



# Technology Supported Behavior Restriction for Mitigating Self-Interruptions in Multi-device Environments

2017.09.14.

Jaejeung Kim, Chiwoo Cho, Uichin Lee

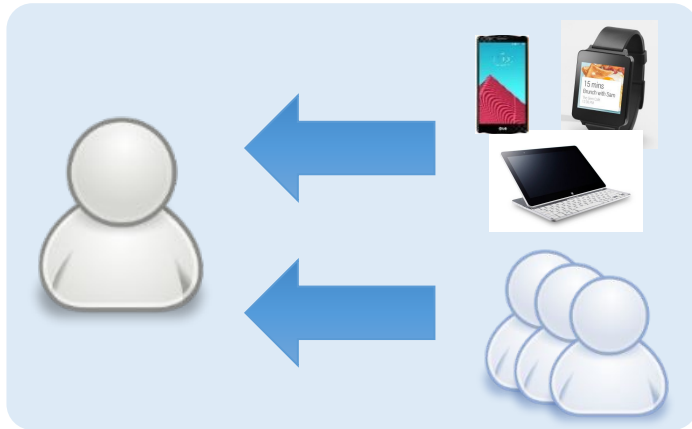


Knowledge workers face frequent interruptions.

Office workers switch tasks every 3 minutes [Gonzalez and Mark, 2004]

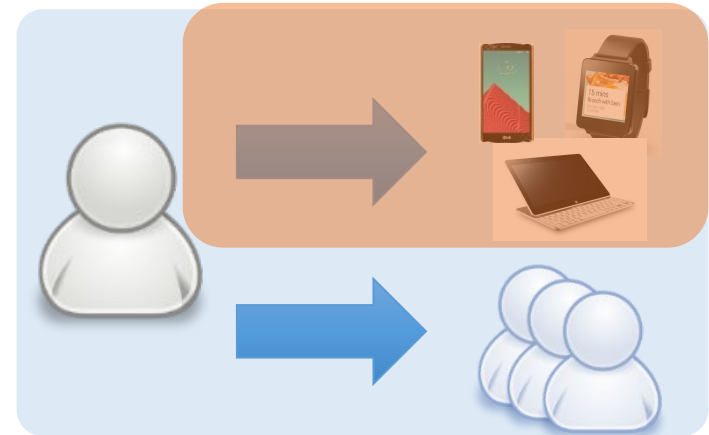
Students interrupt their tasks every 6 minutes [Rosen et al. 2013]

# Types of Interruptions



## External interruption

*“Interruptions from external sources”*



## Self-interruption

*“Discretionary task interleaving”*

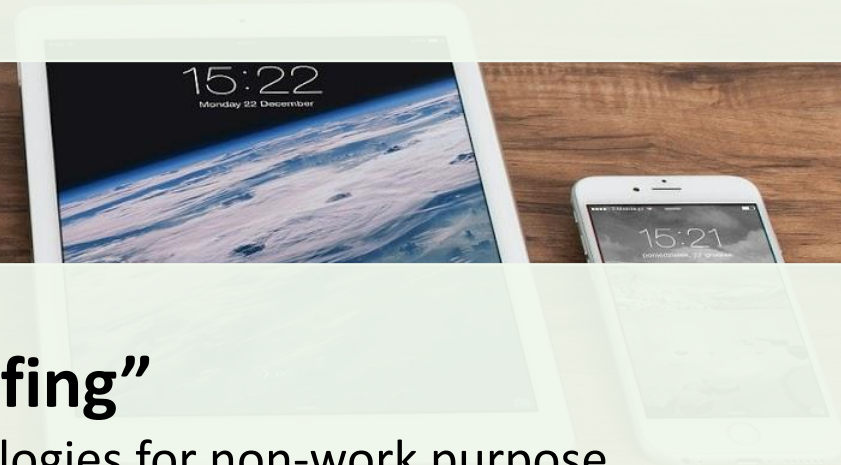
**40-52%** of the interruptions in an office environment were self-interruptions  
[Czerwinski et al. 2004; Mark et al. 2005]

Self-interruptions are **more disruptive than external interruptions**  
[Katidioti et al. 2016]

# Problematic Use of Digital Devices



PC, smartphones are used for **work productivity**  
At the same time, it is also a **source of self-interruption**



## “Cyber-loafing”

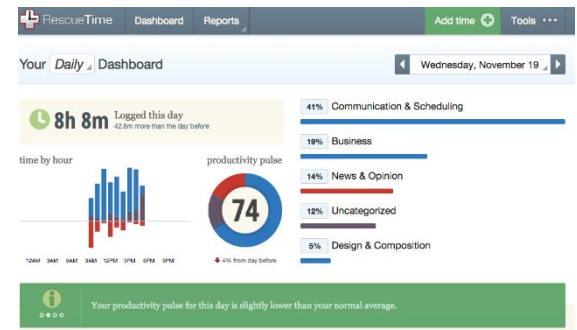
Voluntarily use of digital technologies for non-work purpose

[Blanchard et al. 2008, Henle et al. 2012]

# Promoting Productive Technology Use

## Usage tracking/reflection

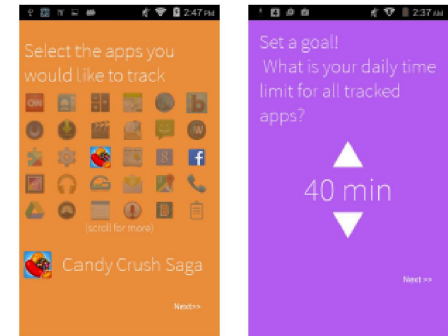
- RescueTime, ManicTime, Slife
- Status bar, widgets reduced non-work related web usage [Lottridge et al. 2012]



<RescueTime>

## Goal setting and reinforcement

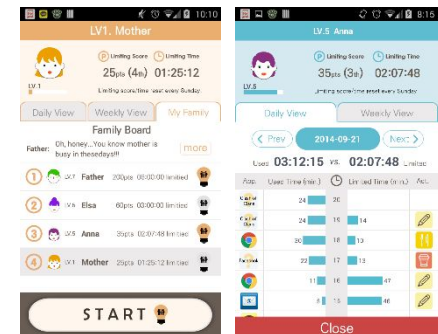
- MyTime allows users to set daily goals, and sends timeout messages when violated [Hiniker et al. 2016]
- Awarding badges helps reinforce behavior maintenance [Ostaszewski et al. 2015]



<MyTime>

## Social learning and blocking

- NUGU offers temporary usage blocking, which significantly decreased smartphone use and perceived level of managing interruptions [Ko et al. 2015]

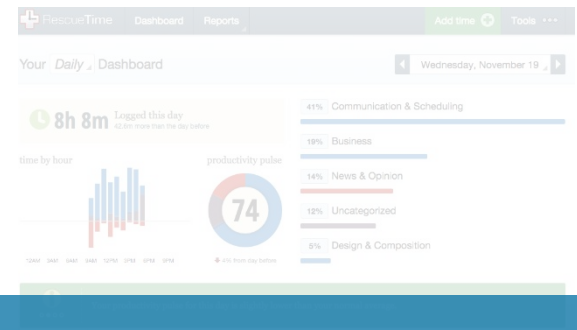


<NUGU>

# Promoting Productive Technology Use

## Usage tracking/reflection

- RescueTime, ManicTime, Slife
- Status bar, widgets reduced non-work related web usage [Lottridge et al. 2012]



<RescueTime>

Our work builds on the **technology based intervention**

&

Target current problematic **multi-device environments**

- MyTime allows users to set daily goals, and sends timeout messages when violated [Lupillo et al. 2017]
- Awarding badges helps reinforce behavior maintenance [Ostashewski et al. 2015]

<MyTime>

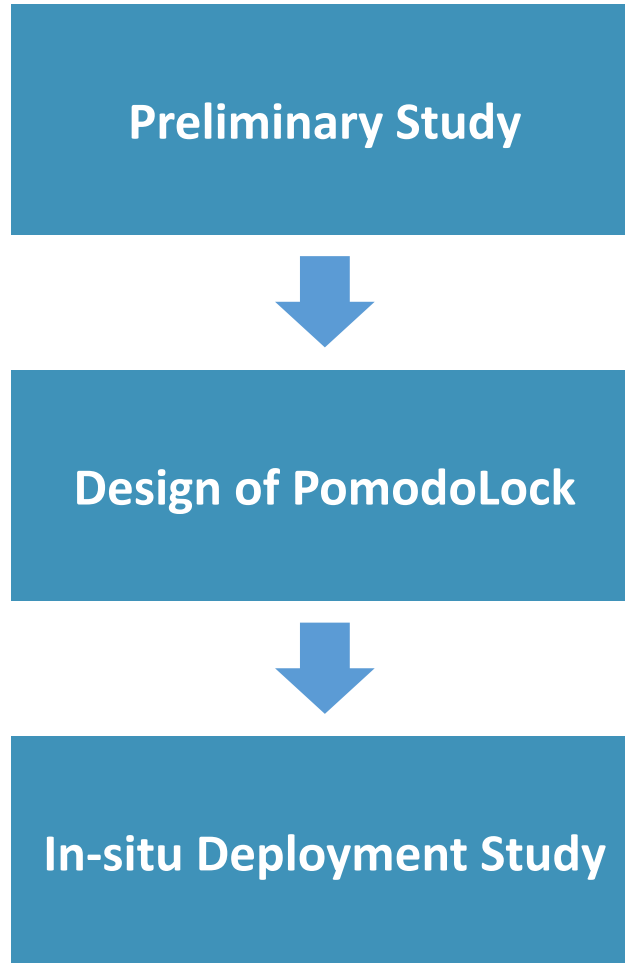
## Blocking and Social Learning

- NUGU offers temporary usage blocking, which significantly decreased smartphone use and perceived level of managing interruptions [Ko et al. 2015]



<NUGU>

# Study Overview



# Preliminary Study

## Aim to understand:

- The **types of devices** and their uses in the working environments
- What are the **types of interruptions** from digital devices
- If any **coping strategies** are employed to manage interruptions

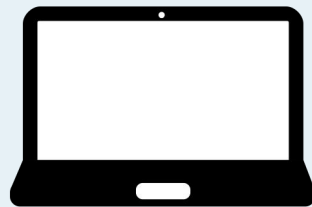
## Interviewed 16 graduate students

- Who consider themselves as less productive at work
- Have thought of or executed strategies to be more productive



# Digital Devices / Uses in the Workplace

## Type of devices



16



16

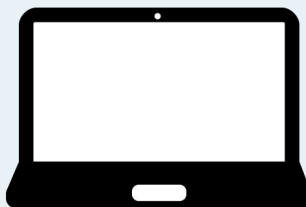


1



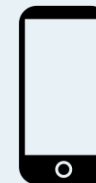
0

## Usage in the workplace



### Main task device

- ✓ Information search
- ✓ Creating documents
- ✓ Coding applications



### Minor(sub) task device

- ✓ Information search
- ✓ Communication (phone call, instant messengers)

# Experienced Interruptions / Management Strategies

## *External-interruptions*

### Source device



(e.g. instant messengers and service notifications)

### Managed by

- Configuring notification modalities (e.g. sound  vibration, mute/light only)
- Turning the device off

### Distraction level

- Not very distracting (“ignorable” and “not taking away much time”)

# Experienced Interruptions / Management Strategies

## *Self-interruptions*

Source device



(e.g. web-browsing, SNS, news, videos, games)

Managed by

- “....” (Can’t manage)
- “self-control”
- “erase the app” or “turn the device off”

Distraction level

- Very distracting
- Relatively “harder to resist”
- “recovery to the main task takes much time once engaged with content”

# Design Implications

## Creating a temporal period for focusing on one task

*“I **allocate a certain time to concentrate** on completing a task” (P3)*

- **Timeboxing technique:** individuals allocate fixed time slots and use self-pressure to complete a task [Pash et al. 2011]
- **Pomodoro Technique:** using a 25 minute timer followed by 5 minute break to focus on one task [Cirillo, 2014]

# Design Implications

## Technically isolating the user from interruption sources

*“I have **deleted several apps** that disturbs my work” (P7)*

*“When I go to the library to study, I **turn off** my smartphone and **put it in my bag**” (P14)*

- PC and smartphones are used for main tasks – **cannot be simply turned off**
- Need to **selectively disable or block** interruption sources at a fine-grained level

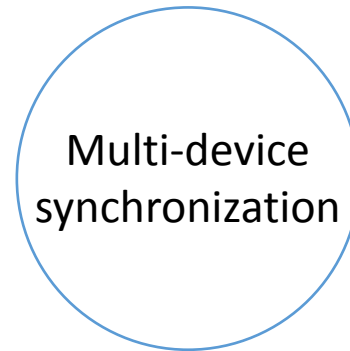
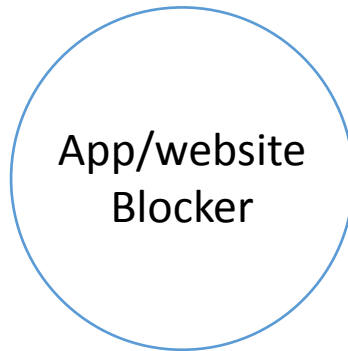
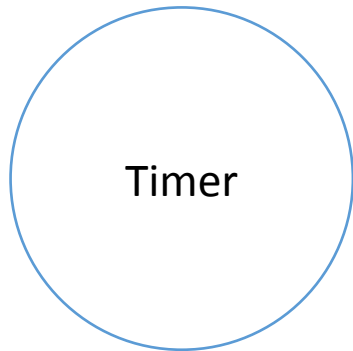
# Design Implications

## Multiple devices should be synchronously managed

*"I erased **Facebook on my smartphone**, but I found myself checking **Facebook on PC**" (P11)*

- Interruptive sources are all available on both PC and smartphone
- Blocking one could drive the user to the other device

# PomodoLock Design & Implementation



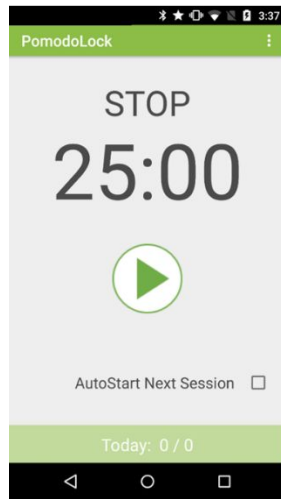
We embedded three main features into our self-interruption management application – PomodoLock

# PomodoLock Design & Implementation

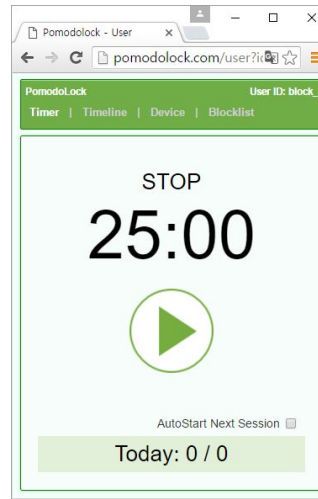
Timer

App/website  
Blocker

Multi-device  
synchronization



Smartphone



Web



PC (Windows)



Notification Pop-up

- Same design across platforms
- 25-minute timer followed by 5-minute break
- Notifies the user when timer is over
- May check "AutoStart" to automatically continue to next session

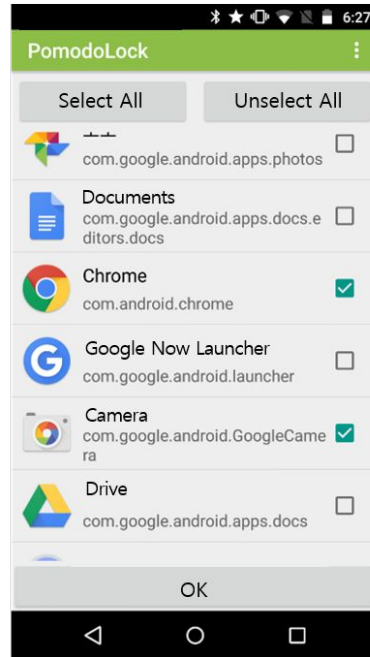


# PomodoLock Design & Implementation

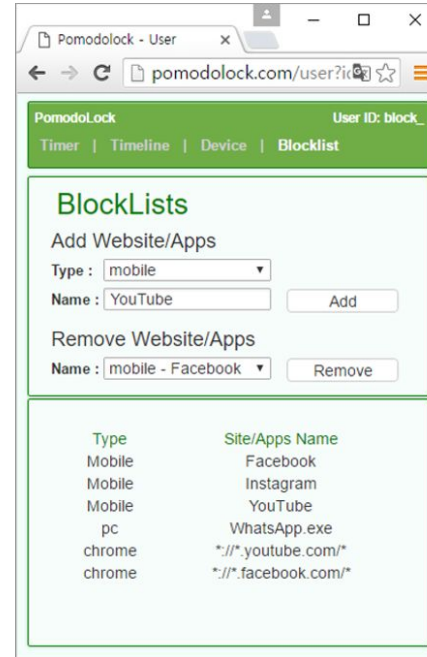
Timer

App/website  
Blocker

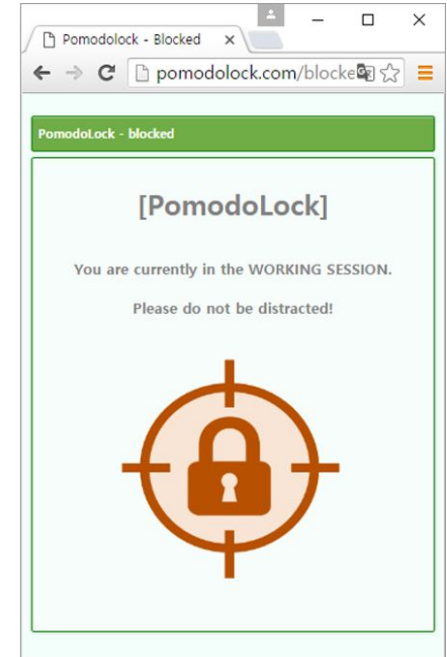
Multi-device  
synchronization



Target app selection  
on smartphone



Target website/PC  
application selection on  
the web



App/website blocked  
message

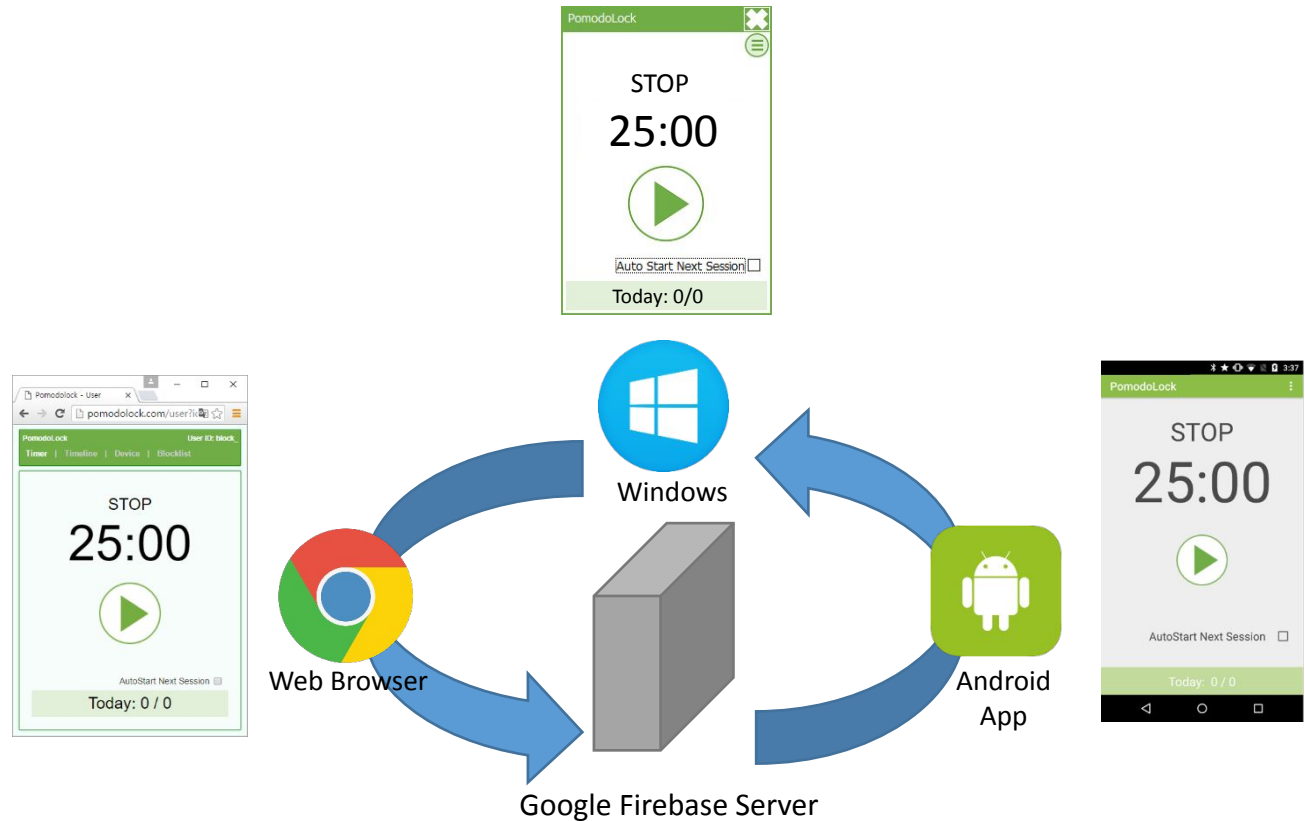
- Selectively blocks user-defined apps/websites
- Only works during timer activated period
- Block message pops up upon the use attempt

# PomodoLock Design & Implementation

Timer

App/website  
Blocker

Multi-device  
synchronization



- Selectively blocks user-defined apps/websites
- Only works during timer activated period
- Blocked message pops up upon the use attempt

# Research Questions

1) In what context was PomodoLock used?

2) How effective was PomodoLock in mitigating self-interruptions?

3) Did participants experience any negative emotions (e.g. stress or coercion) due to the behavior-restricting mechanisms embedded in PomodoLock?

# Experiment

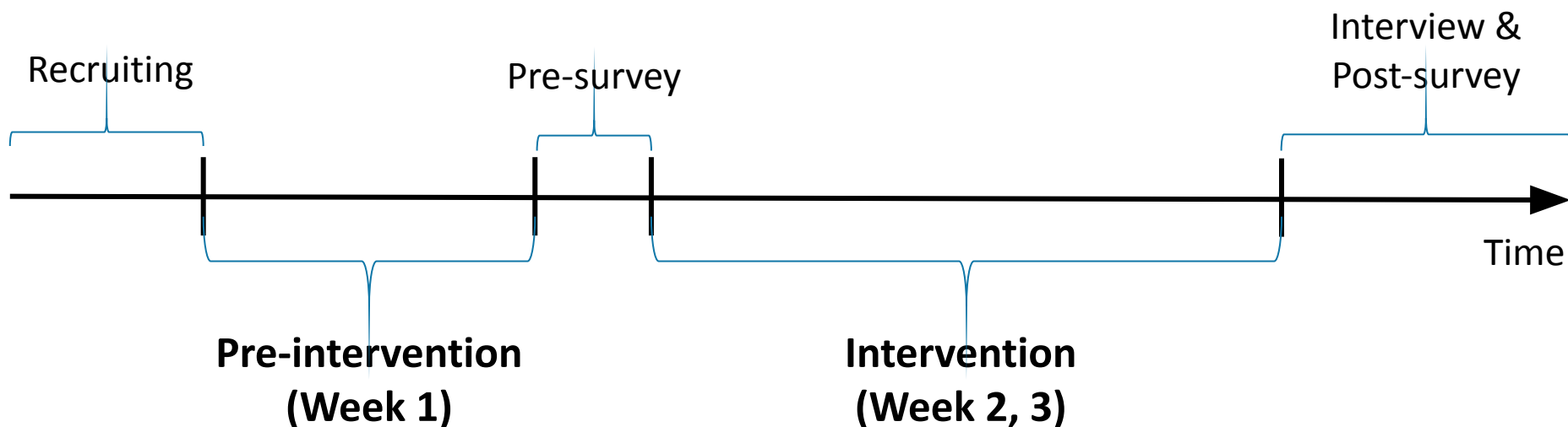
- **Participants**

- 40 graduate students (mean age = 26.5; sd = 2.9) were recruited in campus (4 were discarded due to individual's issues)

- **Between-group design**

- Control Group: Timer only
- Experimental Group: Timer + Blocker

- **Three-week, in-situ deployment**



# Research Questions

1) In what context was PomodoLock used?

2) How effective was PomodoLock in mitigating interruptions?

3) Did participants experienced any negative emotions (e.g. stress or coercion) due to the behavior-restricting mechanisms embedded in PomodoLock?

# RQ1: Understanding the Use/Non-use Context

## Time Pressure

High	Low
Non-use	Use

*“I found myself shopping online when I was working on a loose deadline” (E3)*

# RQ1: Understanding the Use/Non-use Context

## Proximity

Far	Close
Non-use	Use

*“When I am on a PC searching for information, I tend to go on surfing for irrelevant things. . .” (E13)*

# RQ1: Understanding the Use/Non-use Context

## Collaboration needs

Yes	No
Non-use	Use

*"I needed to contact my co-worker ... I stopped the PomodoLock timer" (E15)*



# Research Questions

1) In what context was PomodoLock used?

2) How effective was PomodoLock in mitigating interruptions?

3) Did participants experienced any negative emotions (e.g. stress or coercion) due to the behavior-restricting mechanisms embedded in PomodoLock?

# RQ2: Understanding the Effectiveness

**Experimental group: 41.5% more usage...  
Yet not significant ( $p=0.1$ ,  $d=0.54$ )**

Measures	Control	Experimental
Number of Pomodoro session(25 minute block) completions	2.09 (sd=1.36)	2.96 (sd=1.35)

# RQ2: Understanding the Effectiveness

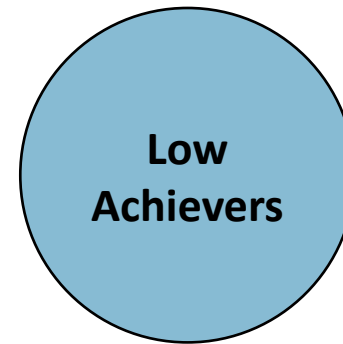
## Blocker was more effective on Low Achievers

Completed 153% more session than the control group  
( $p=0.033$ ,  $d=0.78$ )



High  
Achievers

>5 Pomodo sessions



Low  
Achievers

<5 Pomodo sessions

	Mean (SD)		Cohen's <i>d</i>	P-value
	Control (Timer)	Experimental (Timer+Blocker)		
High Achievers	4.7 (1.19)	4.8 (1.93)	0.06	.962
Low Achievers	1.7 (0.90)	2.6 (1.34)	0.78	.033

# RQ2: Understanding the Effectiveness

**Synchronous timer**



**Increased awareness**

*“Wherever I lay my eye on it, PomodoLock reminded me of my working status” (E4)*

**Synchronous blocking app/websites**



**Decreased temptation**

*“... applications are available on both the PC and smartphone. Blocking both cut off my temptation to use them.” (E13)*

# Research Questions

- 1) In what context was PomodoLock used?
- 2) How effective was PomodoLock in mitigating interruptions? How did each features contribute?
- 3) Did participants experience any negative emotions (e.g. stress or coercion) due to the behavior-restricting mechanisms embedded in PomodoLock?

# RQ3: Understanding Negative Emotions

Perceived coercion and stress were greater in Control Group



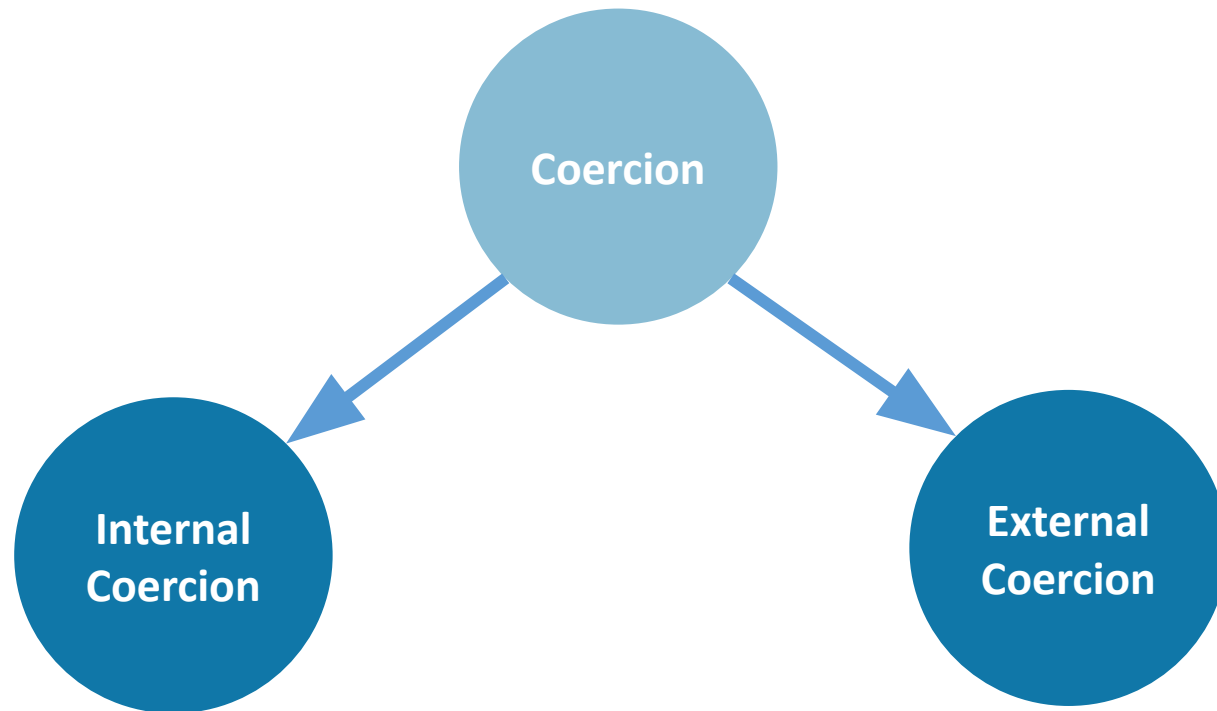
Separated coercion and stress into two dimensions

	Mean (SD)		<i>P-value</i>
	Control	Experimental	
Perceived Coercion	<b>3.22 (1.11)</b>	<b>2.44 (1.04)</b>	.038
Perceived Stress	<b>2.83 (0.70)</b>	<b>2.28 (0.83)</b>	.037

<Perceived Coercion and Stress in 5-point Likert Scale>

# RQ3: Understanding Negative Emotions

Two dimensions of coercion and stress

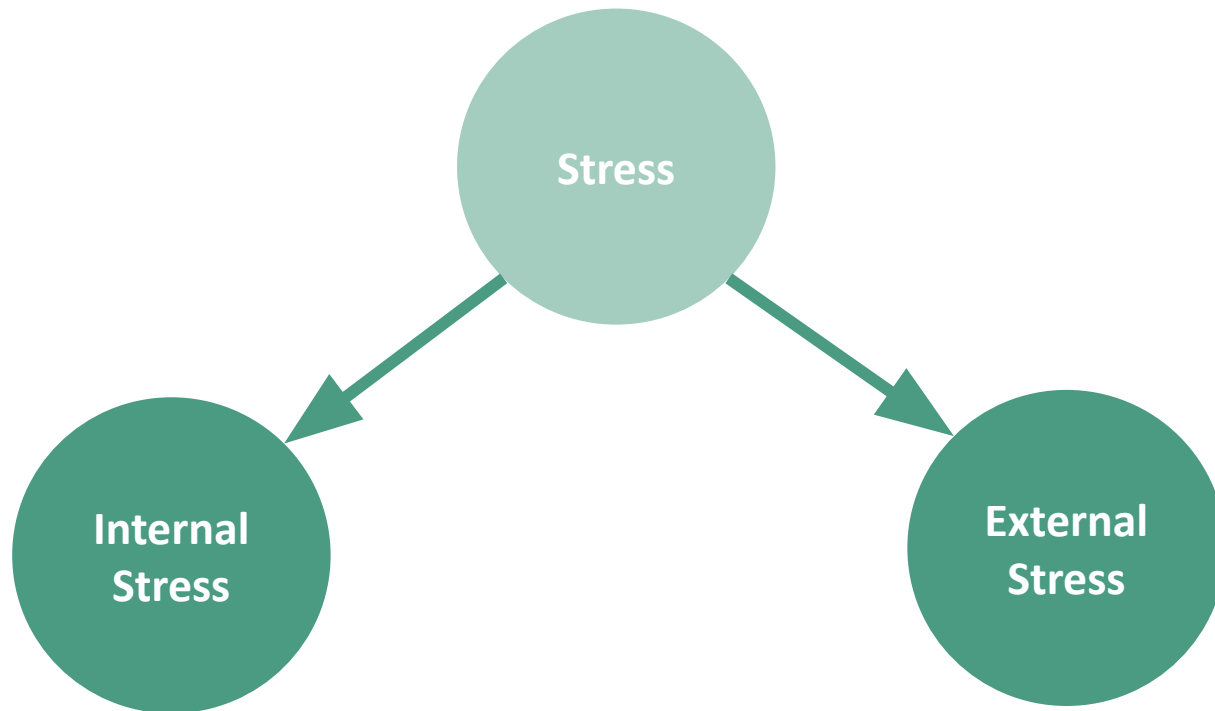


**“coercion from oneself”**  
(i.e., self-enforcing effort to a behavior)

**“coercion from app features”**  
(i.e., behavioral restriction mechanisms such as timeboxing and blocking features)

# RQ3: Understanding Negative Emotions

Two dimensions of coercion and stress



**“stress from internal coercion”**

**“stress from external coercion”**



# RQ3: Understanding Negative Emotions

**Timer+blocker condition** experienced

**significantly less internal coercion and stress**

than the timer only condition.

		Mean (SD)	Cohen's <i>d</i>	<i>P</i> -value
Perceived external coercion	Timer	3.3 (1.68)	0.25	.467
	Timer + Blocker	3.7 (1.49)		
Perceived internal coercion	Timer	5.1 (1.08)	1.52	.000
	Timer + Blocker	3.3 (1.27)		
Perceived stress due to external coercion	Timer	2.4 (0.78)	0.70	.048
	Timer + Blocker	3.2 (1.40)		
Perceived stress due to internal coercion	Timer	3.6 (1.29)	1.62	.000
	Timer + Blocker	1.9 (0.73)		

<Perceived Internal/External Coercion and Stress in 7-point Likert Scale>

# RQ3: Understanding Negative Emotions

Timer+blocker condition experienced

significantly less internal coercion and stress

Baumeister's Strength Model of Self-Control

“person's strength (or willpower) for self-control is a limited resource”

		Mean (SD)	Cohen's d	P-value
Perceived external coercion	Timer	3.3 (1.68)	0.25	.467
	Timer + Blocker	3.7 (1.49)		
Perceived internal coercion	Timer	5.1 (1.88)	1.52	.000
	Timer + Blocker	3.3 (1.27)		
Perceived stress due to external coercion	Timer	2.4 (0.78)	0.70	.048
	Timer + Blocker	3.2 (1.40)		
Perceived stress due to internal coercion	Timer	3.6 (1.29)	1.62	.000
	Timer + Blocker	1.9 (0.73)		

App/website blocker reduces the required amount of strength for resistance

# Summary

## Preliminary study (n=16)

- Self-interruptions are harder to mitigate
- Self-interruptions comes from multiple sources
- Derived design for time-boxing, fine-grained blocking with multi-devices

## In-situ deployment study (n=40)

- **Time pressure, proximity, collaboration needs** encourage/discourage use
- **Low achievers** with the blocker **completed 153% more** sessions than without
- Multi-device synchronization **increased awareness** and **decreased temptation**
- The **blocker** introduced **less coercion and stress**

# Implications

Designing the “blocker” for appropriate level of coercion

Length of  
intervention

Fine grained  
customization

Autonomy to  
start/end  
intervention

# Implications

## Design for Multi-device Synchronous Management

- The effect of behavioral intervention with synchronous devices may greatly increase its effect
- Need to consider all the task dependent devices
- They need to be orchestrated according to the context
- Need to be aware of “working around the technology”



# Technology Supported Behavior Restriction for Mitigating Self-Interruptions in Multi-device Environments

Jaejeung (JJ) Kim | [jjk@kaist.ac.kr](mailto:jjk@kaist.ac.kr)

# Implications

## Engaging Users with External Triggers

- Current design fully rely on one's will to start
- Avg. of 2-3 Pomodoro sessions were below expectations
- Many mentioned simply “forgetting to use”



- External trigger (e.g. notification) may increase engagement

# Limitation and Future Work

- Not fully coercive
- Broadening/lengthening the deployment study
- Assessing the productivity
- Working around technology restrictions