LocknType: Lockout Task Intervention for Discouraging Smartphone App Use

Jaejeung Kim[1], Joonyoung Park[1], Hyunsoo Lee[1], Minsam Ko[2], Uichin Lee[1]

[1] KAIST, [2] Hanyang University

KAIST HANYANG UNIVERSITY


Can you imagine a single day without a smartphone?


Smartphone supports:
Productivity
Entertainment
Healthcare
…

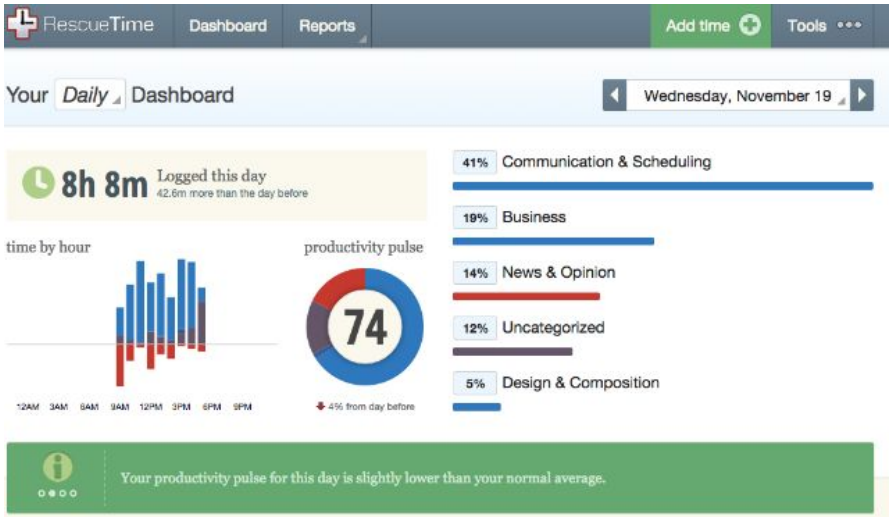

But may also undermine:
Productivity
Health/Safety


“Frequent self-interruptions”
[Gonzalez and Mark, 2004; Rosen et al. 2013]
“Cyber-loafing”
[Blanchard et al., 2008]
“Sleep disorder”
[Lui et al., 2007]
“Depression”
[Lemola et al., 2014]
“Car accidents”
[Klauer et al., 2013]
“Healthcare work accidents”
[Gill et al., 2012]

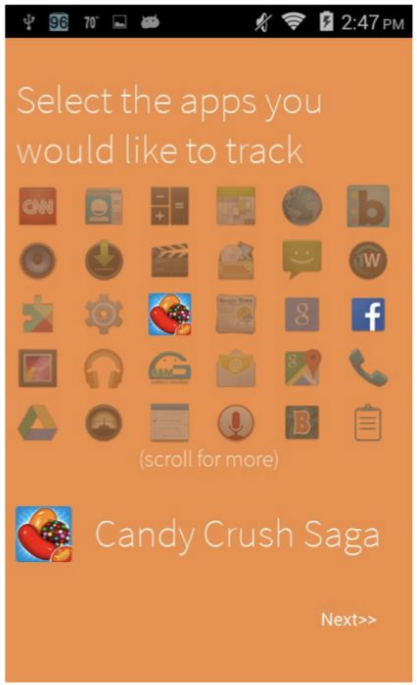
Previous Approach?

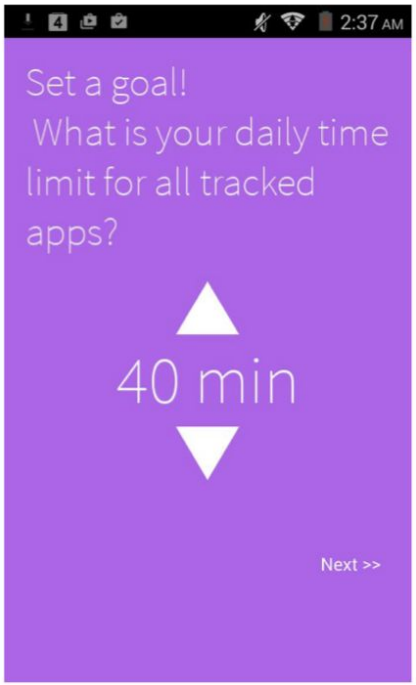
Previous Approaches: Visualization and Reflection

Logging + Tracking → **Visualization** → **Increasing self-awareness for behavior change**



<RescueTime>





<MyTime *[Hiniker et al., CHI17]*>

Previous Approaches: Direct Intervention

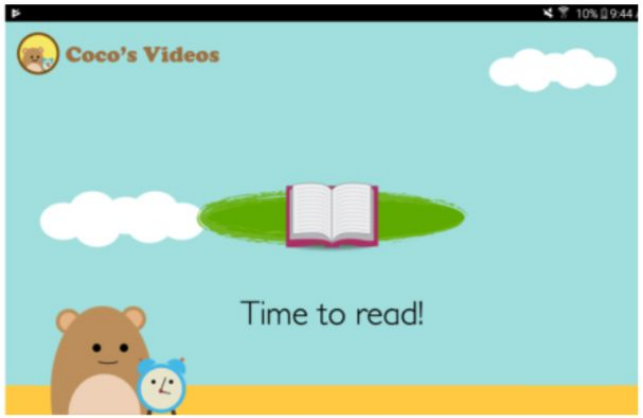
Rule based or Goal-settings

Temporary Blocking

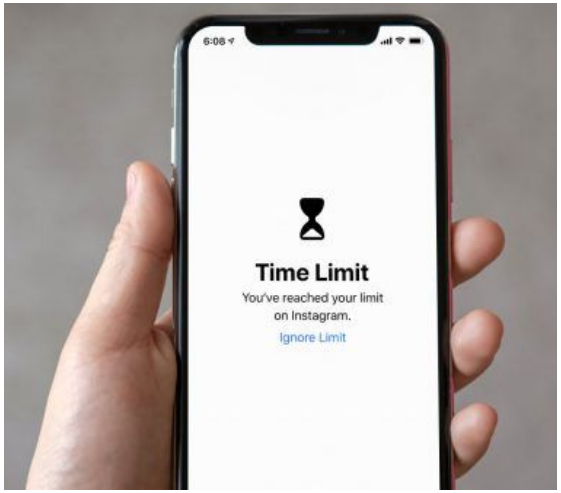
Micro-boundary /Enforcing Lockouts

(Self) Restricting access to undesired interaction sources

<NUGU *[Ko et al., CSCW15]* >



<Coco's Video *[Hiniker et al., CHI18]*>



<Apple's Screentime>

Our approach

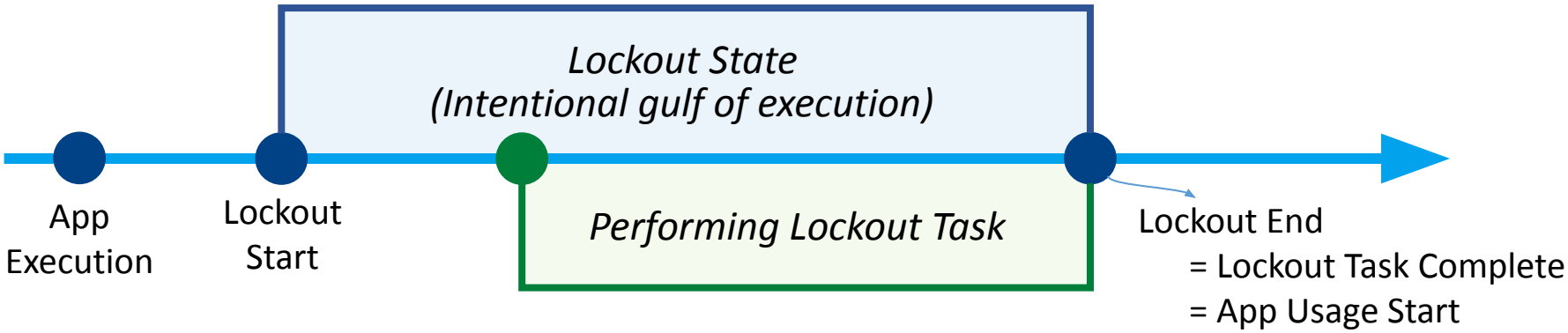
"Lockout Task"

Restrict Access to Target Apps (Lockout)

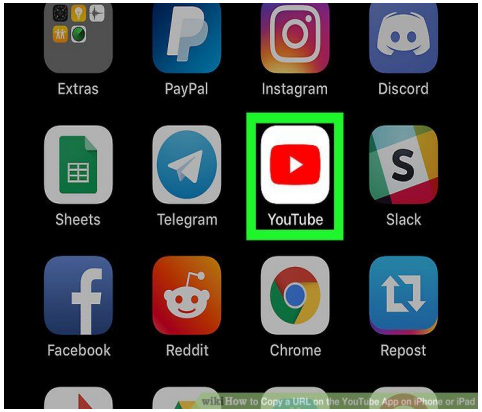
Allow Use Only After Completing a Mandatory Task

“Lockout Task”

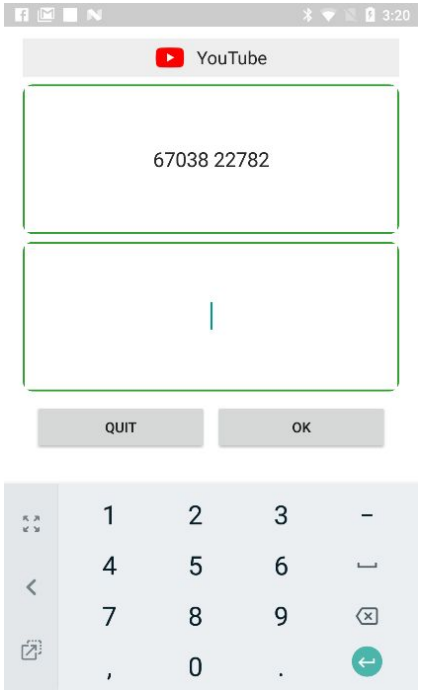
Lockout	The time interval between system feedback and the point at which the system is ready for the subsequent interaction
Lockout Task	A task which need to be completed to dismiss the lockout state



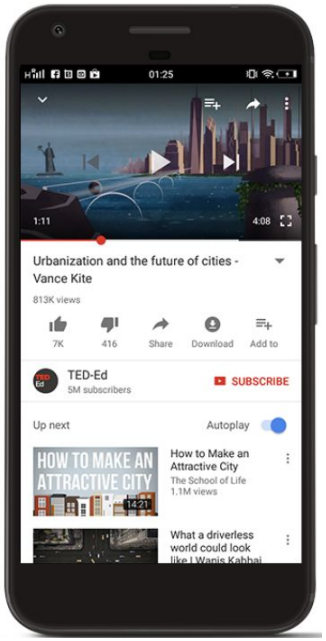
“Lockout Task”



App execution



Perform number input task
(Lockout Task)

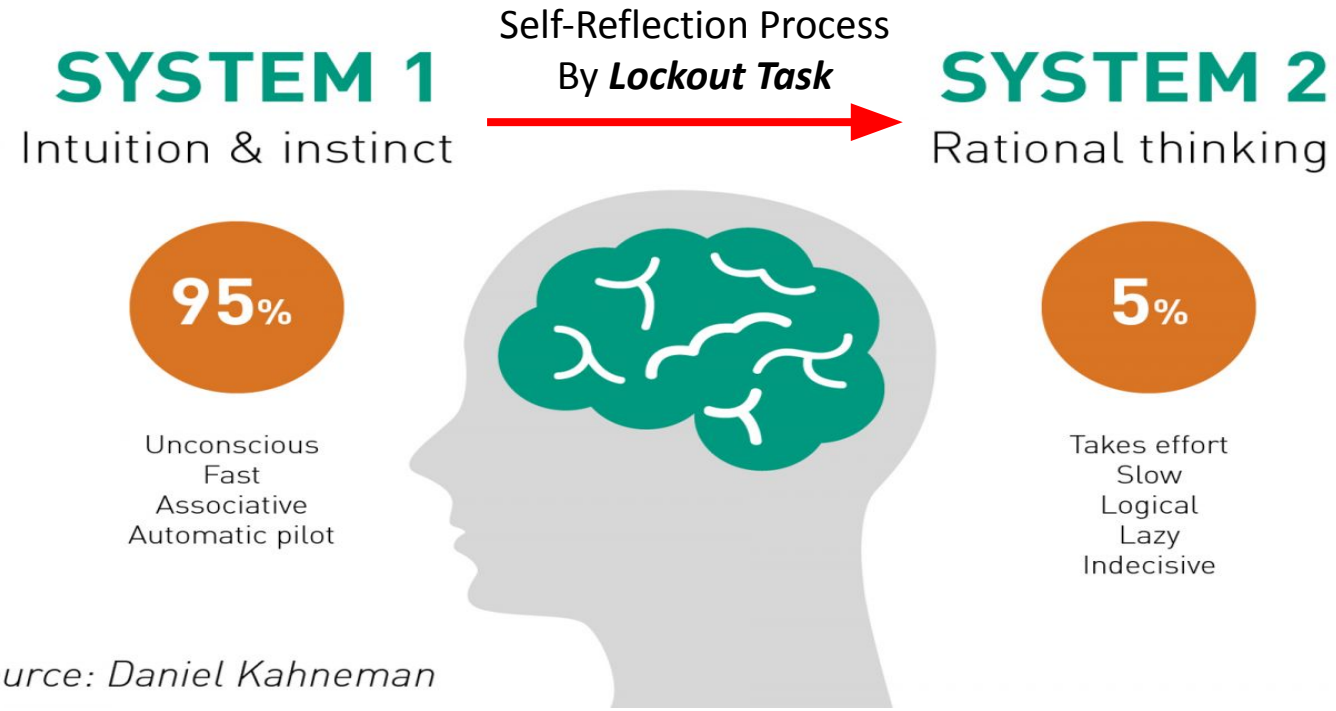


App unlocked
(App Use)

Theoretical Background

Dual Process Theory

A short pause drives system 1 thinking to system 2 thinking, increasing self-awareness



Theoretical Background

Expectancy Value Theory

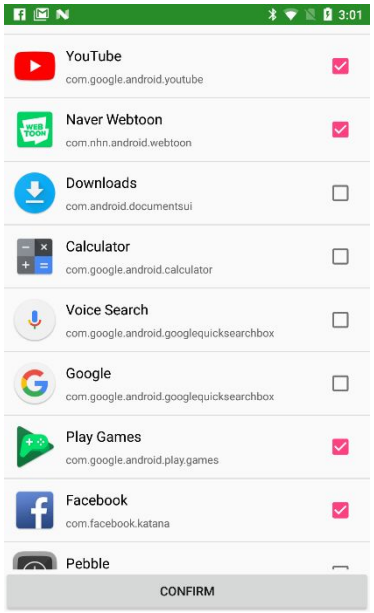
Engaging in cost/benefit analysis.
As the level of (interaction) cost increases, the overall value of the activity (using the app) decreases.

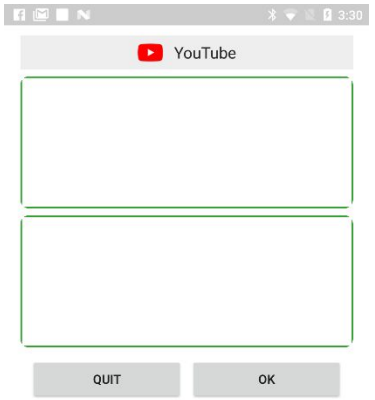
(By *lockout Task*)

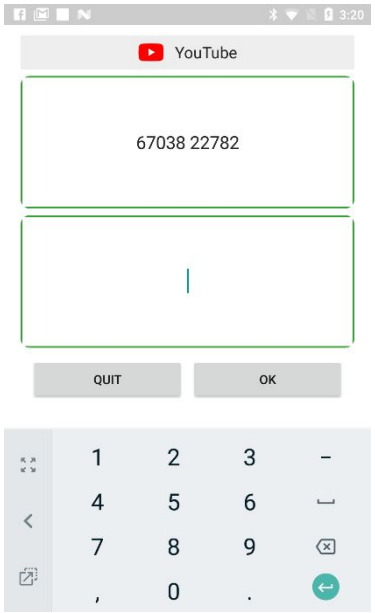
Research Questions

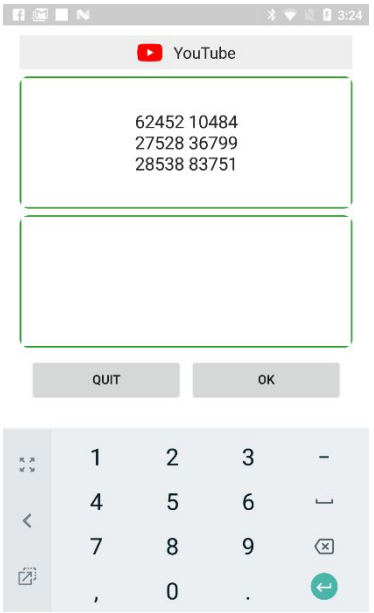
1. How much do lockout tasks with varying workloads discourage app use?
2. What are the follow-up behaviors after making app use/non-use decisions?
3. What are the key determinants of smartphone use/non-use decisions?

LocknType Design







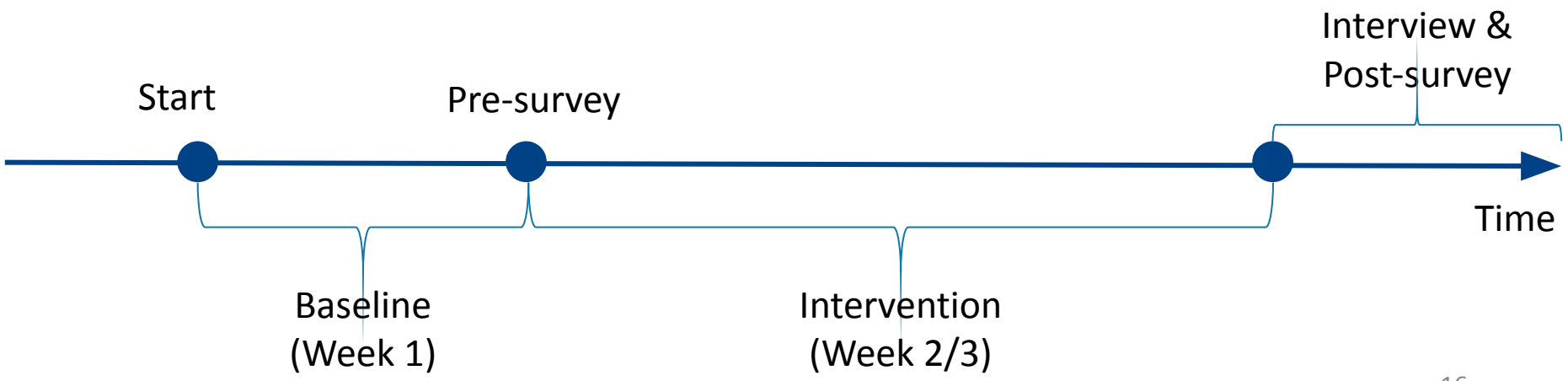


Target app selection	No-digit entry (LT0)	10-digit entry (LT10)	30-digit entry (LT30)
Participants were asked to select apps suggested by the researcher (based on the baseline usage)	Impose a short-pause before running the app	Requires a successful input of 10 digit number to access the app	Requires a successful input of 30 digit number to access the app

Randomly given at each app execution

Experiment

- **Participants**
  - ✔ 40 college students (mean age = 23.0; sd = 3.09)
  - ✔ TTM stage 2&3 (Who are willing, but has taken action for regulating smartphone use)
- **Within-subjects design**
  - ✔ Random lockout task workloads given at each target app execution
- **Three-week, in-situ deployment**



RQ1. Effectiveness of Lockout Task Intervention

Measuring Lockout Task **Workload**

- NASA-TLX
- Completion Time
- Initial Input Success Rate

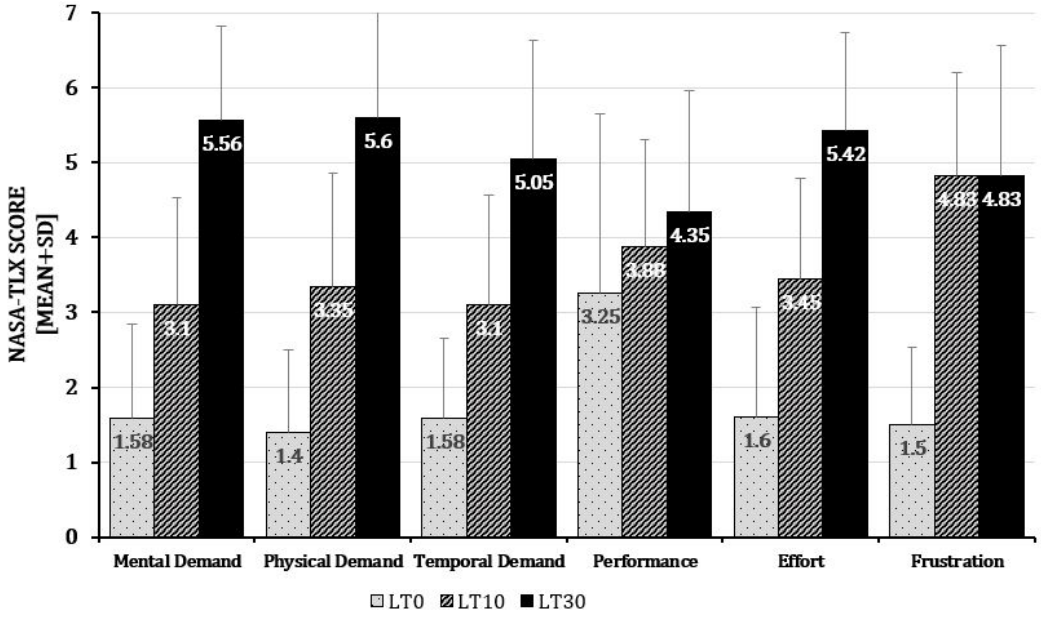
Measuring Lockout Task **Effectiveness**

- App Discourage Rate
- Change Ratio of App Usage Frequency & Time

RQ1. Effectiveness of Lockout Task Intervention

LT Workload Metric

- NASA-TLX
  - Repeated-measures ANOVA
  - Statistical difference among three conditions(p<.000**)

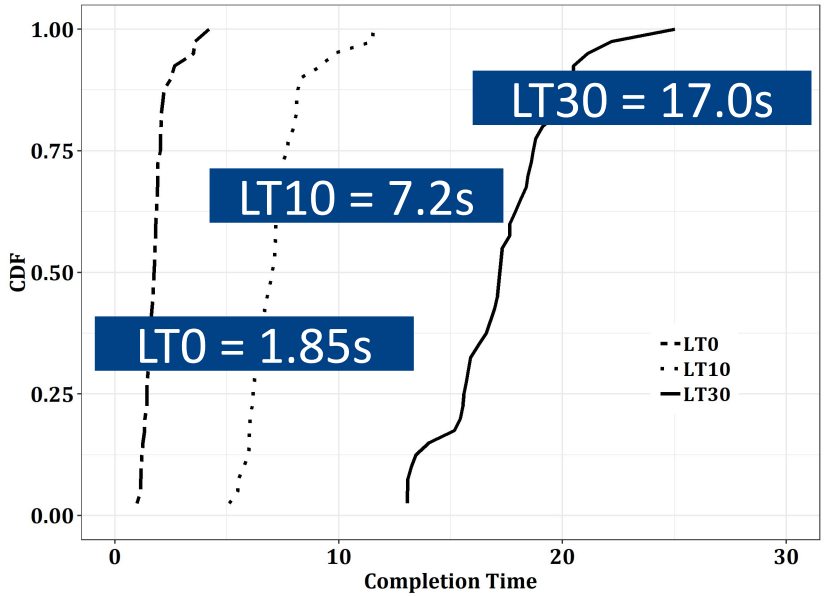


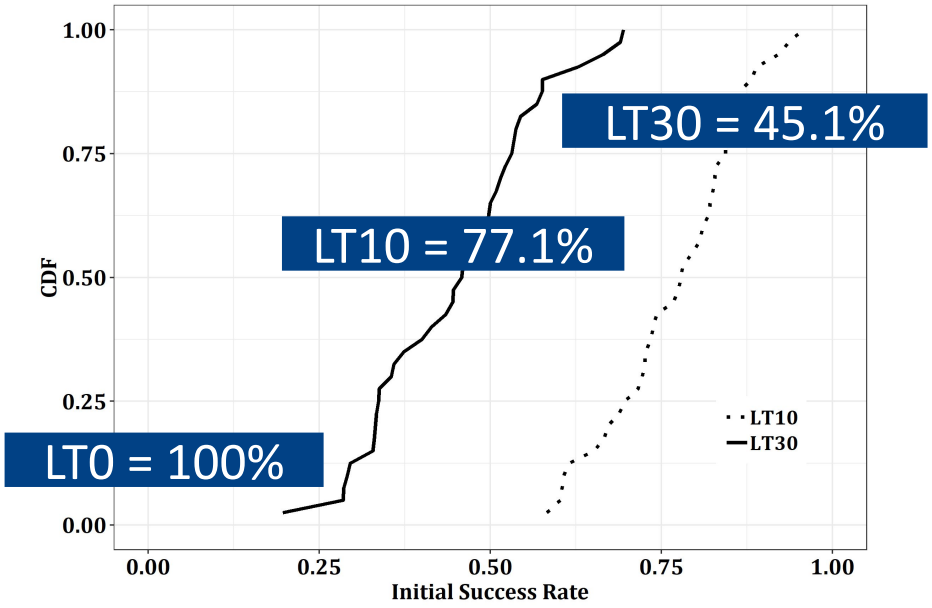
- LT0 = 12.4
- LT10 = 20.22
- LT30 = 31.1

The workload of lockout tasks were in the order of LT30 > LT10 > LT0.
The absolute value reveal that the LT30 was a heavy loaded task.

RQ1. Effectiveness of Lockout Task Intervention

LT Workload Metric	• Task Completion Time (including error correction time) • Initial Success Rate





LT0 was quick and error free, but as the required input increased, the input time and the chance of typo increased – contributing to the heavy workload

RQ1. Effectiveness of Lockout Task Intervention

Measuring Lockout Task **Workload**

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- Completion Time
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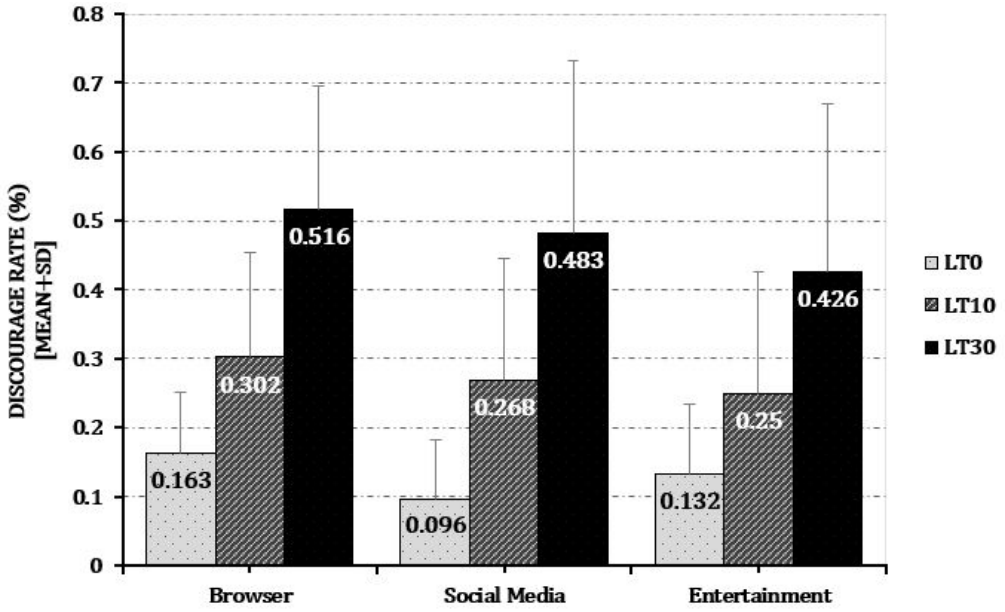
Measuring Lockout Task **Effectiveness**

- App Discourage Rate
- Change Ratio of App Usage Frequency & Time

RQ1. Effectiveness of Lockout Task Intervention

LT Effectiveness

- App discouraged rate (fraction of LT non-completion instances)



Average Discourage Rate

- LT0 = 13.1%
- LT10 = 27.4%
- LT30 = 47.5%

Even a slight pause (LT0) stopped 13.1% app use attempts.
The burdensome 30 character input task stopped nearly half app use attempts

RQ1. Effectiveness of Lockout Task Intervention

LT Effectiveness

- App usage frequency and time

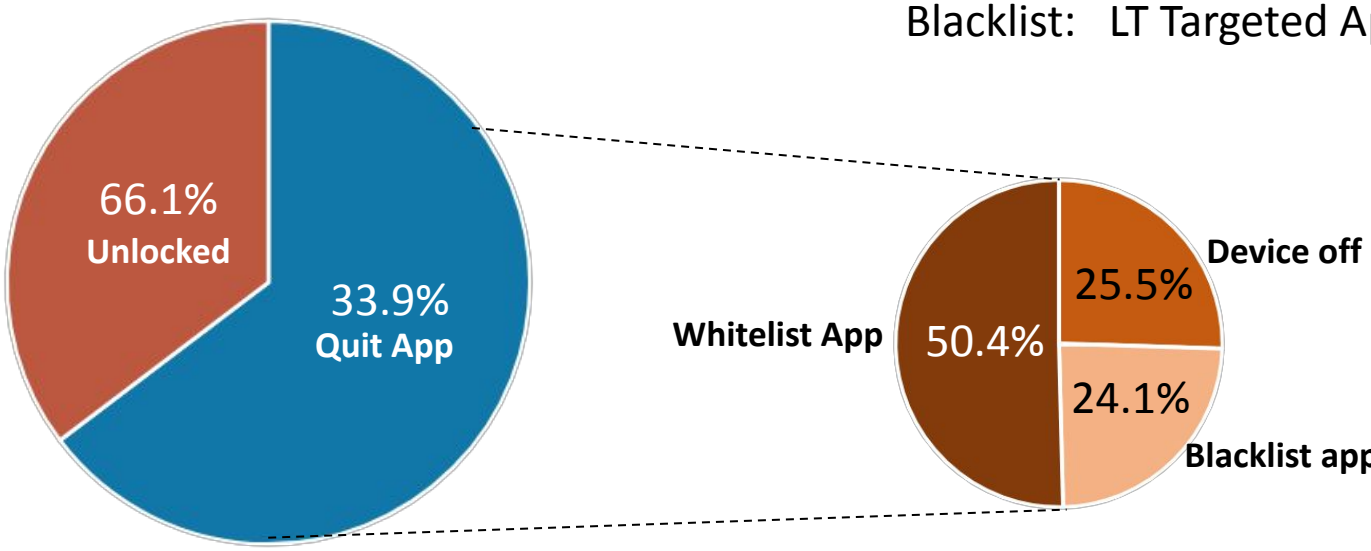
Change Ratio	Mean(SD)	95% CI	p-value
LT Freq.	0.505(0.163)	[0.162, 0.476]	0.000
LT Time	0.922(0.322)	[-0.185, 0.028]	0.143
Non-LT Freq.	1.245(0.347)	[0.134, 0.356]	0.000
Non-LT Time	1.319(0.490)	[-0.162, 0.476]	0.000
Total Freq.	0.970(0.242)	[-0.030, -0.107]	0.442
Total Time	1.062(0.243)	[0.062, -0.015]	0.113

<Change Ratio of Baseline vs treatment>

LT targeted app frequency decreased, but time remained same.

RQ2. Post-behavior Analysis

Whitelist: Non- LT Targeted App
Blacklist: LT Targeted App



<Lockout Task Intervention Behavior>

33.9% of all lockout tasks were discouraged

<Follow-up Device Use Behavior>

50.4% moved on to whitelisted app
24.1% to another blacklisted app
25.5% cases of device turn off

RQ3. Thematic Analysis on Use/Non-use Determinants

Category	Sub-category	Description
User States	Time Availability	How much free time a user has at the moment
	Willingness/Mindfulness	How willing or mindful a user is about self-regulating phone usage
	Physical/Mental Condition	Whether a user is in a good physical/mental condition to perform a goal task
	Subjective Social Norm	The degree to which one is aware of (and follows) the social norm
LT Workload Context	Temporal Demand	How much time will cost to perform a given LT task
	Physical Demand	How much physical effort should be exerted to perform a given LT task
	Mental Demand	How much mental effort should be exerted to perform a given LT task
Task Context	Task Urgency	How quickly does the task needs to be completed
	Task Importance	How important is the task to be completed
	Alternative App Availability	Whether there are alternative apps of achieving the goal task

Mixed combination of user-states/task-context/lockout-task workloads influenced use/non-use decisions

Findings & Implications

Short pause works

- The light, short pause (LT0) engaged the participants toward rational re-evaluation of app use intention, discouraging in 13.1% app use cases

Costly interaction works better

- The burden of performing a heavy workload task in addition to the short pause doubled (LT10) and even tripled (LT30) the discourage rate
- Other similar tasks that requires physical/mental/temporal demand can be designed as a behavioral inhibitor.

Findings & Implications

Above all, depends on the context

- Even if LT30 was given, the participants completed the lockout task if the app was really necessary

Need to Providing Flexibility

- False-positive lockouts (LT30 given in good/meaningful use intention) negatively affect user experience and productivity
- Flexible and adaptive lockouts are required (context-aware; temporary exception features etc.)

Findings & Implications

Follow-up guidance required

- The participants mentioned **“regretfully-long use”** once they started to use the app (similar to Lukoff et al, 2018)
- Lockout tasks intervenes only at the app execution process
- Follow-up guidance is required after the completion of lockout task, or even during the app use (from simple message to another lockout task intervention)

LocknType: Lockout Task Intervention for Discouraging Smartphone App Use

jjk@kaist.ac.kr