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Unhooked by Design: Scrolling Mindfully on Social Media by Automating Digital Nudges

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Completed Research

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Abstract

In 2020, over a billion people spent at least three hours a day on social media, primarily engaging in what is described as mindlessly scrolling through their newsfeed. This illustrates the growing societal concern of digital wellbeing and social media addiction. Reducing the time spent on these platforms is challenging since they are designed to be addictive. This paper presents the design and evaluation of a digital nudging intervention that unhooks users from their mindless social media use by making them more mindful. We evaluated the intervention through a two-week single case experimental design (N =20). The findings show that weekly digital consumption was significantly reduced by over 20.58%. The evaluation of the intervention's usability and potential revealed that the intervention made participants mindful of their digital behavior and scored high on usability. Our findings advance how ethical nudges could be self-designed, considering privacy to mitigate social media addiction.

Keywords

Digital nudges, Social media addiction, Instagram addiction, Mindless scrolling, Automation, Self-nudging.

Introduction

A wide distribution of smartphones has changed the relationship we have with technology, and it is not always a healthy one. The same device that helps us get productive, i.e., sending emails, browsing the web, and improving communication, can also have a negative impact on our mental health (Chen 2020). In just two years, the American consumer has, on average, increased the time spent on their smartphones by 63% (Neilsen 2015). The applications inside our smartphones that seem to capture most of our attention are related to social media (Sha et al. 2019). In fact, in some countries, the self-reported averages of social media usage surpass 4 hours a day (GlobalWebIndex 2019).

This hyperconnectivity can lead to potential dysfunctional behavior (Rutkowski and Saunders 2018), ranging from mental distraction (Mark et al. 2018) to mental health problems, such as Obsessive-Compulsive Disorder (OCD), depression (Appel et al. 2016; Boer et al. 2021) and degraded social interaction (Lee et al. 2014). In cases where social media usage impairs social activities, interpersonal relationships, or psychological health and wellbeing, researchers label it as a form of social media addiction (Andreassen 2015). More distressingly, other negative states, such as the feeling of envy (Krasnova et al. 2015), loneliness (Ponnusamy et al. 2020), and anxiety, are also correlated with social media usage (Kuss and Griffiths 2017).

Such hyperconnectivity is not surprising since it is precisely what social media platform designers aim for (Giraldo-Luque et al. 2020; Purohit et al. 2020). Eyal (2014) introduced the Hook Model, a practical framework to think about addictive social media design features. The model presents a circular 4-phase feedback loop that increases engagement: First, *a trigger* (e.g., a push notification) brings a user to the platform. Second, once on the platform, users are nudged to perform *actions* (e.g., liking, posting, creating a friend list). Third, these actions become *investments* in the platform, which makes it harder to leave ("It took time to create my friend list"), they also act as triggers for other users ("somebody liked your post"), and they are used to populate the endless newsfeed of users. The newsfeed is one of the central design features in the fourth and last phase of the model, the *variable reward phase,* where users are rewarded continuously with new content to view, comment, share, or like (Baym et al. 2020). It leads to many users

mindlessly scrolling through their newsfeeds (Rauch 2018). Many of these design features can be described as digital nudges, i.e., indirect incentives that drive user choices.

To reduce social media overuse, mobile phone providers and third-party developers have started to provide solutions, many of those using digital nudging design principles (e.g., default, feedback, friction). Sometimes these interventions are referred to as digital detox apps. For instance, *Apple* provides weekly usage feedback reports and app limits. *Nudge.io* offers a solution to unfollow friends or hide some parts of the news feed (Purohit et al. 2020). Unfortunately, at this stage, there is still sparse research about the efficacy of such interventions. Furthermore, researchers have pointed out that privacy and ethics threats pertaining to digital detox could make their adoption more difficult (Widdicks 2020). For instance, in a digital detox app study by Monge Roffarello and De Russis (2019), a participant mentioned, "Just another data-stealing greedy app!! Hate greedy data-stealing apps, Robbery! Deleted". In another study by Purohit et al. (2020), a participant mentioned, "I felt as if I took a risk in relation to my FB-data giving over some control to [the digital detox app]."

Indeed, whereas digital nudging mechanisms are promising candidates to change user behavior, it is vital that they do not risk the users being manipulated. To tackle the issues mentioned above, this paper presents the design and evaluation of a privacy-sensitive digital nudging intervention that unhooks users from their mindless digital behavior by increasing their mindfulness.

Methodology

In this article, we, like Holzer et al. (2020), chose the design science research methodology (DSRM) approach by Peffers et al. (2007) for the reason that DSRM is a proactive approach that aims to solve an identified research problem by creating and evaluating the artifact that impacts people and organizations. In the Introduction, the paper first identifies the problem, the first step of the DSRM. The Related Work section defines the objectives of the solutions, the second step of the DSRM. The third step of the DSRM, namely the design and development of the solution, is presented in the Intervention Design, while the fourth step, Demonstration, is detailed in the section with the same name. The fifth step of the DSRM, the solution's evaluation, is detailed in the Evaluation Setup and Evaluation Results sections.

Related Work

In this section, we discuss the research efforts closest to our problem and define the objectives of the solution. Thaler and Sunstein (2009) defined nudging as "... any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives." During the last decade, scholars and practitioners have demonstrated digital nudges' effectiveness to change people's behavior (Caraban et al. 2019). For example, making individuals mindful of the online privacy policy by changing the digital choice environment (Bergram et al. 2020). By definition, *digital nudges* refer to nudges that are provided via digital technology and employ user-interface design elements that guide people's choices or behaviors in digital environments (Weinmann et al. 2016). Whereas these digital nudging principles are used to increase time spent online, they can also help users reduce their social media consumption through digital detox apps (Purohit et al. 2020).

The existing research on digital nudges not only helped mitigate social media consumption but also zeroed in on potential issues like when the nudge is too forceful, leading to friction and less usability. For instance, researchers at Cornell Tech leveraged nudging and negative reinforcement concepts with their vibration intervention (Okeke et al. 2018). This intervention nudged users whenever they exceeded the daily usage limit of Facebook. The intervention design, no doubt, decreased Facebook usage; however, most participants felt irritated and annoyed by the digital nudge and returned to their old habits when the intervention was removed. Similarly, researchers used notifications to mitigate social media use by delivering the reminder after the users hit the daily goal limit (Kim, Jung, et al. 2019). Nevertheless, 92% of the participants ignored and continued using social media. The intervention gave a chance for self-reflection, but it was frequently ignored (Kim, Jung, et al. 2019). These findings convey that digital nudging interventions are potentially effective but can show a usability risk that could decrease efficacy.

One of the aspects that can lead to better or worse usability and effectiveness of digital nudges is timing (Purohit and Holzer 2019). Indeed, one of the particularities of digital nudges compared to physical ones is

that they can be timed and personalized more precisely, based on user interaction, location, or other contexts. Nudges delivered at the wrong time can lead to decreased satisfaction, negative emotions, hyperactivity, and distraction (Adamczyk and Bailey 2004; Kushlev et al. 2016; Mark et al. 2008). Researchers have identified the opportune moments to deliver digital nudges in the form of notifications that can be non-interruptive (Mehrotra et al. 2016; Okoshi et al. 2015; Pejovic et al. 2015). These findings indicate that identifying an adequate nudging moment is an essential aspect of the digital nudge design.

Two additional challenges when designing digital detox apps have to do with privacy and ethics. Digital detox apps are positively motivated and designed for digital wellbeing, i.e., reducing digital overuse and addiction (Tseng et al. 2019). Recent experiments have been instrumental in revealing the primary reason for users' reluctance towards digital wellbeing / digital detox apps: privacy (Kloker et al. 2020; Purohit et al. 2020). Digital detox solutions negatively impact by creating a possible tradeoff between privacy and "fit" of the intervention (Widdicks 2020), compromising users' data privacy (Calvo and Peters 2014; Lee et al. 2019; Widdicks 2020), when privacy in itself is an essential aspect of digital wellbeing (Peters et al. 2018). Adopting a privacy-by-design approach could solve this issue, but the topic is rarely addressed in digital nudging research. A further issue is related to the fact that nudging users can be perceived as a deception. Indeed, much of the designs used by social media designers are at odds with the ethical guidelines to design ethical nudges. These guidelines suggest that nudges should be (1) transparent, (2) easily avoidable, and (3) designed with the wellbeing of the user in mind (Gold et al. 2020; Thaler 2018). One approach to ensure that the end users' wellbeing is taken into account is to provide self-nudging tools. That is, instead of relying on third-party applications, people can design and structure their environments in ways that make it easy for them to make the right choice (Reijula and Hertwig 2020).

Intervention Design

The problem statement pointed out that social media users tend to spend too much time on social media mindlessly, which they might not find useful. The solution's main objective is not to prevent users from scrolling through their newsfeed but to reduce it by making it more mindful. The related work pointed to several promising design choices. The solution can leverage digital nudging interventions to break free users from the latches of variable rewards like mindless scrolling. However, these interventions need to be simultaneously strong to allow users to change behavior as well as soft to avoid backfiring, which may eventually lead to users forsaking the intervention altogether. Furthermore, the intervention should be designed with privacy and ethical concerns in mind.

To find an adequate position on the design space to provide an effective yet soft nudge, i.e., a nudge that does not impose any restrictions and can easily be ignored, we can play with two variables: the intervention type (e.g., temporary visual notification, lasting haptic vibration) and the intervention moment (i.e., before, during, or after mindless scrolling). We chose to design a soft nudge type (temporary visual feedback) combined with a potent nudge moment (during scrolling). The idea was to provide feedback to users about their current social media consumption through a temporary visual banner (in the style of a push notification). We refer to the feedback notification as MISFEED Nudge (Mindful Scrolling Feedback Nudge). Research has shown that push notifications are non-interruptive when they are well-timed and are perceived as a reminder even when delivered at a greater frequency multiplying the exposure of the notification content (Morrison et al. 2018). Previous research findings indicate that if an intervention is delivered at the beginning of the target behavior, it might break the desire or urge to conduct the behavior (Kim, Park, et al. 2019; Sarker et al. 2014); in our case, the behavior is mindless scrolling. Along this line, we chose to deliver a MISFEED nudge to users after a specific time of using the app (1 minute) and repeat the feedback every minute after that.

To design an ethical nudge, the intervention should be (1) transparent, (2) easy to opt-out, and (3) the users' wellbeing should be taken into account. It is possible to meet the first requirement by merely advertising the nudge for what it is: a feedback mechanism that aims at reducing a user's time spent on a social media platform. As the MISFEED Nudge is soft (it displays a temporary banner), it can easily be ignored and thus meets the second requirement. To meet the third requirement, we take the approach to let users nudge themselves, i.e., not only allow them to opt-out of the nudge but also allow them not to be nudged in the first place. To design a solution with privacy in mind, a privacy-by-design approach should be adopted. As such, critical data should be identified, and systems should avoid collecting them as much as possible from

the start. To time the feedback nudges, it needs access to primary social media usage data, i.e., when a user opens the app. However, it does not need to access any other sensitive user data.

Demonstration

We built the intervention design using the shortcuts automation app, which comes pre-installed on *Apple* iOS 13 onwards. Shortcuts provide a robust and visually interactive way to implement a well-timed feedback nudge while ensuring privacy and ethics. Shortcuts are effective in building a set of instructions that can be triggered by various events, such as when an app is opened. With this tool, simple nudges can be designed without installing and trusting third-party applications. Furthermore, as the instructions are visible to users in Figure-1, it is accessible for inspection. The MISFEED Nudge's implementation in the shortcut app and the resulting notification banner is shown in Figure-1. In the first step, we created timer actions from 1 minute to 10 minutes, named timer collection, followed by the creation of reset timer, named terminate timer. Next, we ran both the shortcuts within automation based on two conditions: 1) When a user opened Instagram, automation executed timer collection shortcut, and the timers would start running 2) When a user closed Instagram, automation would execute terminate timer shortcut, which would reset the timers to zero in the timer collection.

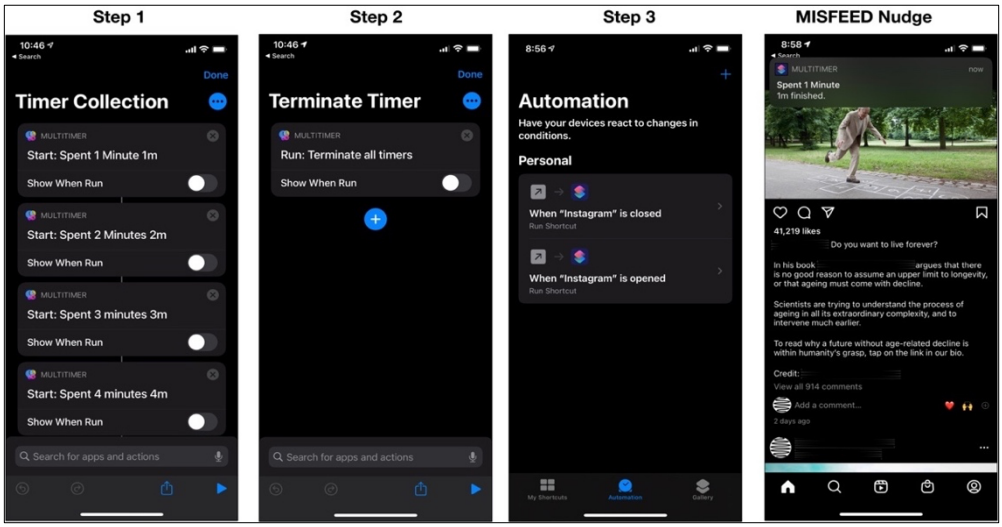

Figure 1. The steps to create an automated intervention in shortcuts app for Instagram

Evaluation Setup

To evaluate the intervention's impact, we experimented with 20 students, recruited from the pool of graduate students at our university, and evaluated the MISFEED Nudge on the Instagram social media application. We chose Instagram as the target application for two reasons: 1) The participants' self-rated time spent on Instagram was three times higher than Facebook. 2) In comparison, Facebook and Twitter have received more attention from scholars. Considering the immense popularity of Instagram, there have been limited studies on Instagram Addiction (Kircaburun and Griffiths 2018; Ponnusamy et al. 2020). We ran a single-case experimental design (N = 20) where participants were exposed to the intervention on Instagram. Our experiment ran for two weeks: a one-week baseline period, a one-week intervention period. This allowed participants to act as their own controls by comparing baseline (i.e., before the intervention) and intervention performance. The use of a single-case experimental design allows for high-quality research to be conducted with a small sample size (Krasny-Pacini and Evans 2018). During the intervention period, participants received the feedback nudge described in the previous section with notifications every minute they spent on Instagram. All the participants were given similar instructions.

A pre-survey was conducted with 55 students. The pre-survey included questions on (i) self-rated time spent on various social networking platforms, (ii) demographic information, (iii) questions from the BSMAS social media addiction scale (Andreassen et al. 2012), an instrument for measuring hazardous social media addiction on the Internet and (iv) willingness to participate in a future study to reduce their addiction on

social media. To participate in the study, students had to be active Instagram users (at least ten minutes of usage per day) on iOS. We filtered students on their Instagram using habits on their iOS and their willingness to reduce their time on Instagram. All selected participants had to have their iPhones already installed with the Instagram mobile app. After invited students consented to the study, a link to text and video-based tutorials on creating the nudge intervention using Shortcuts App on iOS was delivered.

To track Instagram usage behavior, the instructions on the shortcut app also included logging timestamps when the app was opened and closed onto a local CSV file on the participants' phones. During the first week, i.e., the baseline period, only the timestamps of opening and closing the Instagram were recorded in the CSV file. No intervention was provided during that period. The second week of the study was the treatment period in which participants turned on the feedback nudge intervention. At the end of the second week, participants completed an exit survey and received instruction on deleting the shortcut automation. The participants then sent over their CSV files and a screenshot of the native screen time app to enable researchers to double-check the accuracy of the data collected.

Evaluation Results

This paper's main objective was to design a 1) usable nudge, which is 2) effective at reducing the time spent on scrolling through social media feed by 3) making individuals more mindful.

The MISFEED Nudge showed Good to Excellent Usability

A requisite for an intervention's success is that users should find value in it and are willing to use it. They should find it usable and meaningful. In particular, we aimed for an intervention that was not perceived as annoying or irritating. To evaluate the intervention's usability, we used the IUS scale (Intervention Usability Scale) (Lyon et al. 2020). This scale is adapted from the SUS scale (Brooke 1996) that can generate reliable results even with small sample sizes (Tullis and Stetson 2004). The MISFEED nudge scored a mean of 77.3 points out of 100, indicating Good to Excellent usability (according to SUS Score interpretation guideline).

The MISFEED Nudge Significantly Reduced the Time Spent on Instagram

We analyzed the MISFEED nudge's impact on each participant's total amount of time on Instagram for a week. We performed paired sample t-test. Our sample size was N < 25; hence it required that we met the normality assumption, i.e., the difference in scores must be normally distributed in the population. In Table 1, we can observe that the mean difference between baseline and treatment is statistically significant at $p < 0.001$ with a very large effect size $d = 0.98$. We evaluated the Shapiro-Wilk test to assess the normality of our data. We found that it was not statistically significant, i.e., not violating the normality assumption required by our t-test (Table 2).

Measure 1	Measure 2	t	df	*p*	Cohen's d
Baseline	Treatment	4.403	19	<0.001	0.984

Table 1. Average time spent on Instagram

Conditions		W	*p*
Baseline	Treatment	0.976	0.881

Table 2. Test of Normality (Shapiro-Wilk)

Measure 1	Measure 2	t	df	*p*
Baseline	Treatment	0.161	19	0.437

Table 3. The average number of times Instagram opened

The findings reveal that the intervention significantly reduced the time spent by the participants on Instagram. Figure 2 illustrates the variations in the total amount of time spent by the participants over the

baseline and treatment periods using Instagram. The amount of time spent on Instagram per week during the treatment period decreased by over 20.58%. These findings suggest that the MISFEED nudge successfully and effectively reduces the time spent on the target application. In addition to measuring the total amount of time participants reduced on Instagram using the intervention, we were also interested in finding out if the intervention was able to reduce the number of times participants opened Instagram. In Table 3, we observe that the mean difference between baseline and treatment was not statistically significant. Therefore, MISFEED Nudge did not reduce or increase the number of times participants opened Instagram.

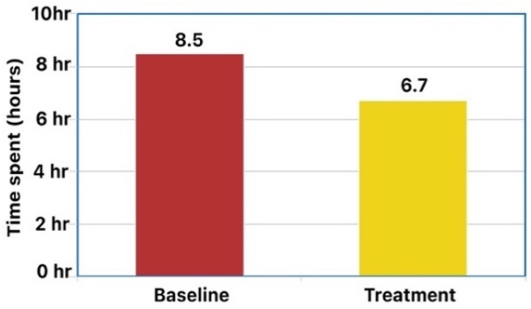

Figure 2. Time spent on Instagram across the baseline week and treatment week

The MISFEED Nudge made scrolling more Mindful

To assess if the intervention was effective and made participants mindful when using the app, they were asked to answer the items in Table 4 measured on a Likert scale from 'Strongly disagree' to 'Strongly agree.' The items were adapted from the app behavior change scale (McKay et al. 2019). To analyze the items, we applied a One-sample Wilcoxon signed-rank test that measured if the median is significantly different from 3. The effect size is calculated using the Rosenthal correlation coefficient (Rosenthal et al. 1994). The result indicates that the intervention encouraged participants to become (1) mindful of their digital behavior on Instagram, (2) encouraged them to reduce their Instagram usage, and (3) assisted them in self-monitoring their Instagram usage.

Item	*Z*	*p*	Effect size(*r*)
The Feedback intervention that you experienced allowed you to easily self-monitor your Instagram usage?	3.739	.000	.83 (very strong)
The Feedback intervention that you experienced provided you encouragement to reduce your Instagram usage?	3.448	0.01	.77 (strong)
The Feedback intervention made you more mindful while using Instagram	2.723	0.006	.60 (strong)
The Feedback intervention encouraged you towards positive habit formation	2.401	0.05	.45 (moderate)

Table 4. Items for measuring the effectiveness of intervention and mindfulness

Furthermore, we were also interested in understanding diverse perspectives about the intervention. Participants responded to the open question, "What is the best thing about the Intervention?" All 20 participants reported that timely intervention made them more mindful and aware of their behavior on Instagram. All the answers to the open question pointed towards the theme of mindfulness. Here we report few comments from many; one participant reported that "Being informed of the time spent on Instagram by notifications made me leave the application." Another user commented, "When I'm on Instagram without really being interested in what I see, the reminders just push me to quit the app because the way I'm occupying myself is useless." Another interesting comment stated by the user "The intervention made me realize how much time I spend on an app and the fact that it has been 10 minutes that I am on it but felt like I just opened the app 2 minutes ago." Taken together, these findings suggest that the MISFEED nudge was useful for participants, and it increased their awareness of digital behavior on the target application.

The intervention instilled self-awareness, which is an aspect of mindfulness (Brown and Ryan 2003). More precisely, the intervention offered a state of awareness that promotes digital wellbeing.

To assess if intervention changed the way participants used Instagram, we asked the following item "Did the Feedback intervention change the way you use Instagram?". If participants reported "yes," they were then followed up by an open question, "Please describe how did it affect or change the way you use Instagram?". 65% of the participants reported that intervention had changed the way they use Instagram. For instance, a participant wrote, "When I went to Instagram, I only looked at the story. I very rarely watched publications randomly. I got lost less in Instagram." Another participant reported, "I used to close the app and open it again a few minutes after (habit) and the fact that the timer starts again, it makes you realize that you spend too much time on it." Some participants thought the intervention increased the number of times they open Instagram while reducing their overall Instagram usage "This experience mostly impacted my time spent on the application every time I opened it. When I received a notification, it made me leave the application, and I find this positive. Even though maybe we open the application more often, we don't stay there as long. I think it is a good initiative to reduce our screen time on this application."

Discussion and Conclusion

We investigated how a usable, privacy-sensitive, and ethical digital nudging intervention could be designed to effectively make social media users more mindful while scrolling through their newsfeed and reduce their time on the platform. We designed the MISFEED nudge intervention as a feedback notification displayed while a user is on the social media platform. Our results supported the fact that such soft and transparent digital nudges can be designed and yet remain effective in curbing digital consumption. Participants indicated that the nudge made them more mindful of their social media consumption and our findings show that weekly digital consumption was significantly reduced by over 20.58%. Furthermore, the intervention exhibited good usability, which conveys that increased mindfulness did not come at the cost of adding excessive friction to the user experience, which could potentially lead to users abandoning the nudge.

Our research makes the following contributions to the existing literature for reducing social media overuse. First, it shows that the design of a feedback nudge timed during social media usage can significantly reduce the time on a social media platform by increasing user mindfulness. This complements existing research, which focused more on using commitment nudges, e.g., setting limits with potentially strong nudges, i.e., continuous vibration or firm limits (Kim, Jung, et al. 2019; Okeke et al. 2018). Whereas timing has been identified as an essential factor in the design of digital nudges, few studies have explicitly investigated it. Our results show that feedback received right at the time of the behavior can provide a soft cue that can help users get out of a mindless scrolling behavior if they wish. Our findings show a decrease in time on the social media platform, but not a reduced number of times the social media app is opened. These results seem to indicate that the effect of the nudge, which specifically targeted the reward phase of the Hook model, did not spill over to address the trigger phase. Future work could further investigate how nudges can be designed for the different phases of the model.

Second, our research not only focuses on nudge effectiveness but also on privacy and ethical considerations in the problem definition and then discusses design principles to uphold these constraints. Third, our research leads to designing and implementing a novel artifact, namely the MISFEED nudge. This nudge was implemented using *Apple*'s built-in Shortcut app. With this app, MISFEED not only can deliver the nudge in a timely fashion but can also meet the privacy and ethical requirements by preventing any third-party intervention and providing transparency to users regarding the algorithm. Future research could investigate if this process of users co-creating the nudge to such a do-it-yourself app adds to the app's effectiveness, similarly to the IKEA effect (Norton et al. 2012). Besides, it is still not clear how trustful users can be when they have the opportunity to see the high-level algorithm behind the intervention and how much they can be empowered through such interventions.

Our research also makes several contributions to practice. First, whereas phone manufacturers provide built-in mechanisms for reducing digital consumption, they mainly focus on limiting the time spent on apps (very strict intervention) or giving weekly usage feedback (very soft intervention). Our study's results could pave the way for them to develop new soft feedback mechanisms delivered while on an app. Second, social media designers could integrate soft feedback to improve users' user experience who want to reduce their consumption without entirely leaving the platform. Though the use of the Shortcut app, or other automation

apps, as nudge factories, is still in its infancy, the results from our study could encourage others to develop their interventions to encourage digital wellbeing. These nudges could be delivered through different artifacts, from haptics to visual dashboards, and could potentially also include other contextual information as triggers, such as time or location.

This research is not without limitations. As is inherent to any design choice, we had to limit our investigation to a particular location on infinite design space. We focused on a specific time frame, i.e., nudge users every minute when interacting within the target application and a specific digital nudge, i.e., feedback. Future work could further explore the design space in terms of particular timing and nudge types to increase efficiency and reduce friction. Furthermore, our sample size was relatively limited due to COVID-19 restrictions, which made recruitment more difficult and partly because of the mobile device requirement to participate in the experiment (iOS devices only). Future work could replicate these findings with a broader sample over a more extended period. However, despite these limitations, our research allowed us to observe a significant and robust effect of the intervention, which encourages the future towards better user experience on social media.

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