



# Designing for Mindful Human-Computer Interaction

The end-user perspective  
Alberto Monge Roffarello

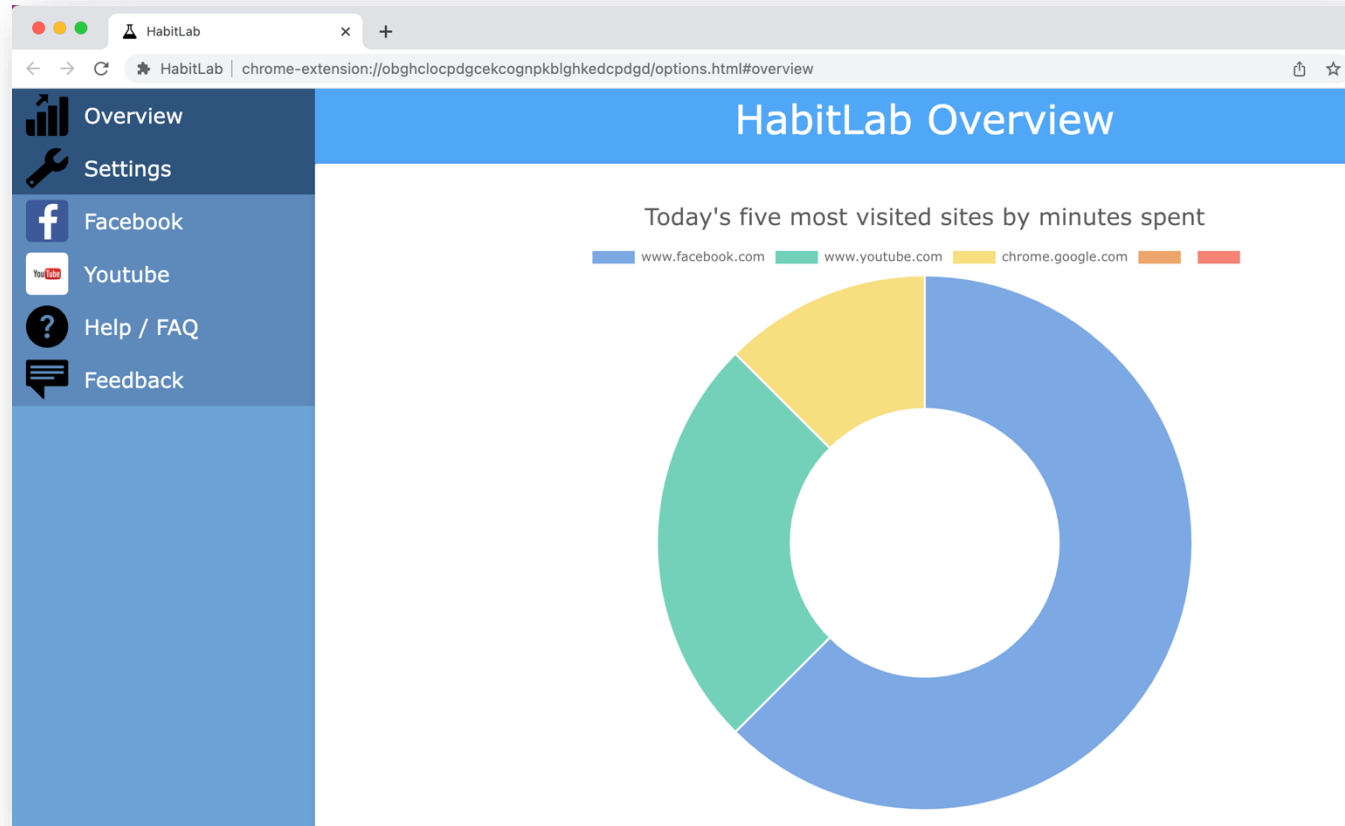
# Outline

- Overview of contemporary DSCTs
- Evaluation of contemporary DSCTs
- Gaps in contemporary DSCTs
- Designing theoretically-grounded DSCTs

# Digital Sel-Control Tools: Introduction

- The last few years have seen the flourishing of **Digital Self-Control Tools (DSCTs)** both in academia and as off-the-shelf products:
  - external tools, such as **apps** or **browser extensions**, that support users to self-regulate their use of devices, apps, and/or websites.
- They typically allow users to:
  - track their usage patterns, and
  - define self-imposed interventions, e.g., usage timers.

# Research and commercial DSCTs

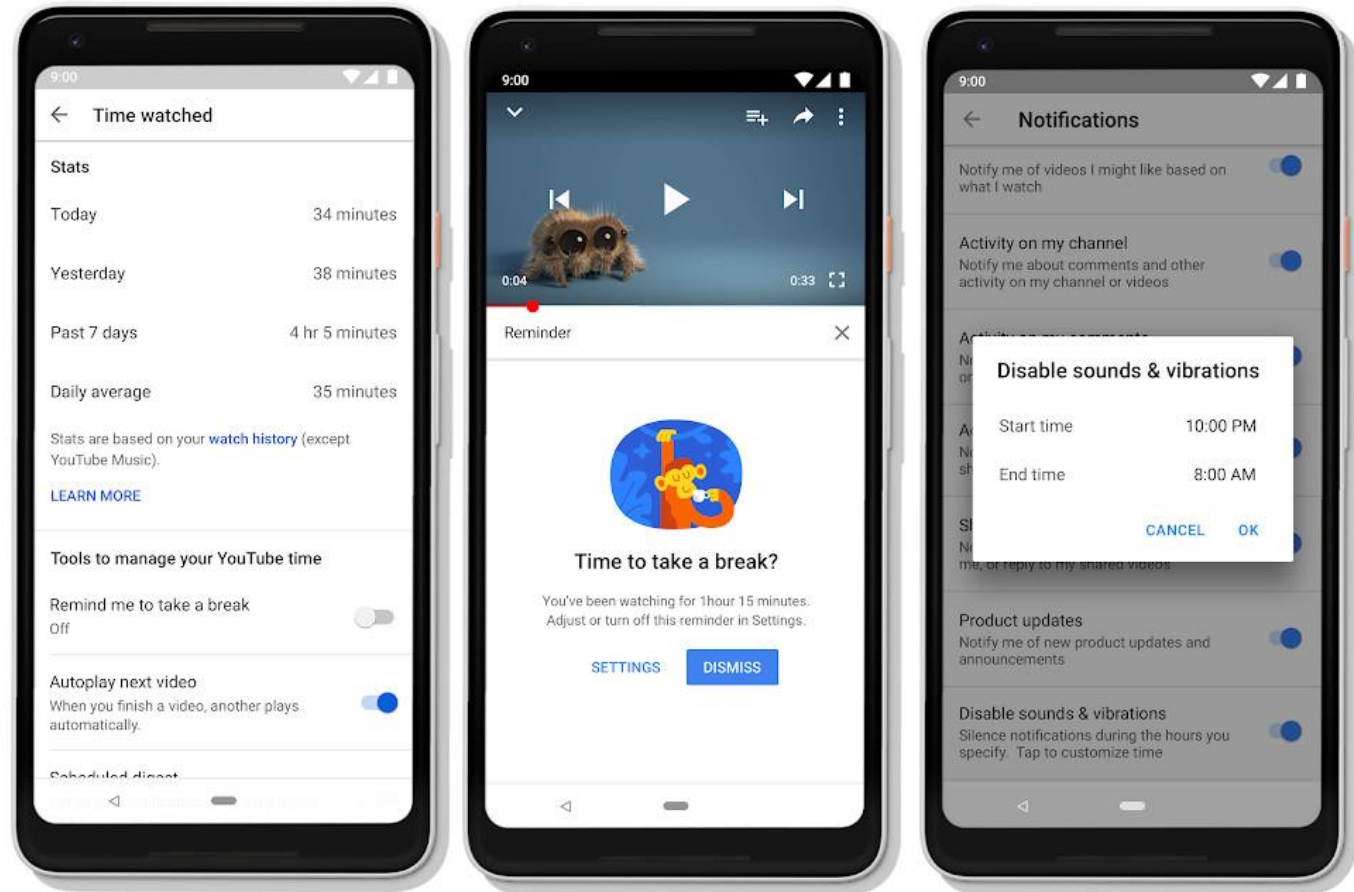
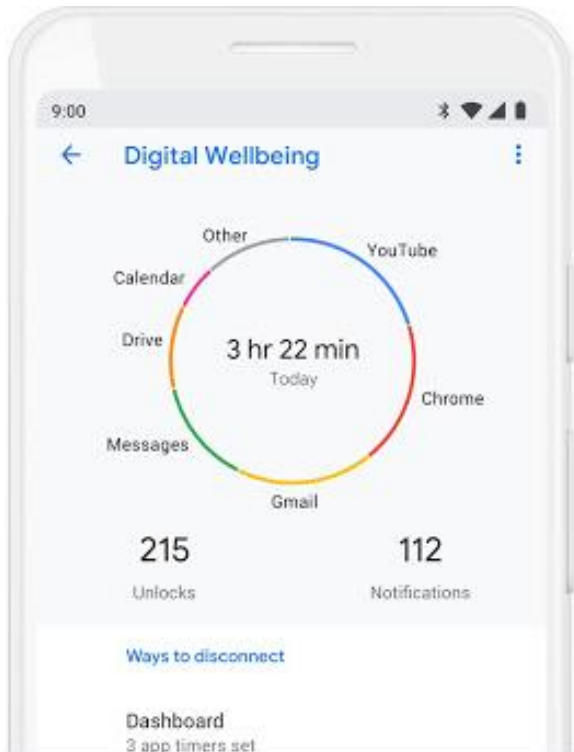


HabitLab  
<https://habitlab.github.io/>



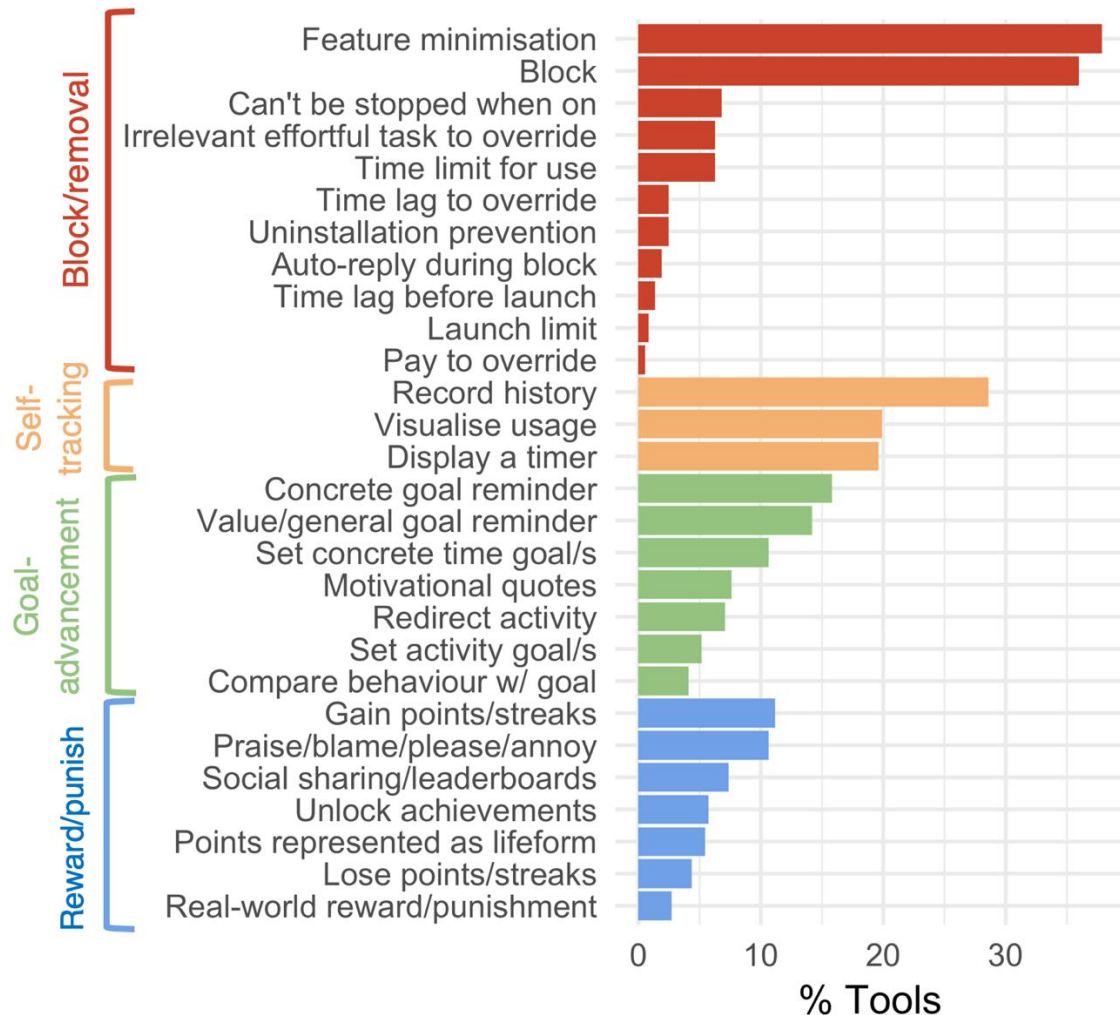
FOREST  
<https://www.forestapp.cc/>

# DSCTs



Google Digital Wellbeing <https://wellbeing.google/>

# What do current DSCTs do?

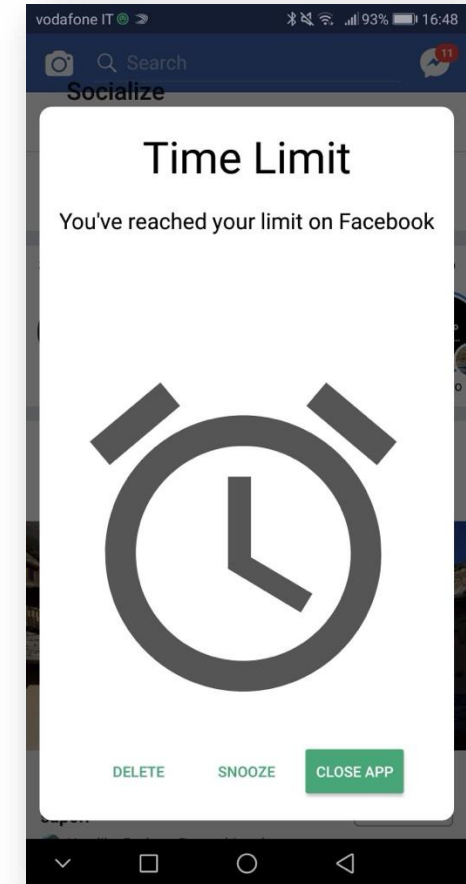


*Self-Control in Cyberspace: Applying Dual Systems Theory to a Review of Digital Self-Control Tools*

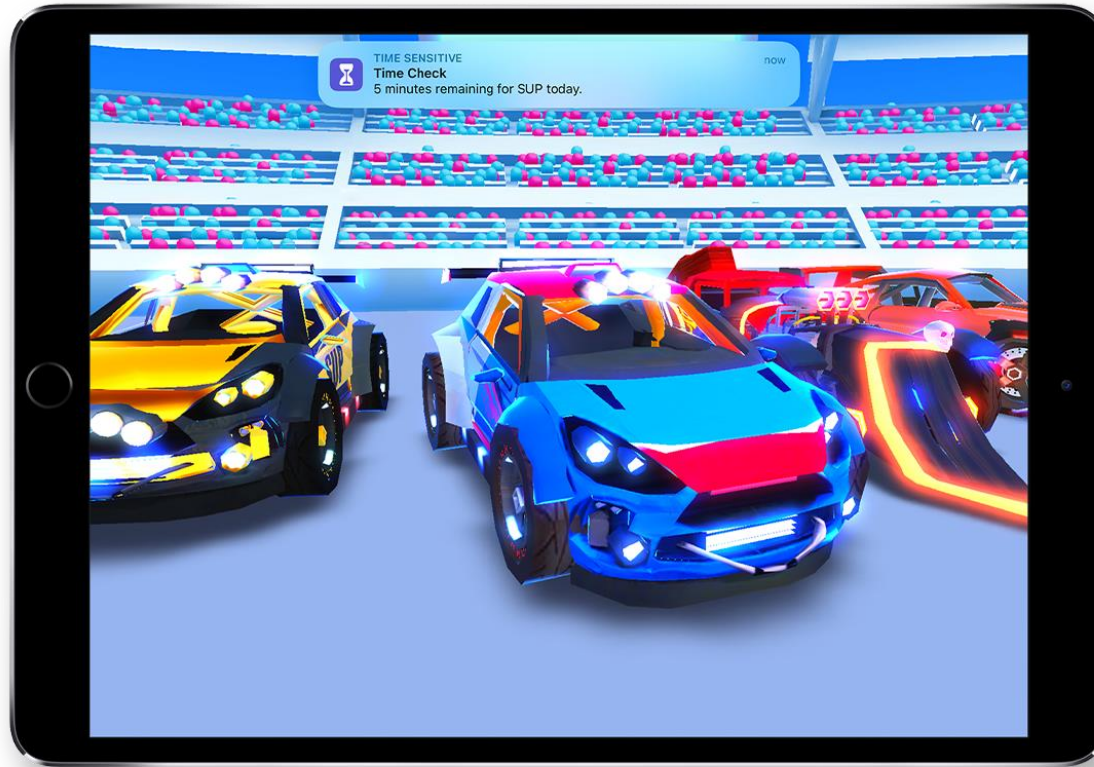
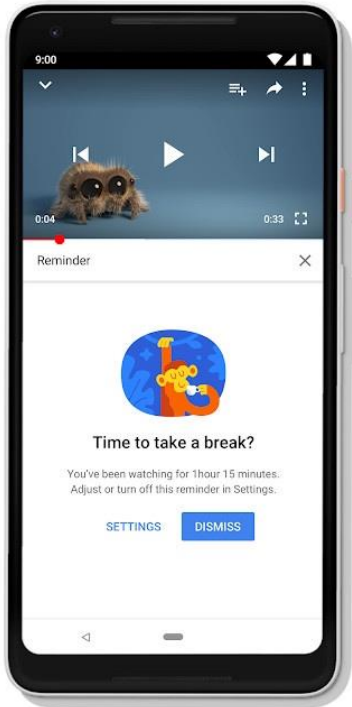
<https://arxiv.org/abs/1902.00157>

# Block/Removal (74% of tools)

- The most common type of feature is to **block or remove** distractions.
- Through block/removal, DSCTs might:
  - enable people to **block themselves** from using specific apps or websites or their smartphones altogether (more common);
  - **remove** specific distracting **features** within the services they use (less common).
- Examples:
  - usage timers and blockers;
  - whitelists and blacklists;
  - friction desing: introducing something (e.g., a time lag, an additional task) to make techonology usage more difficult.



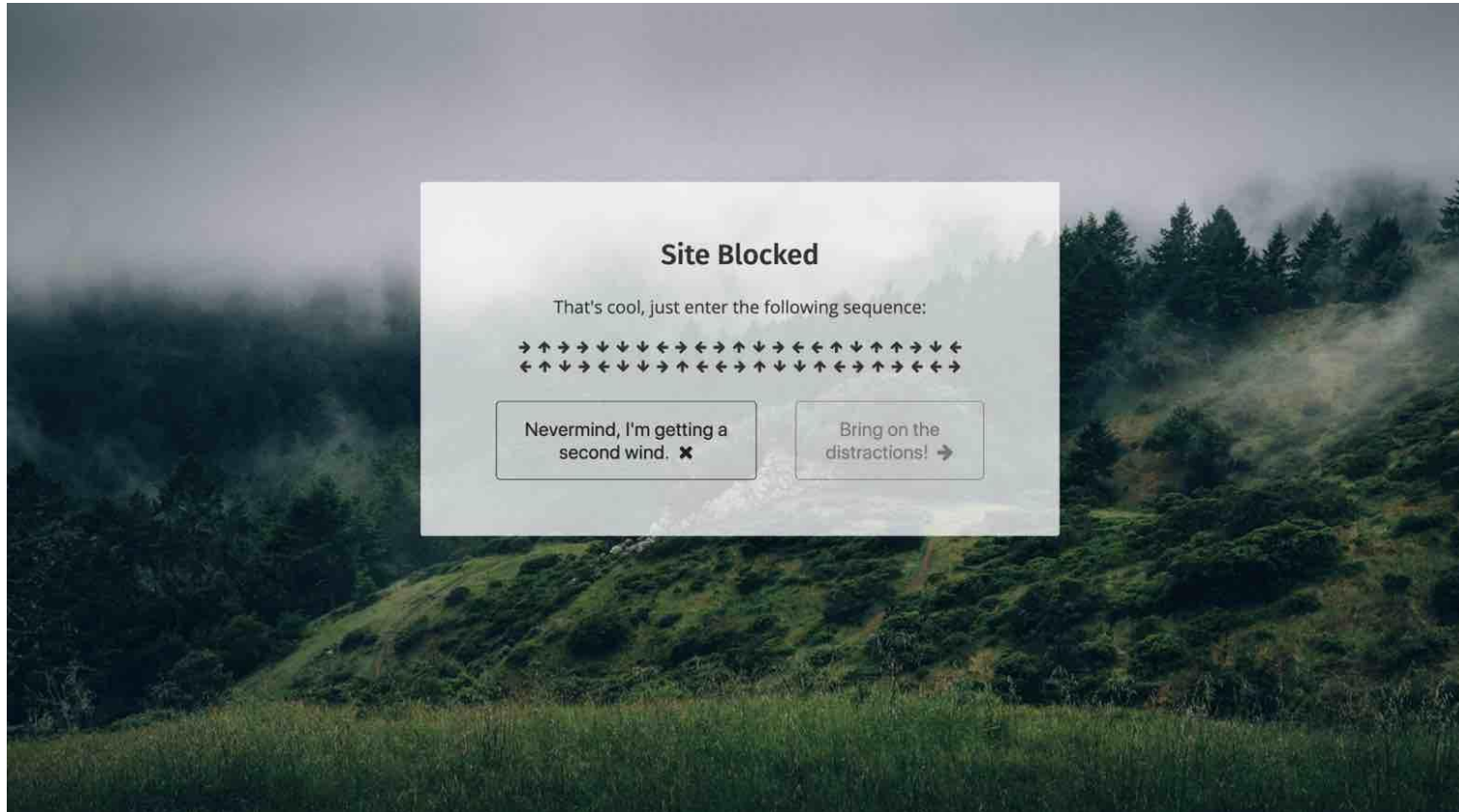
# Block/Removal



Google Digital Wellbeing and Apple Screen Time allow users to set up usage timers for specific apps. When a usage timer expires, there is a warning, e.g., a notification



# Block/Removal

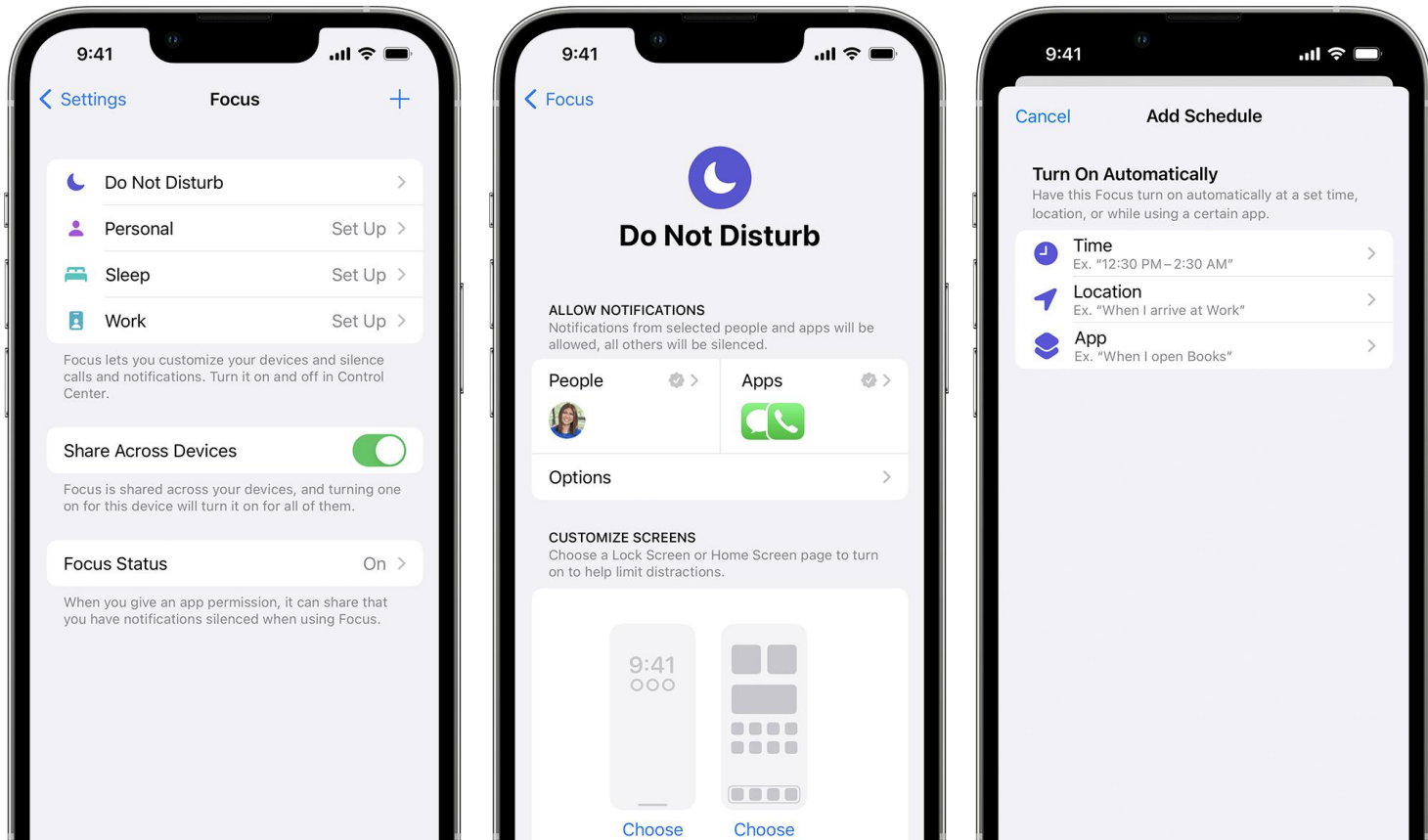


[Focusly](#) blocks access to websites on a blacklist, then helps people stick with their intention by requiring them to type in a series of 46 arrow keys in a specific order, before they can stop a blocking session.

# Block/Removal

iOS and Android smartphones have a **“focus mode”** feature to disable notifications.

On Pixel smartphones you can set up a **“bedtime mode”** that silences the phone and remove the screen's color.



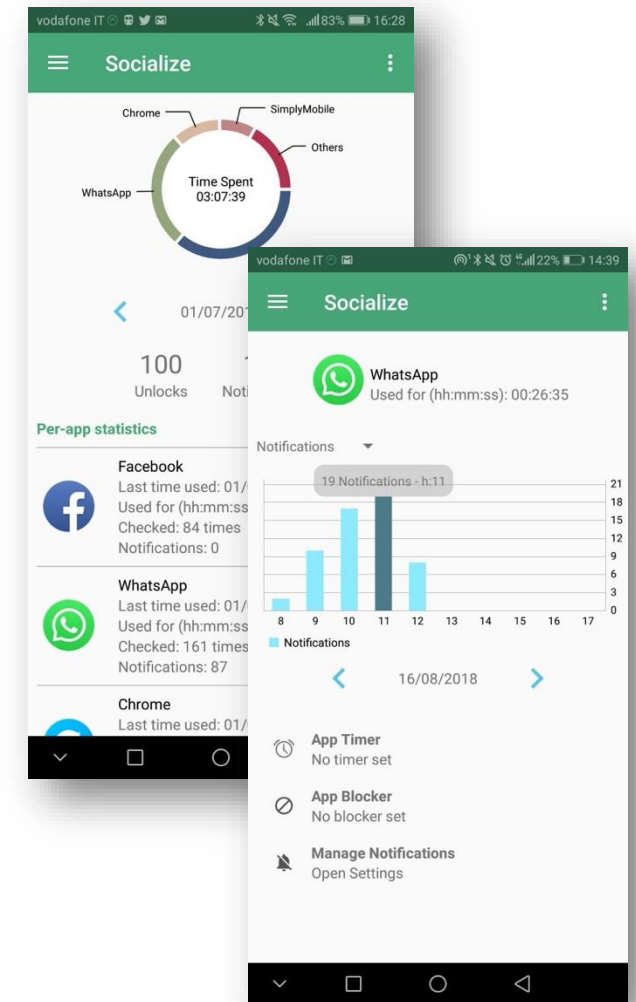
# Block/Removal



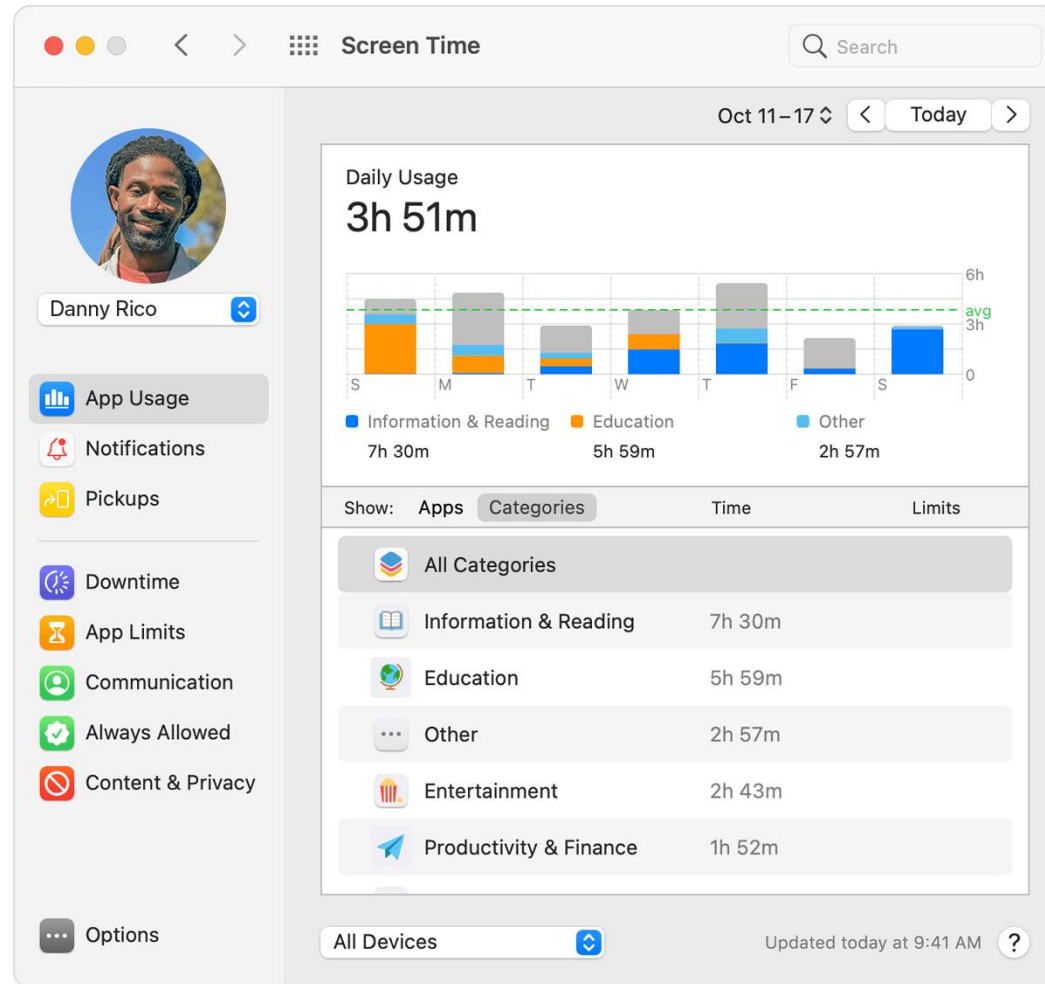
The [News Feed Eradicator](#) removes the newsfeed from Facebook and replaces it with a motivational quote. Similar extensions do things such as remove suggested videos on YouTube.

# Self Tracking (38% of tools)

- Several DSCTs record and visualise how people use their device, or display timers so that people can keep track of how long they've stayed on task.
- They make use of **productivity dashboards** with usage **statistics** and **charts**.
- They enable users to:
  - **"self-evaluate"** themselves by monitoring their own behavior with technology;
  - decide what countermeasures to take:
    - "I noticed I was using Instagram too much, let's set a timer to limit my use."

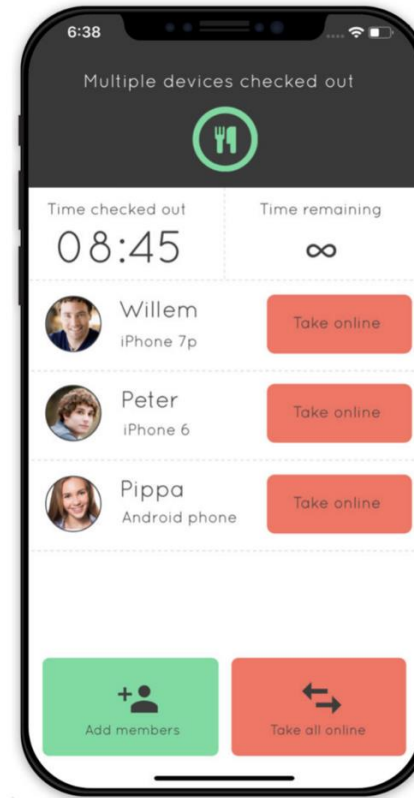
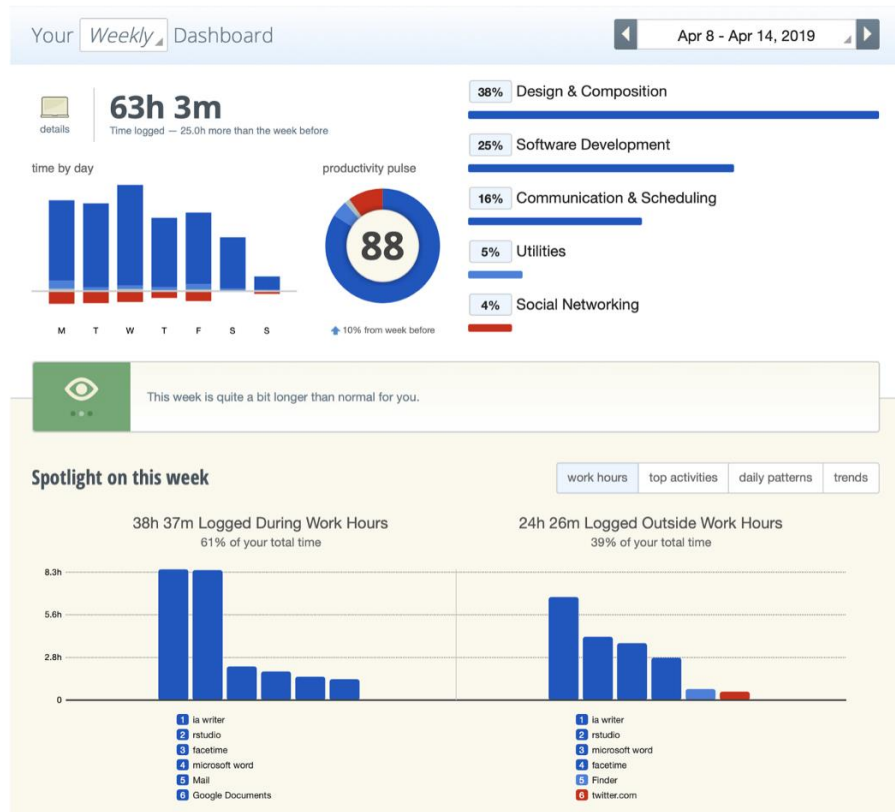


# Self Tracking



Google Digital Wellbeing and Apple Screen Time have their own dashboards for self tracking.

# Self Tracking

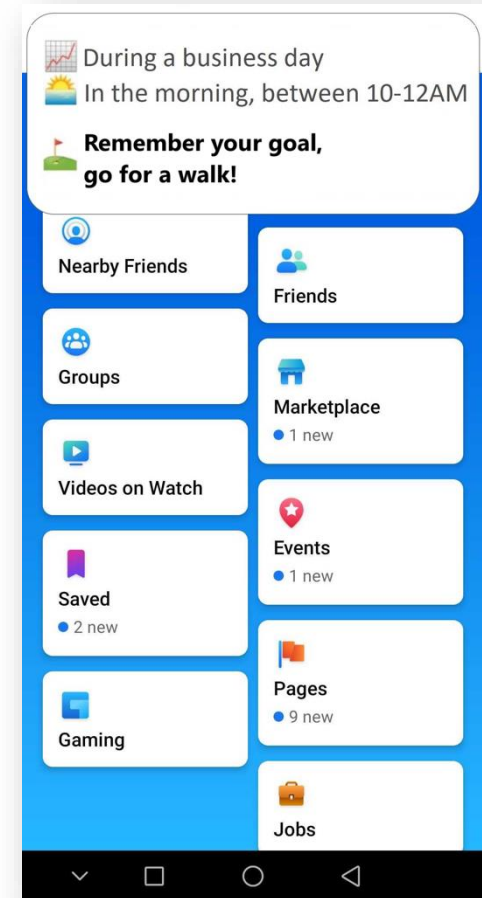


[RescueTime](#) (left) tracks and visualises time spent on laptops.

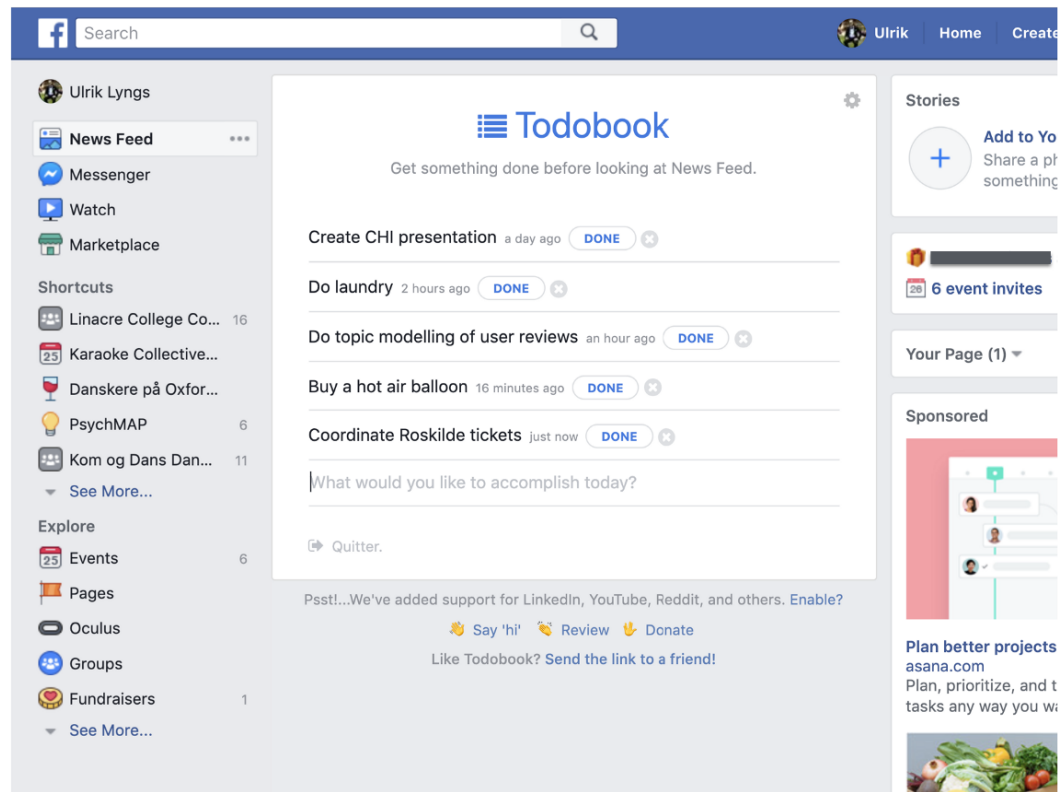
[Checkout of Your Phone](#) (right) tracks how long you've time you've managed not to use your smartphone.

# Goal Advancement (35% of tools)

- Some DSCTs include features for **nudging** people towards working on the **right tasks** when they actually use their devices.
- They may allow users to set **usage goals** and control their progress:
  - "I want to use Twitter at most half an hour a day."
- They may use notifications and reminders with motivational sentences to **encourage** users to meet their goal.



# Goal Advancement



Todobook (left) replaces Facebook's newsfeed with a to-do list

Time (right) is a to-do list which provides continual task reminders if the user leaves the app.

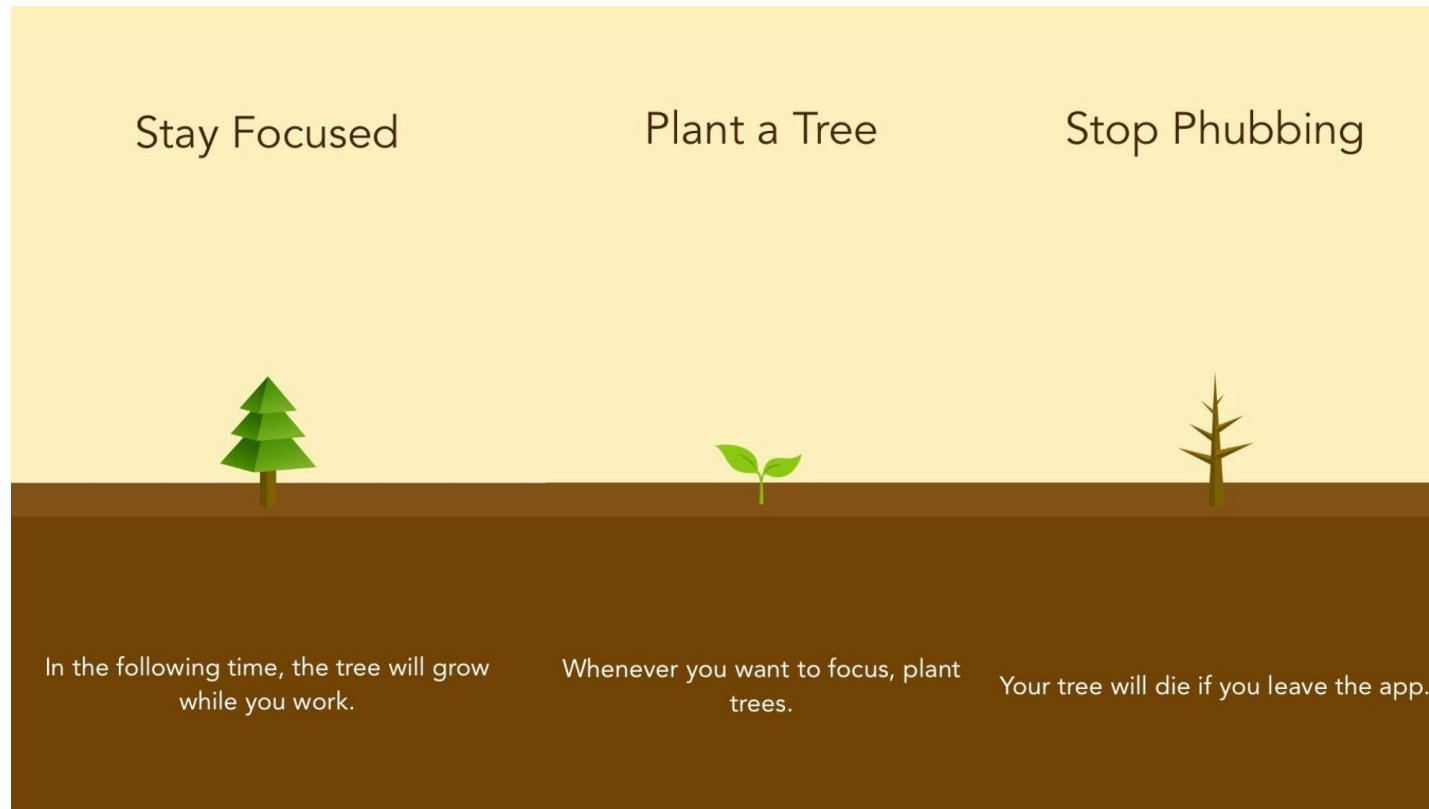


# Reward/Punishment (22% of tools)

- Some DSCTs include features that **reward** or **punish** people for how they use their devices.
- They may use **gamification**:
  - the use of a device, app, or website is tied to a score;
  - points are earned if self-imposed usage limits are met;
  - there may be the possibility to share scores and "challenge" other users

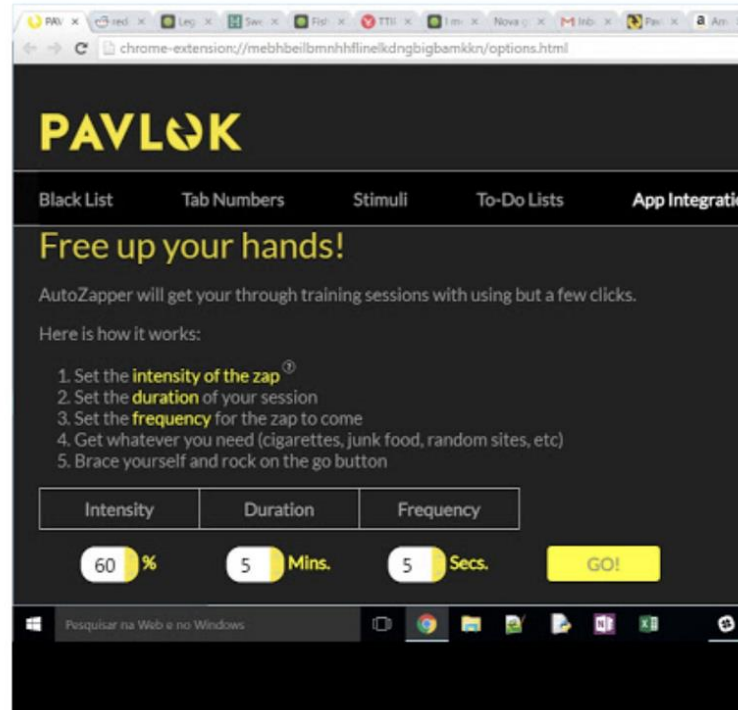
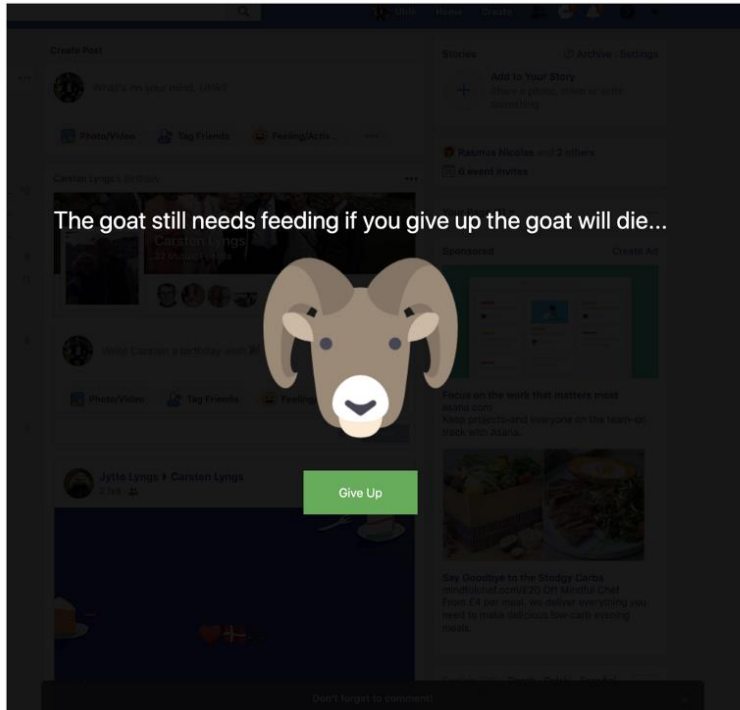


# Reward/Punishment



Forest grows virtual trees that may be killed if one's device is used inappropriately.

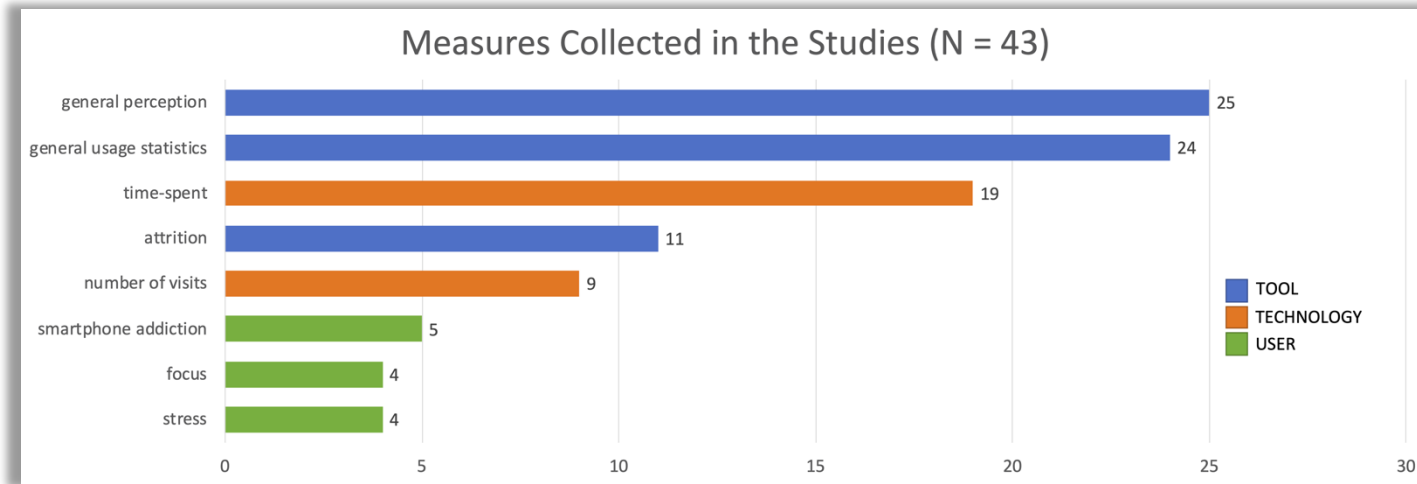
# Reward/Punishment



[Timewaste Timer](#) takes money out of your bank account if you spend too much time on Facebook.

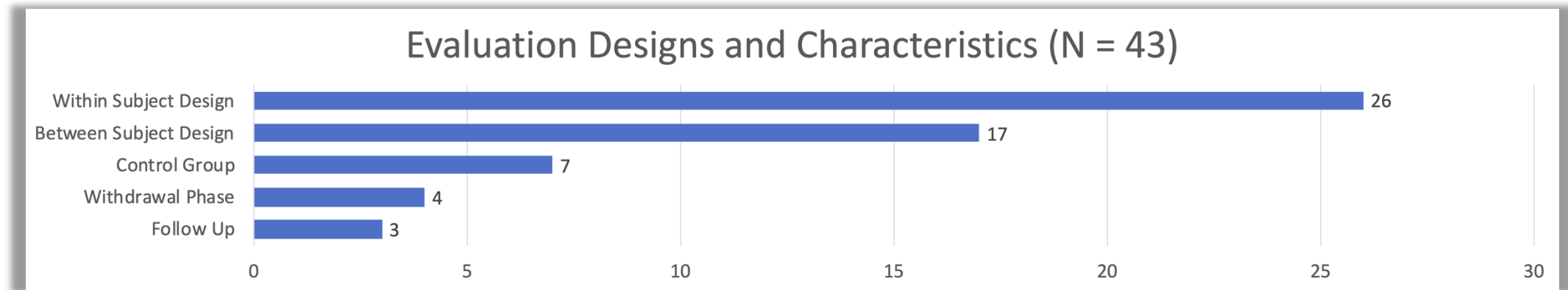
[PAVLOK](#) lets you automatically administer yourself electrical shocks via a bracelet if you try to access blacklisted websites.

# Evaluation of Contemporary DSCTs: Collected Metrics



Scale	Summary	Paper/Authors
Smartphone Addiction Scale (SAS) [120]	A self-diagnostic scale composed of 33 questions and 6 points from daily-life disturbance to tolerance to evaluate the smartphone addiction using self-reporting.	Kim et al. [105]; Pinder et al. [177]; Monge Roffarello et al. [159]; Ko et al. [114]; Ahn et al. [127];
Nasa-Task Load Index (NASA-TLX) [76]	A multidimensional assessment tool to evaluate perceived workload of a task or a system in terms of mental, physical, and temporal demand, performance, effort, and frustration.	Kim et al. [105]; Kim et al. [106]; Mark et al. [149]; Mark et al. [150]; Liu et al. [133];
Cognitive Absorption Scale [9]	A scale to measure five states associated with deep engagement with technology, i.e., temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity.	Kim et al. [105]; Mark et al. [149]; Mark et al. [150];
General Self-Efficacy Scale (GSE) [92]	A 10-item psychometric scale to assess optimistic self-beliefs and perceived self-efficacy to cope with daily activities and isolated stressful events.	Monge Roffarello et al. [159]; Ko et al. [114];

# Evaluation of Contemporary DSCTs: Study Design



A summary of the designs and the main characteristics of the 43 studies under analysis.

# Within Subject vs. Between Subject

- **Between-subjects** (or **between-groups**) study design: different people test each condition so that each person is only exposed to a single tool/interface/...
- **Within-subjects** (or **repeated-measures**) study design: the same person tests all the conditions (i.e., all the tools/interfaces/...).



NNGROUP.COM NN/g

<https://www.nngroup.com/articles/between-within-subjects/>

# Evaluation of Contemporary DSCTs: Study Design

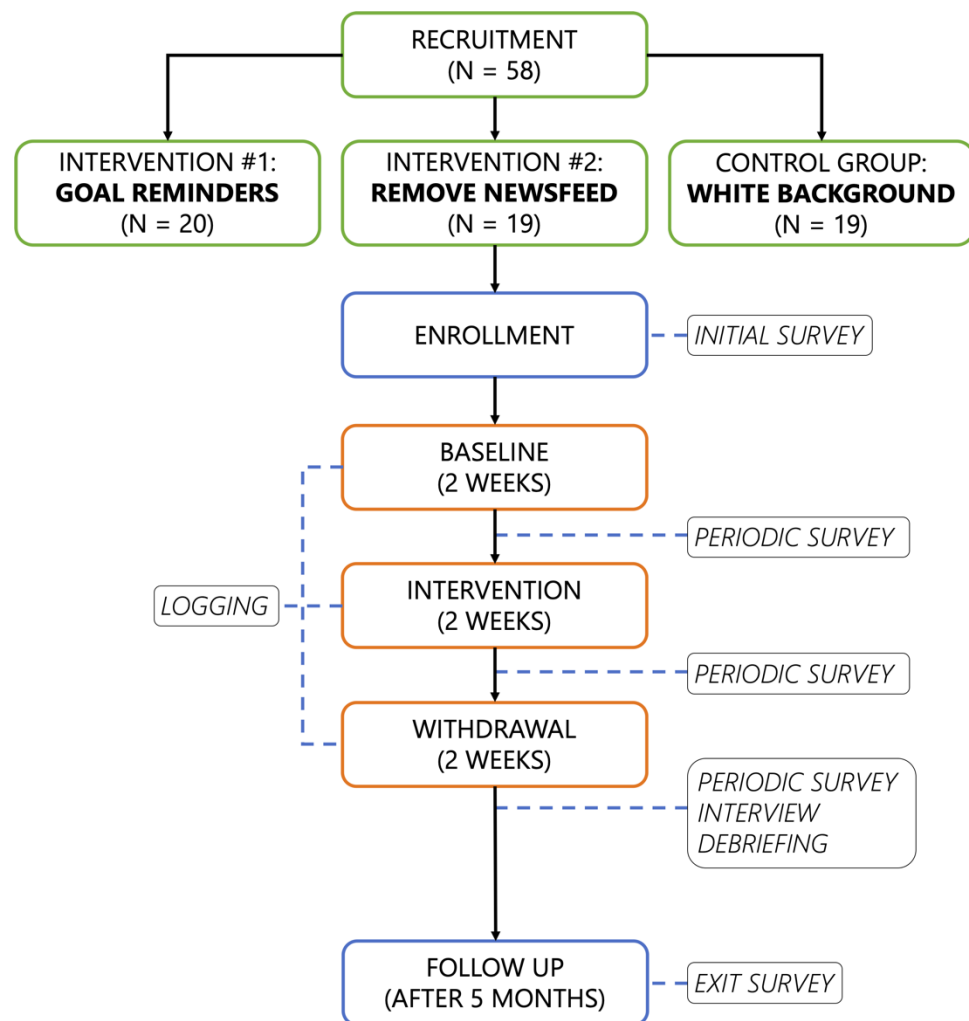
- The average number of participants involved in DSCTs experiments is 36
- The most common type of evaluation adopted by researchers is a 21-day controlled field study that follows a **within-subject** design:
  - the DSCT is deployed on participants' devices;
  - one initial week of **baseline**, i.e., 7 days during which the tool is “transparent” to the participants;
  - two weeks of **intervention**, i.e., 14 days during which participants can use all the functionality of the DSCT.

# Evaluation of Contemporary DSCTs: Problems

- Experiments are typically short (e.g., 21 days) and cannot assess the long-term effects of using a DSCT.
- Experiments rarely include a control group, with a prevalence of within-subject experiments.
- Experiments rarely include a withdrawal phase, i.e., a phase during which the DSCT is (progressively) removed:
  - we cannot know if the usage of a DSCT can promote the formation of new behaviors.
- Strong selection bias towards young university students, and, more generally, towards technology-savvy users that use devices like PCs and laptops every day, e.g., for studying or working.



# Evaluation of Contemporary DSCTs: an Example



Example of a good study design:

- it compares two randomly-selected groups of participants subjected to different Facebook interventions, i.e., *goal reminders* and *remove newsfeed*;
- a group of users receives a “placebo” intervention, i.e., turning the Facebook background from light grey to white;
- it uses surveys and interviews after each phase of the study, including a 5-month follow-up that partially addresses the need for long-term evaluations.

# Self-Monitoring and Short-Term Effectiveness

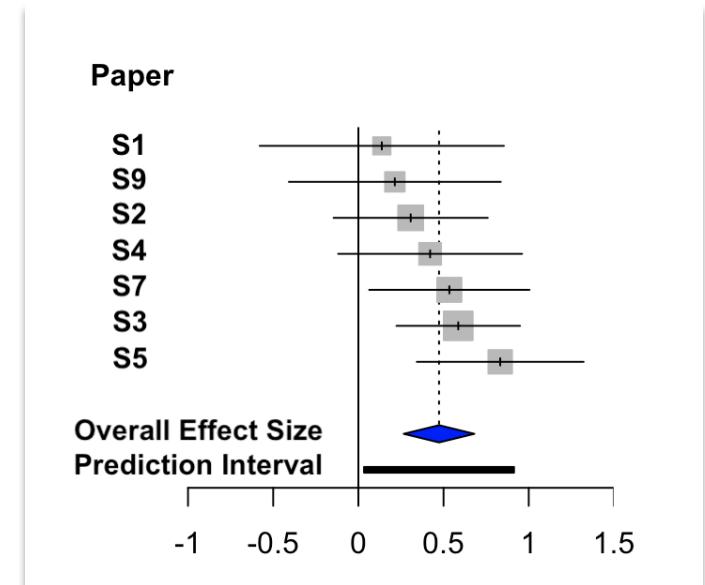
- The majority of contemporary DSCTs are based on self-tracking statistics block/removal strategies, i.e., they have **self-monitoring nature**.
- Users need to figure out for themselves:
  - what are the causes of their problems, e.g., by selecting which apps they would like to use less;
  - what is the most appropriate strategy to intervene on their unwanted behaviors, e.g., by selecting an appropriate time threshold for a usage timer.

# Self-Monitoring and Short-Term Effectiveness

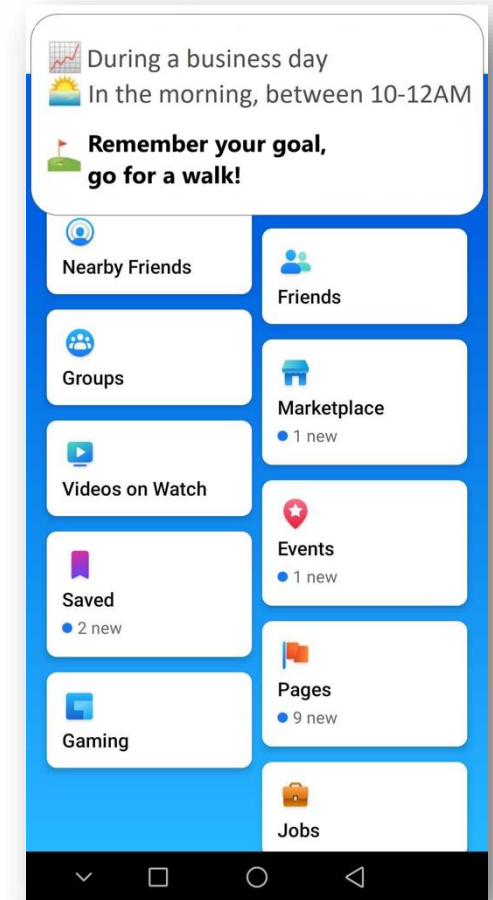
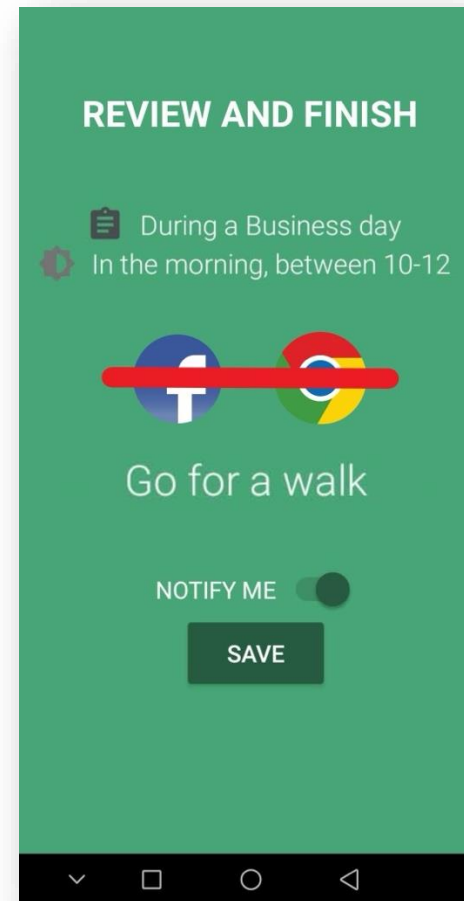
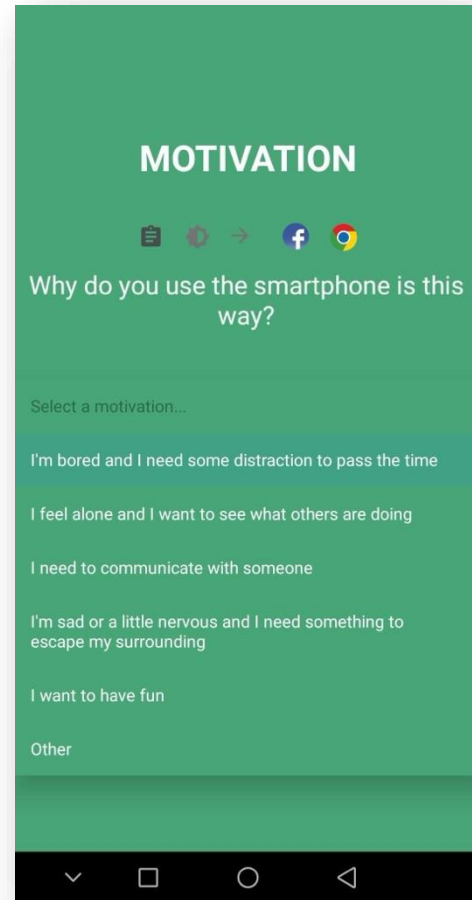
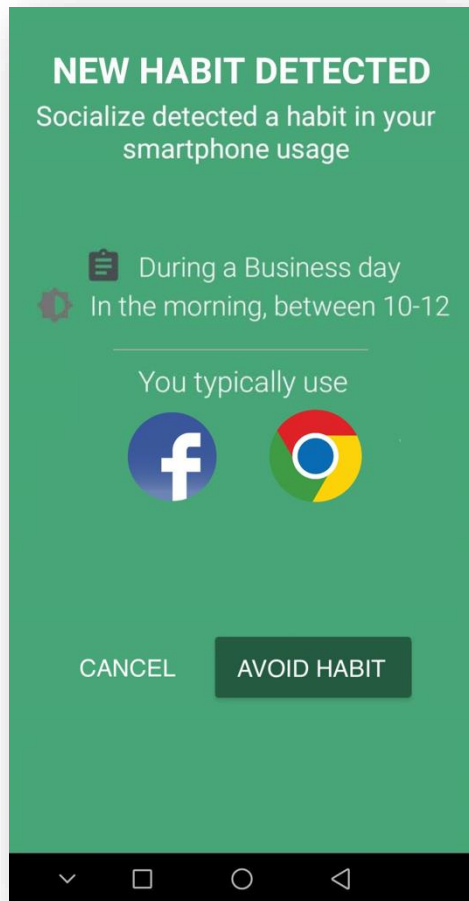
- Unfortunately, problems can be difficult to identify (and to admit), and DSCTs may not match users' expectations:
  - high attrition rate!
- As a result, DSCTs are not effective in the long term:
  - **basic contradiction:** technology to disincentivize the usage of other technologies;
  - **block** of negative behaviors rather than promoting alternative behaviors;
  - work in the **short term:** when users stop using (or use less) a DSCT, their behavior tends to return to previous levels;
  - lack of **proactivity:** users must remember to use the tool and "control" their behavior.

# Self-Monitoring and Short-Term Effectiveness

Paper	Hedges' g	Participants [#]	95% CI
Okeke et al. (S5) [114]	0.8325	35	[0.3430;1.3221; ]
Whittaker et al. (S3) [223]	0.5863	61	[0.2236;0.9489]
Kim et al. (S7) [105]	0.5340	36	[0.0634; 1.0046]
Ko et al. (S4) [112]	0.4211	27	[-0.1187; 0.9609]
Monge Roffarello et al. (S2) [159]	0.3071	38	[-0.1454;0.7595]
Lyngs et al. (S9) [145]	0.2140	20	[-0.4078; 0.8357 ]
Tseng et al. (S1) [177]	0.1375	15	[-0.5791;0.8542]
<b>Overall Effect Size</b>	0.4734	255	[0.2657; 0.6811]
<b>Prediction Interval</b>			[0.0332; 0.9136]



# Socialize: a Proactive DSCT



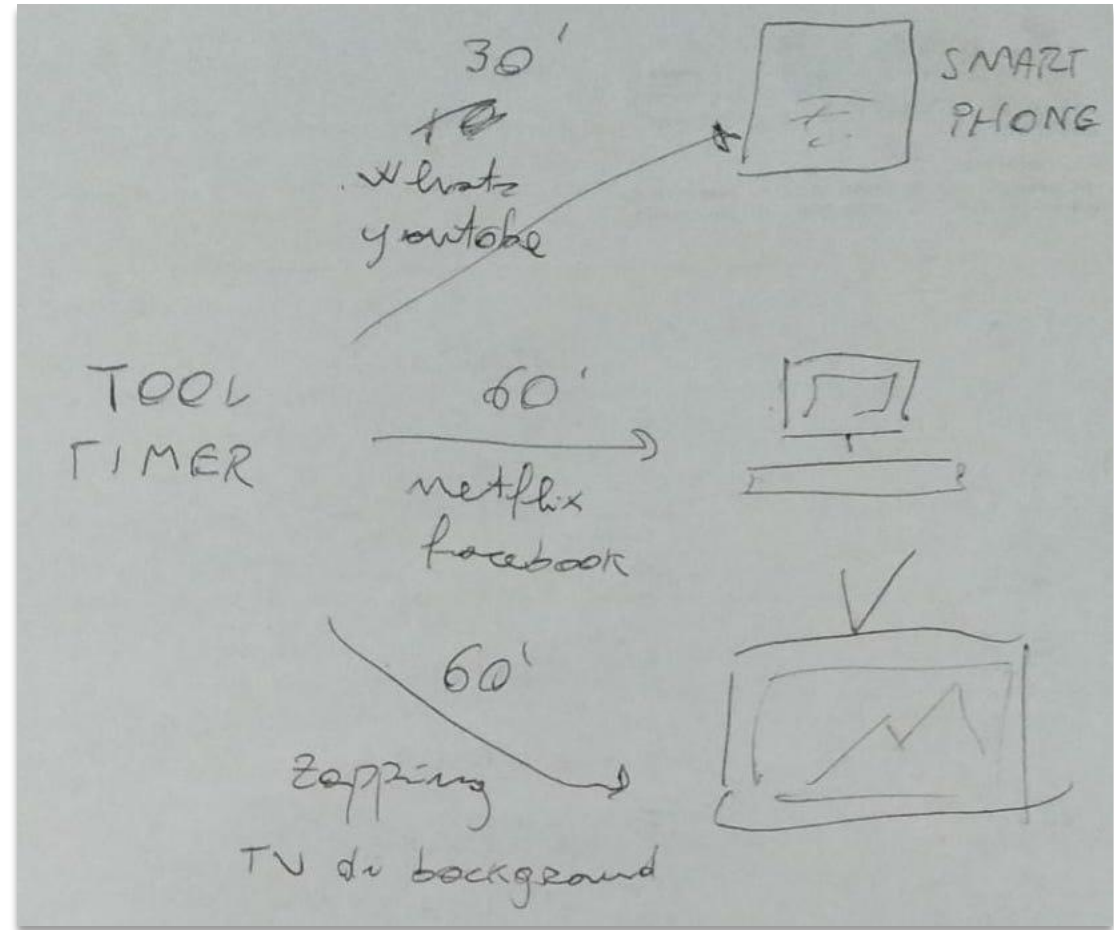
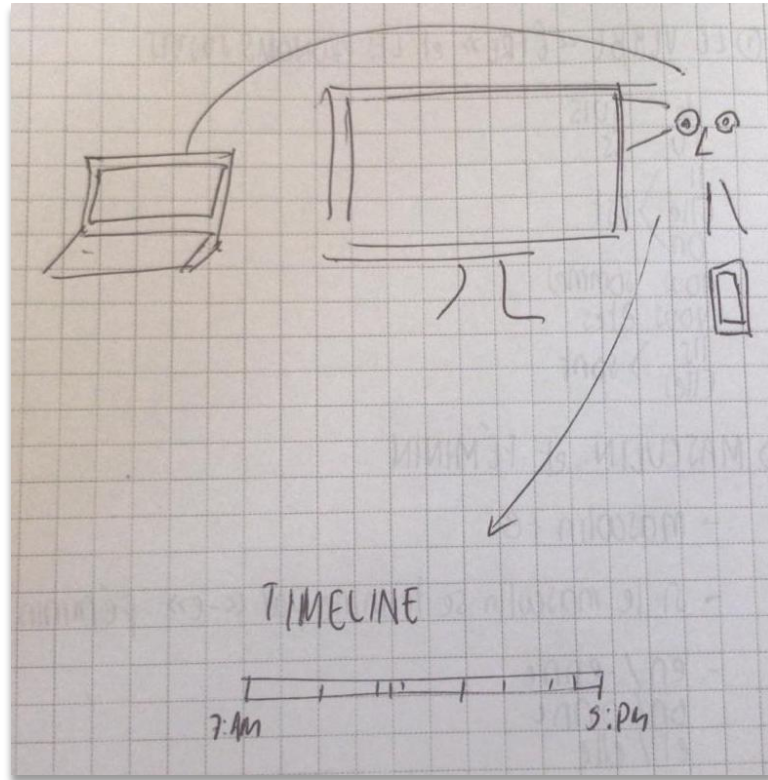
# Single Device DSCTs

- The majority of contemporary DSCTs only take into account the **device on which they are installed**:
  - a mobile app allows monitoring/acting on the apps installed on the smartphone;
  - A browser extension allows monitoring/acting on websites visited with that specific browser.
- Users' digital habits are **more complex**:
  - we own many devices, each with its own characteristics;
  - we often use more than one device at the same time;
  - what if I set a block for the Facebook website, but I can still access it via my smartphone?

# From Single Device to Multi Device DSCTs

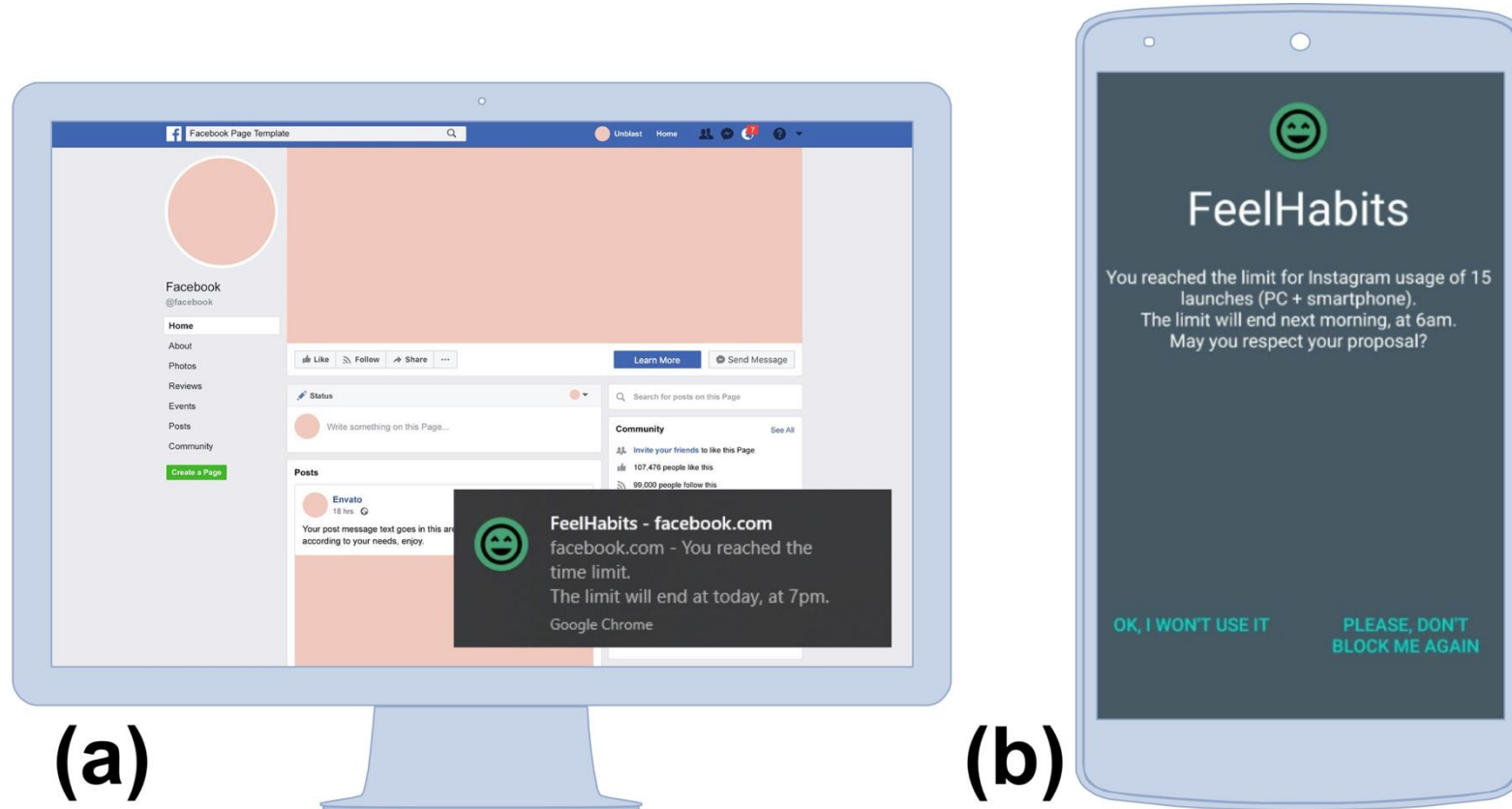
- *“With an Internet connection and a screen, any device can be a source of distraction.” (P7)*
- *“I regularly use my laptop to listen to music while I’m working on the desktop computer. Sometimes, this is distracting, especially when the music is on YouTube and there is a video in the background.” (P11)*
- *“When I am particularly stressed, it’s likely that I interrupt my work on the PC with the smartphone to relieve the tension.” (P20)*
- *Sometimes, when I’m on Facebook on my computer, I take my smartphone, I go on Instagram, and then I unconsciously open Facebook, too. So I have it opened on my smartphone and my PC at the same time. When this happens, I feel really addicted to social networks. (P12)*

# From Single Device to Multi Device DSCTs





# From Single Device to Multi Device DSCTs



# Acknowledgements

- Examples on contemporary DSCTs taken from <https://ulriklyngs.com/post/2019/04/30/367-tools-of-resistance-in-the-battle-for-online-attention/>
- Explanation of the Dual System Theory taken from [https://www.youtube.com/watch?v=sJf\\_F7faczU](https://www.youtube.com/watch?v=sJf_F7faczU)

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