski. 2014. The relationship between cell phone use, academic performance, anxiety, and Satisfaction with Life in college students. Comput. Hum. Behav. 31 (2014), 343–350.

[12] C. Shin and Anind K. Dey. 2013. Automatically detecting problematic use of smartphones. In UbiComp ’13.

[13] Y. Wang and Harald Reiterer. 2019. The Point-of-Choice Prompt or the Always-On Progress Bar?: A Pilot Study of Reminders for Prolonged Sedentary Behavior Change. Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems (2019).

REFERENCES

[1] Abdullah M. Alsalameh, Mohammad Harisi, Muath A. Aduayji, Abdullah Almutham, and Farid M. Mahmood. 2019. Evaluating the relationship between smartphone addiction/overuse and musculoskeletal pain among medical students at Qassim University. Journal of Family Medicine and Primary Care 8 (2019), 2953 – 2959.

[2] S. Barnes, A. Pressey, and E. Scornavacca. 2019. Mobile ubiquity: Understanding the relationship between cognitive absorption, smartphone addiction and social network services. Comput. Hum. Behav. 90 (2019), 246–258.

[3] Peter André Busch and S. McCarthy. 2020. Antecedents and consequences of problematic smartphone use: A systematic literature review of an emerging research area. Computers in Human Behavior (2020), 106414.

[4] A. Chang, D. Aeschbach, J. Duffy, and C. Czeisler. 2014. Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. Proceedings of the National Academy of Sciences 112 (2014), 1232 – 1237.

[5] B. Chen, F. Liu, S. Ding, X. Ying, L. Wang, and Yufeng Wen. 2017. Gender differences in factors associated with smartphone addiction: a cross-sectional study among medical college students. BMC Psychiatry 17 (2017).

[6] Kyung-Seu Cho and J. Lee. 2017. Influence of smartphone addiction proneness of young children on problematic behaviors and emotional intelligence: Mediating self-assessment effects of parents using smartphones. Comput. Hum. Behav. 66 (2017), 303–311.

[7] Xiang Ding, J. Xu, G. Chen, and Chenren Xu. 2016. Beyond Smartphone Overuse: Identifying Addictive Mobile Apps. In CHI EA ’16.

[8] C. Harrison, Z. Yeo, and S. Hudson. 2010. Faster progress bars: manipulating perceived duration with visual augmentations. In CHI.
[9] Joshua Harwood, J. Dooley, A. Scott, and R. Joiner. 2014. Constantly connected - The effects of smart-devices on mental health. *Comput. Hum. Behav.* 34 (2014), 267–272.

[10] Hyeokkoo Eric Kwon, Hyunji So, S. Han, and Wonseok Oh. 2016. Excessive Dependence on Mobile Social Apps: A Rational Addiction Perspective. *Inf. Syst. Res.* 27 (2016), 919–939.

[11] A. Lepp, J. Barkley, and Aryn C. Karpinski. 2014. The relationship between cell phone use, academic performance, anxiety, and Satisfaction with Life in college students. *Comput. Hum. Behav.* 31 (2014), 343–350.

[12] C. Shin and Anind K. Dey. 2013. Automatically detecting problematic use of smartphones. In *UbiComp ’13.*

[13] Y. Wang and Harald Reiterer. 2019. The Point-of-Choice Prompt or the Always-On Progress Bar?: A Pilot Study of Reminders for Prolonged Sedentary Behavior Change. *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems* (2019).