Nudging Users or Redesigning Interfaces? Evaluating Novel Strategies for Digital Wellbeing Through inControl

Nudging Users or Redesigning Interfaces? Evaluating Novel Strategies for Digital Wellbeing Through *inControl*

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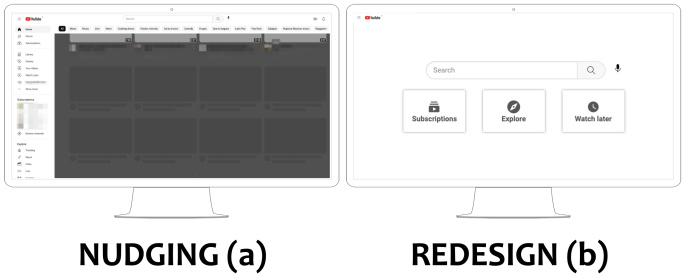

Fig. 1. *inControl* is a browser extension for digital self-control of the YouTube and Facebook websites. Through a *nudging strategy*, the extension progressively darkens the background as long as the user continues to scroll (Figure 1 (a) shows an example from YouTube). Through a *redesign strategy*, the extension redesigns the interface hiding guilty pleasure recommendations and proposing minimalistic interfaces to promote intentional use (Figure 1 (b) shows the redesigned search-first interface of YouTube).

As web designers may deliberately adopt design patterns to hook users' attention, researchers and practitioners have innovated several tools for supporting users' digital self-control, hoping to help users self-regulate technology use – especially social networks and video streaming platforms – and achieve digital wellbeing. Unfortunately, these tools often restrict usage, e.g., through self-imposed timers and blockers, limiting interaction possibilities. This paper describes the design, development, and evaluation of two alternative strategies for digital self-control targeting the Facebook and YouTube websites. Specifically, we implemented a Chrome extension that a) highlights when the user is scrolling infinitely by progressively darkening the background (*nudging strategy*), and b) redesigns the homepages isolating guilty pleasure recommendations and proposing a minimalistic interface (*redesign strategy*). We compared the two strategies in a three-week field study with 14 participants, finding that both strategies promoted intentional use and allowed participants to decrease time spent and passive scrolling. In particular, participants liked the nudging strategy more as it supported conscious use without changing the overall user experience. We conclude with design implications for moving from traditional digital self-control tools to diverse approaches that may better support digital wellbeing in the long term.

CCS Concepts: • **Human-centered computing → Social media**; **Empirical studies in HCI**; **HCI theory, concepts and models**.

Additional Key Words and Phrases: technology overuse, attention-capture patterns, digital wellbeing, nudging, commitment interfaces

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1 INTRODUCTION

In recent years, technology has become an integral part of our daily lives, with several digital services – from social media to video streaming platforms – that help individuals and society for various purposes, from connecting with others to entertainment and educational activities. Nevertheless, there is growing concern about the negative impact these services can have on our digital wellbeing, i.e., a novel psychological construct that defines the challenges of having a good relationship with technology in today's infosphere [10]. In particular, several studies found that users are generally not able to resist temptations of media use [16], thus often falling victim to compulsive behaviors like mindlessly scrolling social media newsfeeds [41] or watching more videos or movies than intended [30, 44].

While users often associate digital wellbeing problems with a lack of self-control [27], a growing body of evidence suggests that such problems do not happen by accident but are deliberately pursued by tech companies [30, 34, 37]. Specifically, a new class of "dark patterns," the so-called Attention-Capture Damaging Patterns (ACDPs) [37], is nowadays used to describe malicious patterns like the possibility of scrolling an interface infinitely or the massive usage of "guilty pleasure" recommendations in social media and video streaming platforms. Such patterns – exploited to maximize users' time spent and interactions and increase advertisements revenue – undermine people's ability to spend time according to their value [29], making them experience a later feeling of regret [37]. Nevertheless, despite this evidence, researchers and practitioners have traditionally adopted generic approaches to support people's digital self-control: Digital Self-Control Tools (DSCTs) [32, 36], in particular, mainly focus on *blocking* the overall interaction with a distractive app or website, e.g., empowering users to define self-imposed usage timers, often leading to high attrition rates [24]. In this paper, we explore the adoption of two alternative and novel strategies that support people's digital self-control by targeting specific attention-capture patterns without blocking the interaction of the user with the digital service:

- a *nudging strategy*, through which we highlight the presence of ACDPs in the interface to increase users' awareness and trigger conscious decisions and more meaningful usage sessions;
- a *redesign strategy*, through which the interface is redesigned to mitigate the disruptive effects of ACDPs and promote intentional use.

While similar strategies are starting to emerge in the digital wellbeing research area [29, 38], it still needs to be determined how they may impact the use of different platforms and, in particular, which would be preferred by users. To answer these questions, we designed and developed *inControl,* a Chrome extension targeting the Facebook and YouTube websites. We selected the two websites to consider platforms with different purposes and usages (a traditional social network and a video-streaming platform), and because both websites have been traditionally associated with digital wellbeing problems and included in digital wellbeing research [29, 30, 33]. Each strategy implemented by *inControl* targets a specific ACDP adopted by the two websites. The extension implements the *nudging strategy* by highlighting when the user is trapped by the Infinite Scroll mechanism [34, 37]: as long as the user scrolls Facebook's newsfeed or the recommended videos on YouTube's homepage, the extension progressively darkens the background (see Figure 1 (a) for an example on YouTube). The *redesign strategy*, instead, targets the Guilty-Pleasure Recommendations provided by the two websites, e.g., the posts that Facebook algorithmically shuffles in its newsfeed or the video recommendations on YouTube: these recommendations are isolated in separate pages, in order to restructure the homepages of the two websites as minimalistic interfaces that promote the main intentional tasks (e.g., searching for a video or posting something, see Figure 1 (b) for an example on YouTube).

We compared the two strategies implemented by *inControl* in a three-week field study with 14 participants, during which each participant experienced the nudging and redesign versions of Facebook and YouTube after a week of control. Results show that both strategies led to an overall reduction in the time spent by users on the target websites in most cases. For example, highlighting infinite scroll (nudging strategy) resulted in an overall time reduction of 34% on YouTube and 57% on Facebook. Similarly, having a mimimalistic homepage (redesign strategy) resulted in a time-spent reduction of 64% on Facebook. Interestingly, the same strategy led users to slightly increase the time spent on YouTube (5%). Furthermore, while both strategies made participants scroll less, we observed an increased number of clicks, hopefully indicating a more intentional and active usage of the two websites. Data from an exit survey also revealed that users particularly appreciated the nudging strategy as it allowed for more informed usage sessions without limiting or changing the website's functionality. On the other hand, some participants said that the redesign strategy impacted their habitual content consumption on the two websites, although they acknowledged that the minimalistic interfaces reduced distractions.

Overall, this paper contributes (1) the design and implementation of two alternative strategies to contemporary DSCTs, i.e., nudging and redesign; (2) the evaluation and comparison of the two strategies demonstrating that both solutions may promote intentional use and impact how users interact with different websites in the wild; and (3) implications for moving from traditional digital self-control tools to alternative strategies that may better support digital wellbeing in the long term.

2 RELATED WORK

2.1 Attention-Capture Damaging Patterns and Digital Wellbeing

In today's attention-based economy [15], technology companies use design and system functionality to take advantage of users' psychological vulnerabilities to capture their attention and increase the amount of time they spend on digital platforms [30, 37], particularly on social media and video-streaming platforms [34]. These mechanisms, called Attention-Capture Damaging Patterns (ACDPs) [37], are similar to the traditional concept of "dark patterns [20]" in that they manipulate users into performing actions that are not in their best interests. ACDPs can take many forms. Generally speaking, Monge Roffarello et al. [37] found ACDPs that may *deceive* users, e.g., by disguising a sponsored content as a regular post from a friend, and other ACDPs that may *seduce* users with short term satisfaction, e.g., the Infinite Scroll or the Pull-to-refresh patterns, which keep users engaged in passive consumption. These and other seductive ACDPs, such as the Guilty-Pleasure Recommendations and Autoplay features of social media platforms, can cause users to sacrifice their sense of control and agency over their attention [29, 30], inducing "zone states [7]" during which users consume content almost unconsciously. In parallel, it is nowadays clear that excessive usage of digital services has the potential to negatively impact people's digital wellbeing from several perspectives, from undermining users' sense of agency and control [30, 43] to creating problems for social interactions [28]. An "addiction debate [27]" is also starting to emerge, with several researchers now suggesting treating excessive use of technology like smartphones and social media as a real addiction [4, 25]. Such concerns are echoed by several media articles [1, 12, 21], and this growing interest in the digital wellbeing topic makes users often experience a feeling of regret for not being able to control technology use [13].

2.2 Digital Self-Control Tools, Nudging Strategies, and Commitment Interfaces

Concerns around technology overuse and addiction have interested different research communities for many years. So far, HCI researchers and practitioners have dedicated their efforts to supporting people's digital wellbeing and self-control by innovating what Lyngs et al. [32] called "Digital Self-Control Tools (DSCTs)." These tools are external mobile apps or browser extensions that assist users in self-regulating other distractive apps or websites, mainly adopting self-monitoring techniques [36]: through dedicated productivity dashboards, end users can monitor their time spent on their devices and define interventions like usage timers and blockers, e.g., to use Instagram no more than 30 minutes per day. Although DSCTs are becoming popular even as commercial applications – e.g., see Forest [39], which has gathered millions of users [32] – their main limitation is that their interventions focus on *blocking* the overall interaction with a given app or website, without targeting the internal attention-capture mechanisms adopted by the same service [30]. Indiscriminately restricting use, however, has the risk of limiting needed interaction possibilities without solving the problems at their very root [29]. It is therefore not surprising that contemporary DSCTs have been found to be ineffective in the long term [35], mainly because they suffer from a high attrition rate [24].

Given the above issues, some alternative strategies to traditional DSCTs are starting to emerge, with the aim of having contextualized solutions that can target digital wellbeing threats without placing too much burden and restrictions on end users. For example, Purohit et al. [38] suggested using the concept of *digital nudges* to make social media use less addictive. Nudges have been defined by Thaler and Sunstein [40] as changes in the architecture of a system that can be used to steer users' behavior without forbidding or restricting interaction possibilities. A nudge that makes an ACDP "more visible," for example, may be used to trigger conscious decisions and more meaningful usage sessions, thus setting the stage for longer-term systemic changes [36]. Another promising alternative to traditional DSCTs is to *redesign* user interfaces to minimize the negative impacts of ACDPs. The Adaptable Commitment Interfaces proposed by Lukoff et al. [29] are an example of tools that modify or recreate an existing interface to prioritize instrumental use and promote users' sense of agency and control. SwitchTube [29], in particular, is an alternative to YouTube that allows users to activate a focus mode in which recommended videos are hidden. At the same time, users are free to use an explore mode to receive recommendations and browse videos with a lower sense of agency. In this paper, we build on these alternative strategies to further investigate their impacts on different platforms and users' preferences towards these solutions.

2.3 YouTube and Facebook Websites in the Digital Wellbeing Research

Being two of the most widely used websites, YouTube and Facebook have been the subject of numerous studies investigating the impact of technology overuse on digital wellbeing [29, 30, 33]. Furthermore, they have been the target of several strategies for supporting self-control. The SwitchTube app by Lukoff et al. [29] and the "no newsfeed" and "goal reminder" strategies explored by Lyngs et al. [33] are just two examples targeting YouTube and Facebook, respectively. In response to these concerns and research efforts, both YouTube and Facebook have implemented features to promote digital wellbeing and reduce technology overuse. For example, YouTube now includes a "Take a break" feature that reminds users to take a break after a certain amount of viewing time, while Facebook includes a "Time on Facebook" feature that allows users to track their usage and set time limits for specific activities. Despite these efforts, Cho et al. [13] demonstrated that users still consider Facebook and YouTube as a source of distraction that may trigger feelings of regret for being overused. Habitual use of YouTube, in particular, has the potential to negatively impact users' preferences and goals [6], as well as users' sense of agency [30]. Similarly, studies found that patterns of

Table 1. Presence of Attention-Capture Damaging Patterns (ACDPs) on Facebook and YouTube websites.

Pattern	Description	Facebook	YouTube
Guilty-Pleasure Recommendations	Viral suggestions to increase use time.	✓	✓
Neverending Autoplay	A new video is automatically played when the previous one ends.	✓	✓
Casino Pull-to-refresh	Animated page reload after swiping.	✗	✗
Infinite Scroll	New content is automatically loaded at the end of the page.	✓	✓
Disguised Ads and Recommendations	Ads and suggestions disguised as regular content.	✓	✓
Recapture Notifications	Notifications to make users start a new session.	✓	✓
Playing By Appointment	Users are forced to use a platform at a given time.	✓	✗
Grinding	Users are forced to perform additional tasks.	✓	✗
Attentional Roach Motel	Logging out or canceling an account is purposefully made difficult.	✓	✗
Time Fog	The interface hides information about time spent.	✗	✗
Fake Social Notifications	System notifications disguised as messages from real persons.	✓	✗

Facebook use may undermine academic performances [42] and promote anxiety, social isolation, and distress [26, 33]. For these reasons, we selected Facebook and YouTube as the two target platform to study the impacts of nudging and redesign strategies on users' self-control.

3 EVALUATING NUDGING VS. REDESIGNING STRATEGIES

We explored the adoption of novel strategies to support people's digital self-control by designing a Chrome extension implementing nudges and interface redesigns targeting specific attention-capture patterns. After selecting two ACDPs operating on Facebook and YouTube, the two authors, together with a master's degree student developing his thesis, used a design process to prototype, build, and pilot *inControl* before testing the extension in the field.

3.1 Preparatory Design Work

3.1.1 Selection of Attention-Capture Patterns. Informed by an established methodology used in previous works, e.g., [34], the two authors – taking the role of HCI experts – conducted an exploratory analysis by manually inspecting the Facebook and YouTube website to define which ACDPs are shared by the two platforms and select a subset of them to target. The need for HCI expertise, in particular, is motivated by the fact that regular users are not able to detect dark patterns in most cases [9, 18]. Table 1 summarizes the results of our analysis, using the typology of 11 ACDPs we extracted in our prior work [37] as a reference.

Not surprisingly [34], the Facebook website turned out to be a container for several ACDPs (9 out of 11), while we found fewer ACDPs (5 out of 11) on YouTube. Such a disproportion can be attributed to the different usages of the two platforms: while YouTube is mainly meant for consuming videos, Facebook is a social media platform that can be used for different purposes, as it includes contents of different natures. For example, we found that the two "gaming" ACDPs, i.e., Playing by Appointment and Grinding, are not directly adopted by Facebook, but are present in social media games,e.g., FarmVille, that can be accessed through the social network.

Of the 5 ACDPs shared by Facebook and YouTube, we selected the following:

- Infinite Scroll for the *nudging strategy*; and,
- Guilty-Pleasure Recommendations for the *redesign strategy*.

We made this choice for two main reasons. First, we considered patterns with different peculiarities: Infinite Scroll is a pattern related to a user's physical interaction, while Guilty-Pleasure Recommendations is a pattern that is more in

Table 2. The three conditions – control, nudging, and redesign – we implemented and evaluated through the *inControl* extension.

Website	Control	Nudging	Redesign
Facebook	Normal Facebook interface.	The background color of the Facebook newsfeed becomes progressively darker as long as the user scrolls down the page.	The home page prioritizes features related to intentional usage (e.g., adding a post or chatting with a friend), isolating distractive features like Facebook Watch in separate pages.
YouTube	Normal YouTube interface.	The background color of the recommended video on the YouTube home page becomes progressively darker as long as the user scrolls down the page.	The home page becomes a search-first interface, with distractive features like recommendations isolated in separate pages.

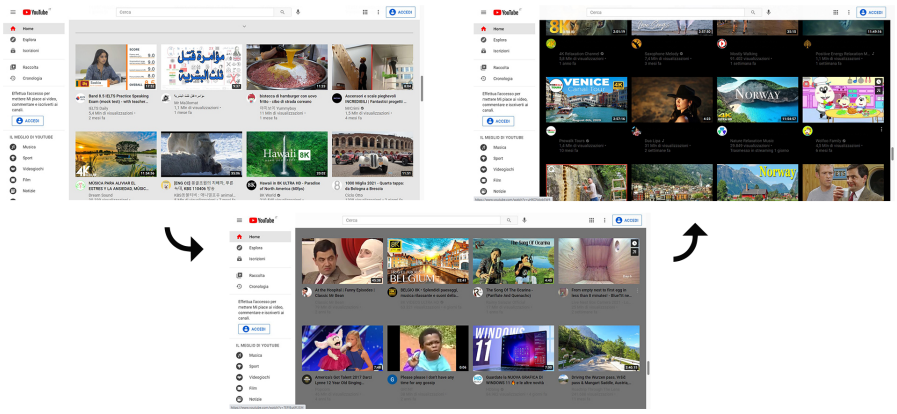


Fig. 2. A prototype of the nudging strategy targeting YouTube: as long as the user scrolls videos on the home page, the background color progressively darkens.

line with the traditional definition of deceptive UI patterns. Finally, as Infinite Scroll requires a physical interaction, detecting it is technically easy, and the pattern is a good candidate for being highlighted by a nudging mechanism. On the contrary, being part of the user interface, patterns like Guilty Pleasure Recommendations are good candidates for implementing a redesign strategy.

3.1.2 Nudging vs. Redesign Strategies. Besides selecting the target ACDP for each strategy, we conducted multiple prototyping sessions to ideate solutions for the nudging and redesign strategies. Table 2 summarizes the results of this design phase, describing the three conditions we implemented in the *inControl* extension and evaluated in the field study.

Besides the control condition, which is transparent for the user, we ideate specific nudging and redesign strategies for the Infinite Scroll and Guilty Pleasure Recommendations ACDPs included on Facebook and YouTube. For nudging the Infinite Scroll pattern, we took inspiration from Anchor [2], an extension that is part of a set of projects for digital wellbeing proposed by Google [3]. Figure 2 shows a prototype targeting YouTube produced during a prototyping session: the idea is to progressively darken the background of the page to let users know "how far" they are going with their scrolling so that they can decide more autonomously when to stop.

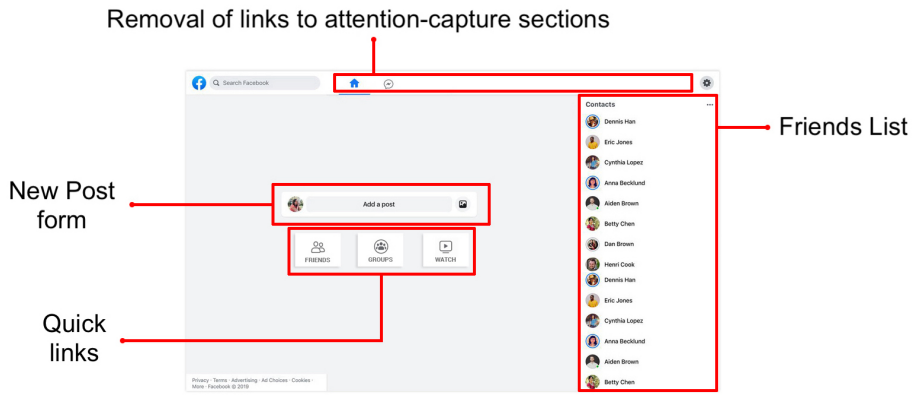


Fig. 3. A prototype of the redesign strategy targeting Facebook: the new home page prioritizes "intentional" features (e.g., adding a post or chatting with a friend) while isolating distractive features (e.g., posts from friends and recommended videos of Facebook Watch) behind quick links.

For the redesign strategy that minimizes the impact of the Guilty-Pleasure Recommendations pattern, we took inspiration from the SwitchTube app proposed by Lukoff et al. [29], and we decided to restructure and simplify the Facebook and YouTube home pages to promote intentional usage and self of agency. Figure 3, for example, shows a prototype targeting Facebook: we envisioned a minimalistic home page that highlights features related to intentional usage (e.g., adding a post or chatting with a friend), while isolating distractive features (e.g., posts from friends and recommended videos of Facebook Watch) behind quick links.

3.1.3 Implementation. We implemented *inControl* by exploiting the Chrome extension APIs[1] to intercept Facebook and YouTube usage and modify their appearance. Furthermore, we used Firebase[2] to log users' data during the field deployment. The extension assigned participants to experimental conditions (Table 2) and used a logger to monitor information about how participants interacted with the two target websites. Before starting the field study, the research team internally piloted the *inControl* extension for two weeks. In this phase, we identified and fixed usability issues, e.g., the background color that darkened too quickly, and problems in logging usage data.

3.2 Methods

3.2.1 Participants. We recruited participants by exploiting internal mailing lists and snowball sampling. We used an entry survey to recruit participants that a) self-declared a daily usage of the Facebook and YouTube websites greater than 30 minutes and b) used Google Chrome as a browser. Overall, 14 users were eligible for the study and participated in the in-the-wild experiment of *inControl*. On average, participants (10 males and 4 females) were 25 years old (SD = 4.42). All of them were university students enrolled in B.Sc. and M.S. courses held at our university. After screening the participants, we contacted them to provide instructions to install the extension on their computers. Participants had to sign an informed consent form before participating in the study.

3.2.2 Procedure and Data Collection. Figure 4 summarizes the procedure adopted in our field experiment. The test was divided into three distinct 1-week phases:

[1]https://developer.chrome.com/docs/extensions/reference/, last visited on May 9, 2023.
[2]https://firebase.google.com/, last visited on May 9, 2023.

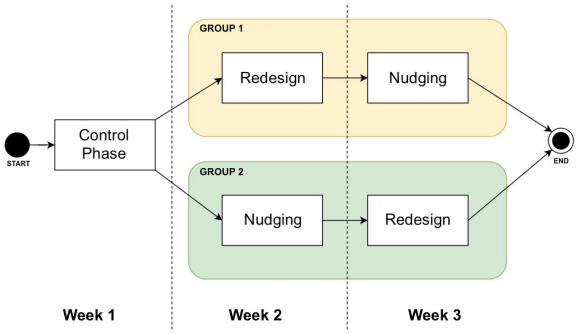


Fig. 4. The procedure followed in the field study of *inControl*.

- **Control** a week during which *inControl* works in the background by merely collecting YouTube and Facebook usage information without implementing any self-control strategy.
- **Nudging:** a week during which *inControl* implements the *nudging* strategy on Facebook and YouTube by highlighting the Infinite Scroll pattern.
- **Redesign:** a week during which *inControl* implements the *redesign* strategy on Facebook and YouTube by restructuring the websites' home pages to minimize the impacts of the Guilty Pleasure Recommendations pattern.

The control phase characterized the first week for all the participants and served as a reference to evaluate the impacts of the two implemented strategies on YouTube and Facebook use. To reduce biases between the tested strategies, participants were randomly split into two groups, with the first one experiencing first the redesign strategy and then the nudging strategy, and the second one experiencing first the nudging strategy and then the redesign strategy. The extension automatically implemented such a process.

3.2.3 Collected Metrics. During the three weeks, we collected different metrics on the impacts of the implemented nudges and redesigned home pages on Facebook and YouTube use. Specifically, *inControl* logged all the users' sessions on the two websites, through which we could calculate metrics like the average daily time spent on a given platform. Furthermore, we also collected the number of clicks performed by users on the two websites and the number of scrolls performed by the users on the interfaces. These two pieces of information were then used to understand whether the presence of a given strategy – besides impacting time spent – also made participants change their interactions with Facebook and YouTube.

At the end of the third week, we also asked participants to fill in an exit survey. In the survey, we asked open-ended questions to investigate users' preferences towards the two proposed strategies, e.g., *"How has the extension changed your use of Facebook and YouTube?"* and *"Which of the two strategies has supported more your sense of agency?"*

3.3 Pre-Registered Hypotheses

In line with best practices adopted in prior work [29], we predefined several specific hypotheses to guide our investigation of how nudging and redesign strategies may influence user experience on Facebook and YouTube. This process helped us define our study protocol in advance and avoid hypothesizing after the results are known [14].

H1: Time Spent. Our first set of hypotheses addressed users' time spent on Facebook and YouTube websites. We expected that the two implemented self-control strategies could reduce the average daily time spent with respect to the

Table 3. A summary of the results of the *inControl* field study, highlighting the average daily time spent and the average number of scrolls and clicks per minute on Facebook (FB) and YouTube (YT) in the control (C), redesign (R), and nudging (N) phases.

	Daily time spent [min]		**Scrolls per minute [#]**		**Clicks per minute [#]**	
	FB	**YT**	**FB**	**YT**	**FB**	**YT**
C	212.50 (SD = 119.20)	287.00 (SD = 121.90)	274.60 (SD = 158.98)	9.29 (SD = 26.65)	2.84 (SD = 2.81)	0.79 (SD = 1.97)
R	67.42 (SD = 57.20)	299.70 (SD = 113.70)	95.66 (SD = 59.72)	4.72 (SD = 15.54)	4.46 (SD = 2.55)	0.55 (SD = 1.33)
N	80.00 (SD = 57.70)	188.80 (SD = 119.30)	199.80 (SD = 78.04)	7.21 (SD = 27.62)	3.43 (SD = 2.78)	0.70 (SD = 1.77)

control phase, with a more prominent effect of the redesign strategy given its more drastic nature. To summarize, we expected the following on both websites:

- H1a: $time(control) > time(nudging)$.
- H1b: $time(control) > time(redesign)$.
- H1c: $time(nudging) > time(redesign)$.

H2: Interactions. Our second set of hypotheses addressed specific interactions – in terms of the number of clicks and scrolls – with the Facebook and YouTube websites. We expected that the two implemented self-control strategies could reduce the average number of scrolls and clicks per-minute with respect to the control phase. Again, we hypothesized that such an effect could be more evident in the redesign strategy, as the two redesigned home pages contained fewer elements to be scrolled or clicked. To summarize, we expected the following on both websites:

- H2a: $scrolls(control) > scrolls(nudging)$.
- H2b: $scrolls(control) > scrolls(redesign)$.
- H2c: $scrolls(nudging) > scrolls(redesign)$.
- H2d: $clicks(control) > clicks(nudging)$.
- H2e: $clicks(control) > clicks(redesign)$.
- H2f: $clicks(nudging) > clicks(redesign)$.

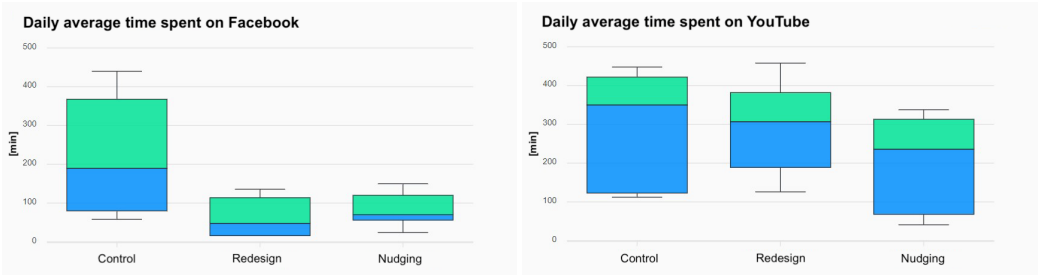
4 RESULTS

The collected data and the participant's answers to the exit survey allowed us to triangulate the experience of 14 participants in our study using objective and subjective measures.

4.1 Quantitative Results

Table 3 summarizes the usage data collected during the *inControl* field study, reporting the average daily time spent and the average number of scrolls and clicks per minute on Facebook and YouTube in the three study conditions, i.e., control, redesign, and nudging.

As better highlighted in Figure 5, both the nudging and the redesign strategy had a quantifiable impact on the time participants spent on Facebook (a) and YouTube (b) each day on average. Specifically, there was a substantial decrease in the time spent by users on Facebook that can be attributed to the *inControl* extension: compared to the control phase (212.50 minutes spent on average), participants spent 67.42 minutes per day on average (-64%) while using the redesign strategy, while they spent 80.00 minutes on average with the nudging strategy (-57%). These reductions confirm H1a, H1b, and H1c for Facebook. On YouTube, instead, only H1a was verified (287.00 minutes in the control phase *vs.* 188.80 minutes in the nudging phase, -34%). We instead observed an increased time spent (299.70 minutes, +5%) in the redesign phase that violated H1b and H1c. Although small, a possible explanation for such an increase could



(a) (b)

Fig. 5. Daily average time spent on Facebook (a) and YouTube (b) in the control, redesign, and nudging phases.

be that the YouTube search-first interface allowed users to consume videos more intentionally, thus involving them more than when bombarded with video recommendations on the home page. Similar results have been observed by Lukoff et al. [29] in their evaluation of the SwitchTube app.

For what concerns the influence of *inControl* on users' interactions with Facebook and YouTube, Table 3 shows that the redesigned strategies – resulting in minimalistic home pages with less content to be consumed – led to a significant reduction of scrolls on Facebook and YouTube, thus confirming H2a: 4.72 scrolls per minute on YouTube (-49% compared to the control phase), and 95.55 scrolls per minute on Facebook (-64% compared to the control phase). On YouTube, we therefore observed an increased time spent and a lower number of scrolls: this finding further points towards a more conscious use of the platform by the participants, as extensive scrolling is typically associated with mindless usage habits associated with a lack of self-control [8]. A smaller reduction in the average number of scrolls on Facebook and YouTube was observed in the nudging phase, too, thus confirming H2b and H2c: 7.21 scrolls per minute on YouTube (-22%) and 199.80 scrolls per minute on Facebook (-27%).

For what concerns the number of clicks, the nudging and redesign strategies resulted in a decrease on YouTube compared to the control phase: 0.55 clicks per minute with the redesign strategy (-31%) and 0.70 clicks per minute with the nudging strategy (-11%). Although these data confirm H2d, H2e, and H2f for YouTube, these reductions, especially those observed in the nudging phase, are smaller than other results reported in this section. The same hypotheses were instead rejected for Facebook. Indeed, there was an increase in clicks both in the redesign phase (4.46 clicks per minute, +57%) and in the nudging phase (3.43 clicks per minute, +21%) compared to the control phase (2.84 clicks per minute). As the time spent on Facebook decreased in the two intervention phases, an increase in the number of clicks suggests a more intentional and active use of the platform.

4.2 Qualitative Results

In the exit survey, participants described *inControl* as useful for having a more conscious use of Facebook and Youtube. Overall, participants said that they gained a greater awareness of their use thanks to the extension, which allowed them to reduce distractions. While participants generally acknowledged that the nudging strategy made them gain awareness *"without removing elements from the screen"* (P4), three users criticized the redesign strategy as it *"reduced the functionality of the websites" (P3).* In particular, a participant said that *"suggestions of new videos is a useful source of content – similar to that I already searched for" (P11).* To mitigate such a problem, two participants suggested the

possibility of letting users decide which strategy to activate, in line with the Adaptable Commitment Interface concept proposed by Lukoff et al. [29].

5 DISCUSSION

Our work set the foundations for adopting alternative strategies to support users in self-regulate their usage of digital devices, with a particular focus on Attention-Capture Damaging Patterns (ACDPs) included in social media and video-streaming websites. In this section, we first discuss our findings on two urgent needs in the digital wellbeing research area: promoting awareness rather than blocking use and innovating adaptive self-control solutions. Then, we discuss the limitations of our work and highlight possible future directions.

5.1 Promoting Awareness Rather Than Blocking Use

As multiple studies and reviews have recently demonstrated, one of the main limits of contemporary solutions for supporting people's digital self-control, i.e., DSCTs [32], is that they mainly focus on making users reduce the time they spend on their digital devices [29, 30, 36]. Commercial DSCTs included in the Android [19] and iOS [5] operating systems, as well as research artifacts like NUGU [23] and Lock n' LoL [22], pursue such a goal by letting users define self-imposed timers that block the interaction with a given app or website after a given amount of time. Applying an intervention that limits the usage of an entire website or app, however, may also interfere with the features of that website or app that are not necessarily a threat to the users' digital wellbeing [29]. At the same time, such a strategy does not address the root cause issues, i.e., the internal ACDPs within the interface [30].

We deemed the findings of our study particularly important, as they contribute to the growing debate that asks digital wellbeing researchers to move beyond traditional DSCTs and screen time metrics [11, 17], considering *"quality of time, not just quantity"* [29]. On the one hand, indeed, the *nudging* and *redesign* strategies implemented by the *inControl* Chrome extension allowed participants to reduce the time they spent on Facebook and YouTube in most cases and reduced scrolling behaviors. At the same time, the redesign strategy made participants slightly increase the time spent on YouTube (5%) and resulted in a higher number of clicks on Facebook (+57%) – even if the time spent on the social network was lower on average compared to the control phase. Overall, this suggests that besides helping users to exercise self-control, having a minimalistic interface allowed users to interact with YouTube and Facebook more intentionally. While Lukoff et al. [29] already demonstrated this tendency on YouTube, our work shows that similar findings also apply to "traditional" social media like Facebook.

5.2 The Need for Adaptive Self-Control Solutions

While both the tested strategies demonstrated the ability to impact usage behaviors, participants expressed their concerns about having solutions that drastically change the appearance of a user interface, demonstrating a preference for the nudging strategy. Nudges that make ACDPs "more visible" could allow users to understand and recognize why using platforms like YouTube and Facebook is so compelling to the point of creating compulsive behavior. As partially demonstrated by our empirical results, such a strategy may also promote meaningful and intentional usage sessions, with the advantages of being less intrusive, i.e., without restricting nor removing interaction possibilities.

That being said, quantitative results of the redesigned Facebook and YouTube interfaces demonstrate that such a strategy is undoubtedly promising. Consequently, our work also echoes findings and discussions about the need for adaptable and adaptive self-control solutions included in a recent work by Lukoff et al. [29].

Adaptable self-control solutions may allow users to activate a given strategy manually, e.g., adding a nudge to the interface or switching to an alternative design, depending on factors like their current intention or mood. While Lukoff et al. [29] explored an adaptable interface for the mobile app of YouTube, the effectiveness of such an approach for different strategies, devices, and target platforms still needs to be determined.

Adaptive self-control solutions may be the next step: instead of asking users to manually switch between strategies – a task that may be challenging – an adaptive DSCT could automatically adopt a strategy that looks promising for a given user in a given context, e.g., adopting personalized prediction models. HCI researchers have already demonstrated the feasibility of analyzing usage data and predicting when a user is trapped in a passive usage session with a device or when the same user has a specific, intentional goal guiding the session [31]. Ideally, user interfaces could provide users with higher-control mechanisms when they have a specific intention and lower-control mechanisms when they have a non-specific intention, e.g., "forcing" a search-only interface for instrumental use [30].

5.3 Limitations and Future Work

Our work has potential limitations. The in-the-wild experiment of *inControl* involved a relatively small group of university students and lasted three weeks, only. These choices and numbers align with most previous experiments about tools for digital self-control: previous work [36] – for example – has found that the average duration of DSCTs experiments is 21 days, with a prevalence of young university students involved. However, we stand with the suggestions provided by the same previous work [36] acknowledging the need to test the generalizability of our findings and proposed self-control strategies in larger and longer studies that involve a varied population.

Furthermore, our experiment followed a within-subject approach through which each participant experienced a control phase and all the intervention strategies. As such, we must acknowledge that some effects of the nudging and redesign strategies may have been circumstantial. Further, between-subject experiments with control groups may be needed to confirm or refute our findings.

Finally, future works could also be conducted to empirically compare effects and users' preferences between the alternative strategies proposed in this work and traditional DSCTs.

6 CONCLUSIONS

This work attempted to take a step beyond restrictive and screen-time-based DCSTs in two main directions: targeting the root causes of technology overuse problems, i.e., the attention-capture patterns exploited by current digital services, and promoting awareness and meaningful use rather than indiscriminately blocking the user's interaction. To this end, we designed, developed, and evaluated *inControl*, a Chrome extension implementing two strategies for digital self-control targeting the Facebook and YouTube websites: a nudging strategy to promote awareness of the Infinite Scroll pattern and a redesign strategy to mitigate the effects of Guilty-Pleasure Recommendations. Results of a field study involving 14 participants showed evidence that both strategies may impact usage behaviors of Facebook and YouTube while promoting intentional and active use, thus demonstrating the possibility of moving from traditional DSCTs to alternative strategies that may better support digital wellbeing in the long term.

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