

**Title:** Designing Technology That Promotes Users' Digital Wellbeing

**Dek:** Existing tools for digital self-control strongly rely on users' self-regulation strategies and capabilities. Recent work, however, highlights the importance of proactively assisting users in learning how to use technology, e.g., through customizable and adaptable interventions.

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**Article text:** In the Information Age, digital technology companies compete to spur users in spending more time on their platforms, and they often adopt recommendation algorithms to grab users' attention. Popular examples are the auto-play of the next video on YouTube or the personalized news feed that users experience on Facebook. While users derive several benefits from technology, including an increasing opportunity for social support, several news media articles and a growing number of research studies are currently criticizing this business model. There is, in particular, an established body of evidence, e.g., [1], suggesting that excessive and frequent use of technological sources like mobile devices, social media, and the Internet, in general, may create problems for people's mental health, as it may negatively interfere with daily activities and ongoing tasks such as studying, driving, and even sleeping. Even "tech insiders" and the same digital companies are now starting to recognize that excessive use of services like social networks and videogames may induce users to experience a lack of self-control and sense of agency. At the same time, more and more users feel conflicted about the amount of time they spend with digital technologies, and the feeling of losing control while passively scrolling social networks like Facebook and Instagram is increasingly common for everyone.

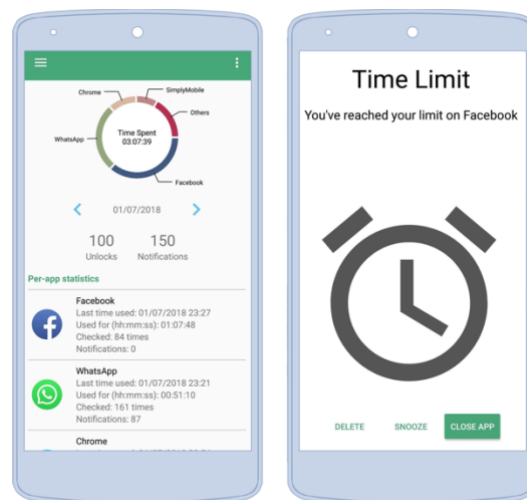
In response, a new kind of psychological wellbeing to be considered in contemporary society, the so-called *digital wellbeing*, has been defined with the aim of measuring "*the impact of digital technologies on what it means to live a life that is good for a human being in an information society* [2]." In the last few years, in particular, there has been a proliferation of Digital Self-Control Tools (DSCTs), i.e., behavior change technologies that allow users to self-monitor their technology use through interventions like timers and lock-out mechanisms. These tools mainly take the form of mobile applications and web-browser extensions, and they are common both in academia and in the market. Researchers, in particular, are continuously investigating novel interventions or variations of existing strategies. HabitLab [3], for example, is a Google Chrome extension that aims at helping people achieve their goals online, e.g., waste less time on Facebook. In parallel, commercial DSCTs have gathered millions of users, and even tech giants like Google and Apple have introduced tools for monitoring, understanding,

and limiting technology use in their operating systems (see, in particular, the Digital Wellbeing initiative by Google [4]).

### The Current Landscape of Digital Self-Control Tools

Two recent reviews [1, 5] of contemporary tools for digital self-control allow us to understand how these tools work, and which strategies they currently employ.

Lyngs et al. [5] analyzed a large set of browser extensions and mobile apps designed as DSCTs and downloadable from the Apple and Google app stores. The authors defined contemporary DSCTs as “*self-binding applications that constrain future usage of devices or specific applications*”. In particular, they classified the strategies adopted by these tools into 4 overarching categories of interventions: block/removal, self-tracking, goal advancement, and reward/punishment. The most common categories are the block/removal strategies, e.g., automatic blocks on the usage of a given app, and the self-tracking mechanisms, e.g., visualizing usage statistics. The same authors also identified different underexplored cognitive mechanisms that could improve the effectiveness of DSCTs, from scaffolding new desirable habits to encouraging users in suppressing unwanted behaviors.



*Figure 1 In our work on digital wellbeing with smartphones, we tested the efficacy of the most common interventions that are nowadays implemented by DSCTs, e.g., visualizing usage statistics and setting up usage timers for specific apps.*

We found similar results in our work on digital wellbeing and smartphones [6]. We discovered that mobile DSCTs are mainly focused on supporting self-monitoring, i.e., tracking user's behavior and providing feedback. In particular, they empower users in defining very simple interventions like usage timers. Through our digital wellbeing app (Figure 1), we also tested the efficacy of the most common interventions that are nowadays implemented in mobile DSCTs, and we found that self-monitoring interventions are only effective in the short-term, when users are actively using the tool.

What is clear from the aforementioned results is that existing tools for digital self-control strongly rely on users' self-regulation strategies and capabilities: by using these tools, users need to understand what the causes of their problems are, e.g., by selecting which apps they would like to minimize, and, at the same time, they must decide what is an appropriate strategy to intervene their unwanted behaviors, e.g., by selecting a proper time threshold for a usage timer. Such an approach depends on the individual's motivation to (continuously) monitor their behavior, and it is not effective for different reasons. On one hand, users often hold unreasonable expectations about certain interventions, and the settings of their DSCTs may not match their expectations, thus increasing the risk of the abandonment of the tool [3]. On the other hand, discontinued use of these self-monitoring strategies makes a changed behavior slowly return to its pre-intervention level.

### **From Timers and Lockout Mechanisms to Practice and Adaptable Interventions**

Stemming from the current landscape of tools for digital self-control, a question emerges: how can we move from simple, short-term strategies like timers and lockout mechanisms to designing DSCTs that effectively support people in regaining control over their digital device use in the long term?

In our recent research activities [1, 7], we started to address this question from different perspectives, by exploring, directly with users, novel approaches and methodologies. To design technology that promotes users' digital wellbeing, we highlight the importance of different aspects, ranging from adaptable interventions to solutions that go beyond tools.

*Data Integration and Cross-Device Interventions.* Contemporary DSCTs often target a single technological source at a time, by using screen time as the main indication of device use. Based on the study results on digital wellbeing in multi-device environments [1], we argue that such an approach may not be fully aligned with people's needs. Indeed, we are nowadays surrounded by a variety of different devices, and smartphones and PCs are not the only source of distractions and digital wellbeing problems. Novel DSCTs should therefore be able to collect and make sense of data coming from different technological sources, and they should allow their users to define cross-device interventions specifically targeted to the characteristics (and the kind of usages) of different devices: the same tool, for instance, may act as a notification filter on the smartphone, while limiting the usage of social networks on the laptop and of websites like Netflix or YouTube on the Smart TV.

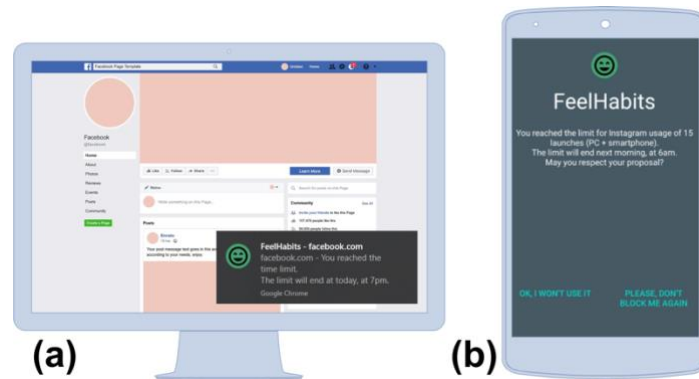
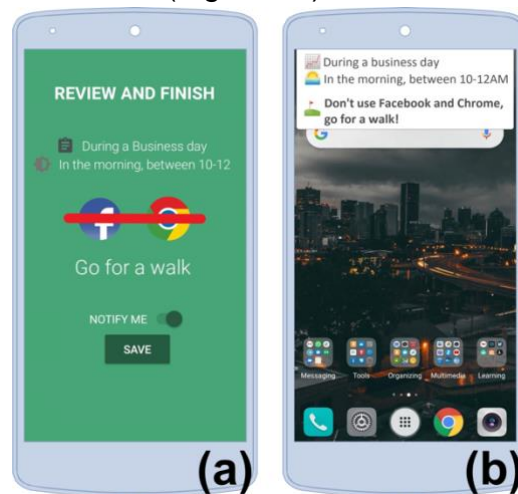


Figure 2 FeelHabit is a novel DSCT that allows users to set up context-based, multi-device interventions, i.e., temporal and/or launch limits for the alternate or simultaneous usage of the smartphone and the PC.

Figure 2 exemplifies FeelHabit [7], our first attempt to develop and evaluate a multi-device DSCT. The tool allows users to set up novel interventions that can adapt to the PC and the smartphone in different contextual situations. These interventions can be defined for the overall multi-device usage of the user, or they can be restricted to the usage of specific services available both as a website and as a mobile app. Furthermore, these interventions can be linked to specific temporal contexts, e.g., the time of the day, and users can use different levels of severity when they are not respected, from simple notifications alerting the user of a reached limit (Figure 2a) on a given device to app-blockers (Figure 2b).

*Proactive and Adaptable Interventions.* Besides the importance of considering different devices, we also think that the way people use technology is strictly linked to their current contextual situation and usage intention: from the point of view of the user's digital wellbeing, passively scrolling Facebook's news feed before going to sleep is probably more "dangerous" than chatting with a friend on the same platform. We therefore call researchers to investigate more "intelligent" DSCTs that are able to analyze and learn from people's usage patterns, e.g., through machine learning algorithms. This would enable future DSCTs to provide proactive support to define tailored interventions, even in cases where users do not recognize the problems that negatively influence their digital wellbeing, e.g., when self-perception diverges from actual use of devices. Figure 2 shows an example of one of our recent efforts in this direction. Socialize [8] is a digital wellbeing mobile app that assists users to avoid meaningless smartphone habits, i.e., recurrent usage patterns performed under stable contextual cues. It employs a machine learning methodology to detect and proactively notify the user situations in which the smartphone is used in a habitual way. The user, then, has the possibility to reflect on the motivations that drive their habitual behavior, and, if they consider it meaningless, they can decide to define an alternative intention, e.g., going for a walk (Figure 3a). Every time the identified meaningless habit happens again, Socialize encourages the user to avoid the behavior, by recalling the alternative

intention specified by the same user (Figure 3b).



*Figure 3 Socialize is a mobile DSC that proactively assists users to avoid smartphone habits they consider meaningless. It proactively alerts users when the smartphone is used in a habitual way, letting users define alternative intentions, e.g., going for a walk instead of using Facebook and Google Chrome in the morning.*

Alongside assisting users in finding the causes of their digital wellbeing problems, e.g., by confronting them with their habitual usage patterns, we also envision DSCs that are able to dynamically adapt themselves in real-time by considering the involved devices, usage patterns, and even the users themselves with their physical capabilities and technology competences. For example, the DSCs can progressively increase or decrease the intervention intensity, or they can change “on-the-fly” the adopted strategy. Recently, we have started to explore the impact of introducing small delays that vary over time to the websites that users consider problematic for their own digital wellbeing [9]. Conscious interventions, such as those that show notifications or block sites, may be effective, but may also cause negative feelings in users, such as helplessness and annoyance. Our goal is to explore interventions that are continuously variable and that may be imperceptible to the user. On one hand, we believe that this kind of intervention would allow researchers to balance effectiveness and low attrition, e.g., by scaling-down strategies that seem to be at a high risk of abandonment. On the other hand, adaptable and varying interventions may allow users to become less dependent on the usage of the DSC. The tool, in particular, could progressively reduce (or increment) its degree of support based on the user’s achievements.

*Learning and Going Beyond Tools.* Another aspect that characterizes contemporary DSCs is that they mainly focus on breaking existing usage behaviors. Although stopping users from compulsively checking social networks is certainly important, previous work suggests that focusing on scaffolding new, desirable habits that may override unwanted behaviors is an alternative approach that is promising (and probably more efficient in the long term) [5, 6]. In our study on multi-device digital wellbeing [6],

we also found that our participants were aware of the importance of *learning* how to properly use technology, mainly because interventions like timers and lockout mechanisms can always be bypassed in some ways, e.g., by using another device. Instead of blocking a “bad” behavior, we see promise in novel DSCTs that act as a learning support for their users, e.g., by suggesting desirable alternatives and/or by helping users to reflect on the negative aspects of their technology use. We partially addressed this challenge with our Socialize tool [8], by demonstrating that the usage of alternative intentions to override meaningless smartphone habits is a promising approach. Finally, while DSCT is certainly an important tool to improve users’ relationship with their devices and online services, we are also aware that understanding how to use technology and achieving digital wellbeing is often a path of personal growth. Consequently, we also support the need of pursuing digital wellbeing outside DSCTs. As reported in our recent interviews [1], educating children about digital wellbeing, e.g., by highlighting both positive and negative sides of using (and overusing) technology, may contribute to the digital wellbeing of future generations, and may be more effective than any lock-out mechanism.

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#### **Images:**

- Figure 1: In our work on digital wellbeing with smartphones, we tested the efficacy of the most common interventions that are nowadays implemented by DSCTs, e.g., visualizing usage statistics and setting up usage timers for specific apps.
- Figure 2: FeelHabits is a novel DSCT that allows users to set up context-based, multi-device interventions, i.e., temporal and/or launch limits for the alternate or simultaneous usage of the smartphone and the PC.
- Figure 3: Socialize is a mobile DSCT that proactively assists users to avoid smartphone habits they consider meaningless. It proactively alerts users when the smartphone is used in a habitual way, letting users define alternative intentions, e.g., going for a walk instead of using Facebook and Google Chrome in the morning.