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Directing smartphone use through the self-nudge app one sec

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Research suggests various associations of smartphone use with a range of physical, psychological, and performance dimensions. Here, we test one sec, a self-nudging app that is installed by the user in order to reduce the mindless use of selected target apps on the smartphone. When users attempt to open a target app of their choice, one sec interferes with a pop-up, which combines a deliberation message, friction by a short waiting time, and the option to dismiss opening the target app. In a field-experiment, we collected behavioral user data from 280 participants over 6 wk, and conducted two surveys before and after the intervention span. one sec reduced the usage of target apps in two ways. First, on average 36% of the times participants attempted opening a target app, they closed that app again after one sec interfered. Second, over the course of 6 wk, users attempted to open target apps 37% less than in the first week. In sum, one sec decreased users' actual opening of target apps by 57% after six consecutive weeks. Afterward, participants also reported spending less time with their apps and indicated increased satisfaction with their consumption. To disentangle one sec's effects, we tested its three psychological features in a preregistered online experiment (N = 500) that measured the consumption of real and viral social media video clips. We found that providing the additional option to dismiss the consumption attempt had the strongest effect. While the friction by time delay also reduced consumption instances, the deliberation message was not effective.

app use | field-experiment | self-nudging | one sec | online behavior

The machine is there to help.

~ Garry Kasparov

The number of today's smartphone users is estimated at over six billion (1). In the U.S., 89% of teenagers between 13 and 17 y have a smartphone, a number that doubled in just 6 y (2). While smartphones enrich people's lives and prove useful in several domains, like physical activity (3) and chronic diseases (4), the literature also reports severe risks to their excessive use. Smartphone overuse was reported to have negative associations with an individual's physical state—like sleep quality (5) and lack of activity (6)—as well as psychological well-being—like anxiety (7), social interaction quality (8), and loneliness (9)—and performance outcomes like school grades (10). Several studies also report negative associations with users' overall satisfaction with life (11), with authors hinting at a bidirectional causal relationship (12). Specifically, social media use, also via smartphones, is a prominently growing phenomenon (2). The reduction of social media consumption has been shown to increase relevant psychological and physiological factors of well-being. Brailovskaia et al. (13, 14) showed that reducing Facebook use improved participants' reported life satisfaction, their level of physical activity, and reduced their depressive symptoms, instances of insomnia, and smoking. Other researchers have found associations between social media use and loneliness (15, 16), social isolation (17), social comparison and envy (18, 19), and suicidal ideation and suicide attempts (20). The effects of social media consumption have been observed across different cultures (11, 20–24). Importantly, these negative effects were also questioned (25–27). Przybylski et al. (28) reconciled both perspectives by finding the association between smartphone use and psychological functioning to be inversely U-shaped. Mostly excessive digital screen time promotes the negative effects described above.

Notably, it seems that such negative effects not only depend on the amount but also the type of social media consumption, that is, on mindless vs. deliberate consumption. Multiple researchers differentiate between types of smartphone use. For instance, Sela et al. (29) show that the associations of smartphone consumption with different health-relevant outcomes seem to depend on their use mode. An automatic or unaware smartphone use mode showed negative relations with individuals' reported quality of life. In contrast, a deliberate and aware use mode showed mild positive associations with life satisfaction. Verduyn et al. (30) present the same conclusion regarding social media consumption. More than ever, it seems important to help individuals manage their smartphone consumption. Research should provide them

Significance

Interventions against excessive smartphone use have predominantly focused on browser extensions and nudges within a problematic digital environment. Smartphone apps are applicable to different environments and more transparent than common interventions. one sec is a self-nudging app that helps users to reduce their consumption of selected apps. We show that one sec nudges users in one out of three cases (36%) to dismiss their consumption attempt after having opened a target app. Users also attempt to open their target apps less often (37%) in general. A controlled experiment disentangles one sec's psychological mechanism. Displaying users with an option to dismiss their consumption attempt is one sec's most effective feature, while the friction it produces by time delay also plays a role.

Author contributions: D.J.G., F.R., and P.L.-S. designed research; D.J.G., F.R., and P.L.-S. performed research; D.J.G. and F.R. contributed new analytic tools; D.J.G. analyzed data; F.R. designed the central intervention tool (i.e., one sec app); and D.J.G., F.R., and P.L.-S. wrote the paper.

Competing interest statement: The authors have public statements and positions to disclose; F.R. is the originator of one sec.

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with tools that counteract most app's purpose to attract their attention (31), automatic or not, ideally in a way that can be implemented by themselves and that avoids paternalistic or attention-grabbing interests.

Apps as Innovative Intervention Tools

External apps provide an optimal structure for self-responsible interventions on digital media consumption. They offer a technical and a psychological advantage over intervention features within an app or platform. For the former, an external app can be applied to an abundance of diverse scenarios and environments, that is, targeting different apps as well as different websites. On the psychological side, an independent app provides users with a control tool that can be installed and used autonomously and is clearly distinct from the source of their problematic behavior, namely, the environment that needs to be controlled. On the one hand, this avoids problems of paternalism as users can become their own choice architects on their smartphones, a concept called self-nudging (32). On the other hand, the distinction between the consumption-shaping tool and the consumption-triggering environment should make the intervention transparent and thereby easier for users to identify and control personal challenges regarding their digital consumption. According to *self-nudging* (32, 33), the personal fit between the individual user and the target apps might substantially enhance the positive effects of an intervention. In the present study, we assume that individuals have some introspective knowledge about not just which apps' consumption is most problematic for them but also for which app the intervention might work best (e.g., mindless scrolling through social media). By giving users back control over their smartphone behavior, such app-based tools can be seen as a category of boosting tools (34) in the toolbox of interventions that enable users to understand the wickedness of the digital environment (35) and manage its cognitive challenges (36).

One Sec against Mindless Digital Consumption

One app that has the potential to serve as such a self-nudge and boosting tool is one sec. It was primarily developed by one of this paper's coauthors Frederik Riedel. In the present paper, we assess its effectiveness in the field and a controlled experiment. The intervention effect of the app is based on three components that are combined in one sec, namely, producing friction by a short time delay, activating deliberation by a message, and providing an option to dismiss opening the target app.

Friction. When users open an app to consume it, one sec imposes a 10-s delay (accompanied by a moving screen effect) before one can continue to the target app. This feature imposes friction on the user's consumption habits. The friction mechanism can be used to steer behavior in different directions, either by making certain choices more cumbersome or by giving people more time to think about their decisions themselves (37 and 38). By slowing down processes in the choice environment, it is often inherent in several features in the digital world, for example, by extra clicks, pop-ups, or nested menu structures.

Deliberation Message. Similarly, the second feature of one sec should activate users' deliberate thinking before they can start consuming an app. When attempting to open an app, they are presented with a short message pointing at what they are about to do. Besides the friction effect, Katsaros et al. (39) had found that different messages accompanying the reconsideration nudge impacted the probability of commenters' sharing a post despite being marked. Some messages, more than others, seemed to activate users' deliberative thinking enabling them to counter their impulsive intentions.

Option to Dismiss. After the message and the friction delay have been displayed, one sec provides the user with the explicit option to dismiss consumption before opening the target app. We would conceptualize this third intervention feature of the app as a convenience nudge. Presenting an explicit option to dismiss consumption makes it easier for users' to not consume by just one touch, thereby changing the choice process. Such options are used widely in the digital world, for example, by pop-ups that give people a chance to reconsider their sharing decisions or aggressive comments (39).

In the first part of this work, we show the effects of one sec from the field in terms of reduced app consumption, its longevity, and the subjective value of those effects for users. Even though this part of the study is exploratory, three research questions about the app's effects on people's app consumption guided our data collection and analysis. First, does one sec reduce participants' digital consumption, specifically social media consumption (RQ1a)? If so, how durable is this reduction effect (RQ1b)? Second, does the app not just positively affect users' consumption patterns but also increase users' subjective happiness and satisfaction with their consumption (RQ2)? Third, does the app increase people's deliberate and purposeful digital consumption (RQ3)?

In addition, we conducted a preregistered controlled online experiment to disentangle the components that constitute one sec's three intervention mechanisms—friction, message, and option to dismiss—by experimental manipulation through random assignment to conditions. The experiment addressed two hypotheses specifically and one research question. First, we hypothesized that the combination of all intervention features should lead to the lowest consumption rate of users, measured as the number of skipped videos (H1a) and overall consumption time of videos (H1b). Second, we expected the control condition without any intervention feature implemented to lead to the highest consumption rate measured by skipped videos (H1a) and consumption time (H2b). Finally, we posed the question of what features of one sec are most impactful in reducing users' digital consumption as skipped videos (RQ4a) and consumption time (RQ4b).

Field Experiment

Results. The complete data set for the self-report collection in the two surveys and the data set on the behavioral monitoring are openly accessible on the paper's project page on OSF, Open Science Framework: https://osf.io/p4wy6/?view_only=f31949eb91084e46929486b08cc38407.

Target Apps and Reasons to Use one sec. Users' most commonly administered target apps for one sec were applications for social media platforms. As shown in *SI Appendix*, Fig. S2, Instagram and Twitter alone produced half of all app activities that had been screened by one sec. Overall, social media apps contributed more than 80% to users' app activities.

Moreover, respondents had installed one sec for very different reasons, that is, problems to be tackled and goals to be reached by using one sec. People self-reported reasons ranging from medical conditions (e.g., Attention Deficit Hyperactivity Disorder and anxiety disorders) to social issues (e.g., imposter syndrome, feelings of inferiority, and incessant social comparisons) to severe practical outcomes (e.g., sleep deprivation, social deprivation, and poor eyesight). Many participants also indicated one or more of the predefined reasons to install one sec (i.e., problems and goals) we presented them

with, for example, reducing automatic and excessive consumption on the smartphone (*SI Appendix*, Fig. S3).

Behavioral Data. To explore one sec's behavioral effects on people's app consumption, we focused on two analyses concerning people's dismissal of opening their target apps and their overall number of attempts to open the target app, respectively. To avoid possible biases in the analysis, we only included participants in the main analyses, who used one sec throughout all 6 wk of the experiment (N = 280). That is, all respondents that stopped using one sec before having finished the 6 wk were treated as dropouts and excluded from the main analyses. However, an extensive analysis, including the dropouts, is provided under *SI Appendix*, SI2.

Dismissed target app openings. We first explored one sec's effect on participants dismissing the opening of a target app after having clicked on it. We refer to this aspect as dismissed target app openings. Computing a binomial test, we find a highly significant reduction effect by one sec on target app openings, $p < .001$. Specifically, in 36% of all attempts to open the target app, one sec leads to users closing this app again before consuming it, CI = [0.35; 0.36]. That is, one sec prevents 36% of app openings and consumption. Fig. 1 shows this effect over all 6 wk of participants using one sec. The relative reduction effect is largest in the first week of using one sec, namely, at 43%, and decreases over week two (36%) until the third week (33%). From there on, one sec's reduction effect remains rather stable (i.e., 32 to 34%) until the end of the experiment after week six.

Reduced total app opening attempts. In addition to the relative number of dismissals of target app openings by one sec, we inspect users' absolute target app opening attempts over 6 wk. As target app opening attempts we count all instances in which a user clicks on a target app, which is an action step made by users before one sec intervenes. Fig. 2 shows that the overall opening attempts of target apps decreases with each subsequent week, being highest in the first week (166 initial app opening attempts per user on average) and lowest in the last week (105 initial openings). This corresponds to a decreased number of overall consumption attempts between the first and the sixth weeks by 37%, which is a highly significant deviation, $p < .001$, in the binomial test. The app reduces users' overall target app opening attempts substantially, namely, by over one third.

Importantly, the reduction in absolute target app opening attempts might drive the observed relative decrease in dismissals of app openings in the first 3 wk (from 43 to 33%). Assumingly,

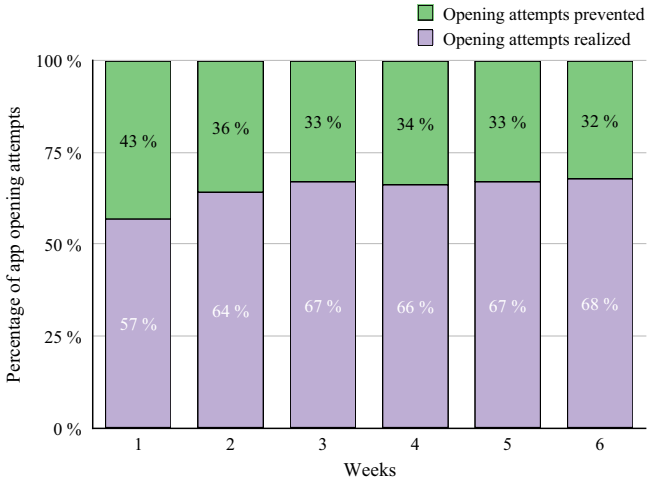

Fig. 1. Dismissals of target app openings indicated as proportion of overall initial target app openings across 6 wk.

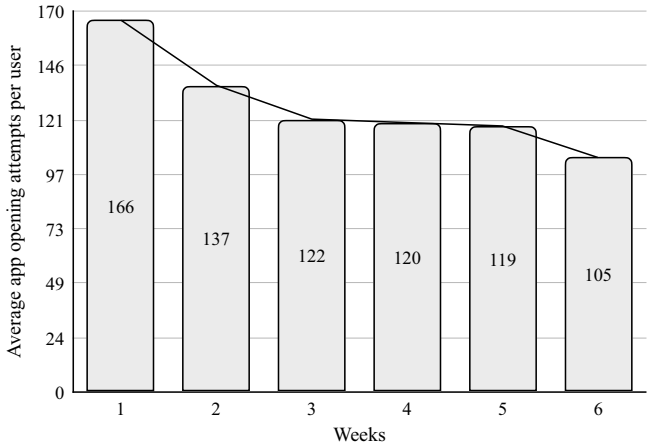

Fig. 2. Reduction of initial target app openings per user across 6 wk.

participants, by using one sec, are able to sort out the most unnecessary opening instances of their target apps in the first weeks. This would result in less relative numbers of dismissals in subsequent weeks accompanied by a decreased absolute number of target app opening attempts.

In conclusion, one sec reduces users' usage of target apps in two mutually reinforcing ways. The app helps participants to dismiss openings of target apps before consuming them (but with decreasing rate) *and* it reduces their overall initial opening attempts of these apps. This combined effect amounts to a reduction of actual target app openings by 57% after having used one sec for 6 wk. That means, far over half of all target app openings are prevented by using one sec. Fig. 3 shows the joint pattern of both observed effects of one sec—dismissal of openings and reduction of initial openings—in each of the 6 wk during the experiment.

We provide the above analyses including dropouts under *SI Appendix*, SI2 where results are similar.

Self Report Data. For insights into psychological dimensions besides behavioral data, we analyze selected variables of the two surveys users participated in before and after the 6 wk. We analyze changes (over the 6 wk) within individuals in their self-reported time spent on digital apps, their perceived problematic app consumption, and their happiness with the consumption.

We use nonparametric testing to compare paired samples due to deviations from normality for all three variables, as is shown in *SI Appendix*, Table S1. In line with paired samples difference testing, we compute a Wilcoxon signed-rank test for each of the three variables, respectively.

Users indicate having spent substantially less time consuming their target apps after having used one sec for 6 wk (Fig. 4*A*), W = 1,451.00, $p < .001$, d = –0.56 (medium to large effect). Specifically, on average, participants report to spend 77 min less on digital apps per day (i.e., in hours ΔM = 1.29) after having used one sec for 6 wk. Further, respondents report that their digital consumption became less problematic by using one sec over the 6 wk (Fig. 4*B*), ΔM = 0.73, W = 794.00, $p < .001$, d = –0.70 (large effect), and users indicate being substantially happier with their digital consumption (Fig. 4*C*), ΔM = 1.29, W = 6448.00, $p < .001$, d = 0.81 (large effect). In conclusion, participants report positive large effect increases on different psychological dimensions that are central to digital app consumption.

See *SI Appendix*, SI3 for additional analyses comparing the new users (N = 719) with an additional sample of existing users (N = 100) that had already used one sec for at least 2 wk before being surveyed. The results are highly similar to the presented findings.

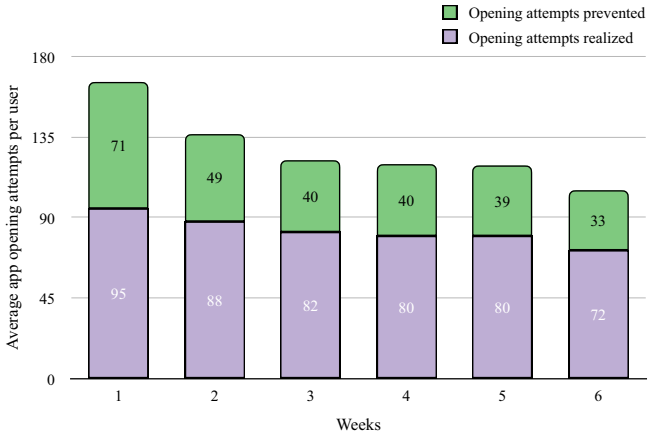

Fig. 3. Overall effect of one sec on target app openings across 6 wk. Green indicates the instances in which a user intended to open an app but closed it due to the one sec intervention. Purple indicates the instances in which users continued opening the app despite one sec's interference.

Indicators of well-being. As additional indicators of digital consumption well-being, in the survey after 6 wk, respondents indicate how much one sec helped them solve their consumption problems and reach their digital use goals, both of which had been defined in the first survey. Most respondents already partly or mostly solved their problems (69%) and reached their defined consumption goals (62%) after using one sec for 6 wk. Relatedly, participants report being substantially satisfied with the progress they already made with one sec in consuming less and more productively. Only a handful indicates being unsatisfied with their progress (7%) or neutral (5%). The majority indicates being either a bit satisfied (32%) or clearly satisfied (44%), and a substantial amount reports being very satisfied (11%).

Moderators of intervention. Finally, via exploratory analyses, we inspect which self-reported psychological variables are associated with the size of one sec's intervention effect on consumption attempts, indicated degree of the problem of consumption, and happiness with consumption. While in our restricted set of measured variables none predicts the size of the intervention effect on consumption happiness, we find relevant moderators for the other two intervention outcomes. A marginally significant interaction effect, $t(137) = 1.78$, $p = .077$, $b = 0.15$, points at the interpretation that users' consumption time was especially reduced across the 6 wk if participants, in the beginning of the experiment, showed a high understanding of how problematic digital consumption is in general. Further, one sec especially decreases the problematic consumption of users who are specifically unhappy with their consumption when beginning the experiment, $t(137) = -2.73$, $P = .007$, $b = -0.23$, and, at this time, also are specifically conscious of the problem digital consumption poses in general, $t(137) = 2.26$, $p = .025$, $b = 0.19$. All three moderation effects could stem from higher awareness of one's own problems with digital consumption before the experiment and might point to a higher commitment to engage and use one sec.

Controlled Experiment

While one sec proves an effective intervention to decrease automatic and increase deliberate consumption and to foster positive psychological effects of subjective happiness and satisfaction with digital consumption, the process of these effects remains unknown. one sec implements three features to intervene, namely, 1) giving the consumer the option to dismiss consumption, 2) displaying mental friction by time delay, and 3) presenting a message that should help deliberate what the consumer is about to do. From the field study it was unclear to which degree each of one sec's three features contributed to the app's positive effects. To disentangle

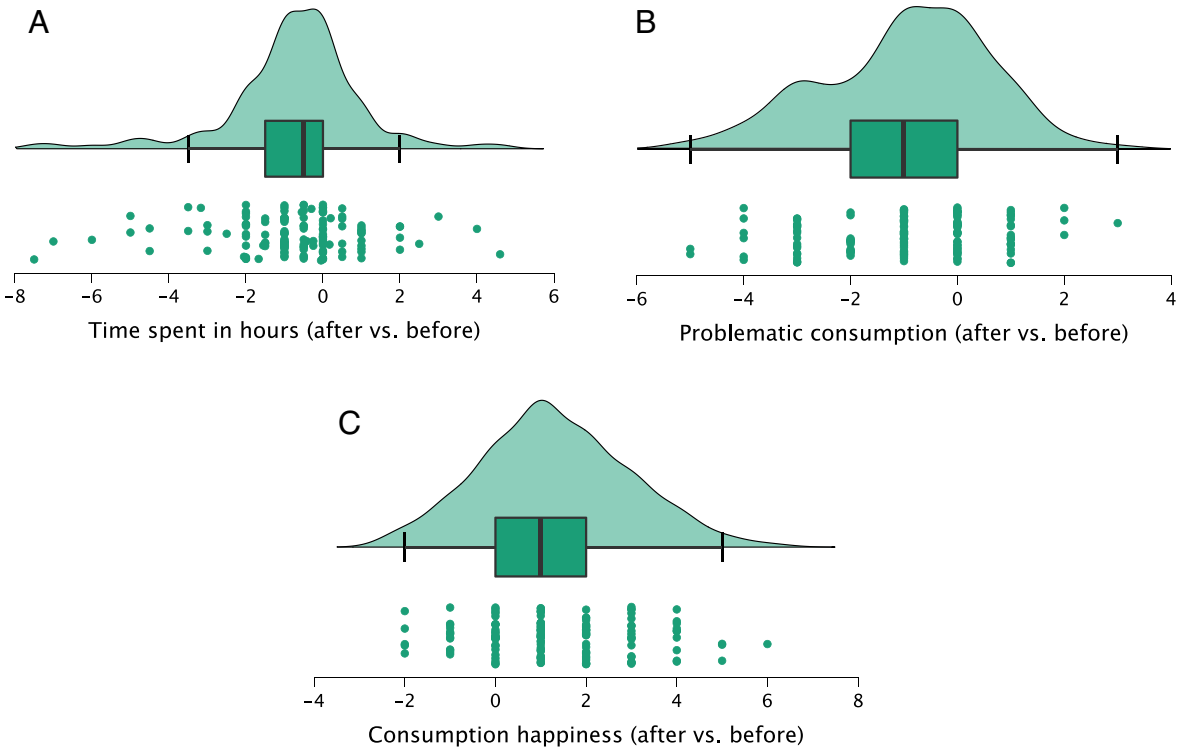

Fig. 4. Differences between users after vs. before 6 wk in self-reported time spent (*A*), problematic consumption (*B*), and consumption happiness (*C*). Time spent is represented in hours to fit the metric scale of the other two variables. The differences are computed by subtracting the value indicated before the 6 wk from the value indicated after the 6 wk.

the effect pattern, we conducted a preregistered, controlled online experiment (https://aspredicted.org/5L1_MPJ).

Results. The complete data set is openly accessible on the paper's project page on OSF, Open Science Framework: https://osf.io/p4wy6/?view_only=f31949eb91084e46929486b08cc38407.

With a sample size of $N = 500$, assuming alpha = 0.05 and a power of 0.80, we were able to detect effect sizes of $d > 0.24$ in a repeated measures ANOVA for between-subject effects and effect sizes of $d > 0.35$ for independent samples t-tests between conditions (indicated with $N = 100$ each).

We inspect two different dependent variables. First, we measured how often participants skipped a video. Second, we assessed how long respondents watched the videos. We start with inspecting how often respondents' skipped videos by computing an ANOVA with the five conditions where participants' behavior across the four videos is averaged. We find a strong main effect of the condition, $F(4, 495) = 16.22$, $p < .001$, showing a large effect, $d = 0.72$. Addressing H1, H2, and RQ4, we inspect the simple comparisons of effect of the full intervention and the control group with all other conditions, respectively, correcting the significance level via the *Holm* method to compare a family of five conditions. The effect pattern is as follows: We find the strongest effects, that is, the most skips of videos, for the full intervention and the option intervention (both do not differ significantly from each other, $\Delta M = 0.27$, $p_{holm} = .220$). As shown in Fig. 5, they both differ significantly from the control group ($\Delta M > 0.76$, $p_{holm} < .001$, $d > 0.66$) and the message intervention ($\Delta M > 0.82$, $p_{holm} < .001$, $d > 0.74$), respectively. From the friction intervention, the option intervention differs significantly ($\Delta M = 0.57$, $p_{holm} = .004$, $d = 0.44$) while the full intervention only shows a descriptive difference ($\Delta M = 0.30$, $p_{holm} = .205$, $d = 0.24$). In summary, the psychological feature of offering the consumer the option to dismiss app consumption has the strongest effect on lowering actual video consumption. Implementing friction by time delay is also effective; however, it does not add to the effect of the option to dismiss. The message before consumption is not effective on its own.

As shown in Fig. 6, we find a highly similar effect pattern for participants' time of video consumption, $F(4, 495) = 14.07$, $p < .001$, displaying a medium to large effect, $d = 0.68$; with the extensive analyses reported in *SI Appendix*, SI4.

Discussion

As analyses of the self-report surveys show, users are especially interested in using one sec, an intervention tool using cognitive friction, to tackle their issues with social media consumption on apps. Above 80% of all use instances monitored and intervened by one sec are with social media apps. Further, participants install one sec for diverse use cases, tackling different problems (e.g., incessant social comparisons or sleep deprivation) and attempting to reach different goals by using it (e.g., reducing overall consumption or more deliberate consumption of digital apps).

Regarding our first research question (RQ1a), participants, after using one sec for 6 wk, open target apps less often. Users, on average, dismiss opening a target app in 36% of all instances in the 6 wk. Relevantly, and addressing RQ1b, the app's positive influence is stable over weeks. While the dismissal effect of one sec decreases in the first 3 wk (i.e., from 43 to 37 to 33%), it remains constant afterward (i.e., between 32% and 34%) until the end of the 6 wk. Providing further support of RQ1a, users show an increasingly reduced number of initial target app opening attempts across the 6 wk, culminating in only 105 app opening attempts in week six compared to 166 attempts in week one (i.e., reduction by 37%). Answering research question two (RQ2), respondents report a substantially increased happiness and satisfaction regarding their app consumption after using one sec for 6 wk. Finally and concerning research question three (RQ3), participants report a more deliberate and purposeful app consumption after using one sec for 6 wk. This is indicated by three findings. Users indicate spending less time consuming digital apps in general and this is supported by a reduced number of overall target app opening attempts. Both these results, from self-reported and behavioral data, point to the fact that participants, through using one sec, reflect more extensively on their consumption of digital apps, reducing the most unnecessary instances of app consumption in the process. Additionally, participants report a less problematic app consumption behavior after using one sec for 6 wk.

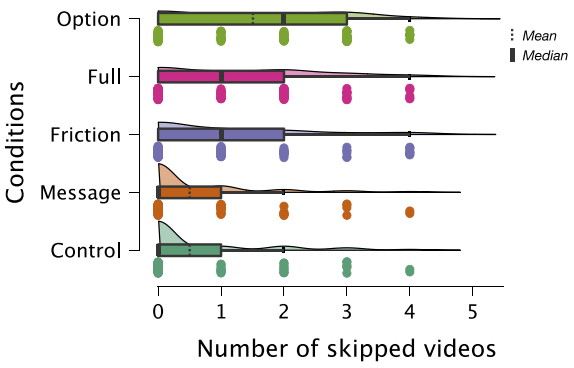

Fig. 5. Differences between feature conditions (control, message, friction, full, and option) in participans' skips of videos.

When disentangling the observed effect, our first hypothesis (H1) regarding one sec's psychological features' effects is partially supported. The full intervention of all three features—option to dismiss, friction by time delay, and deliberation message—is more effective in reducing consumed videos than the control, the deliberation message, and the friction by time delay. Only providing consumers with the option to dismiss consumption, however, is equally effective, descriptively even more effective, than the full intervention. In the same vein, our hypothesis 2 (H2) is partially supported, showing that participants in the control group have the highest video consumption rate, however, showing the same values as the condition with the deliberation message. Regarding our fourth research question (RQ4), we find that the option to dismiss consumption is the most effective intervention. While friction is also effective, it does not add to the effect of the option to dismiss. Only displaying the deliberation message before consumption is not effective.

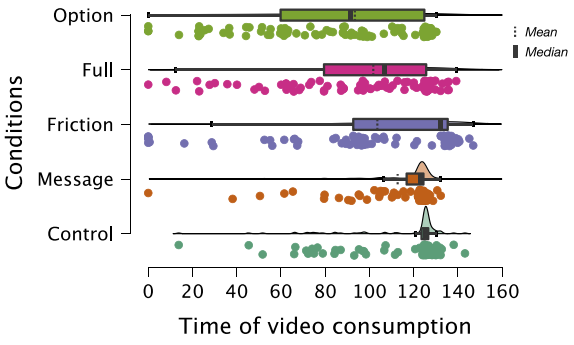

Fig. 6. Differences between feature conditions (control, message, friction, full, and option) in participants' video consumption time.

In summary, we present a self-directed mobile application, one sec, that, on average, reduces the number of instances that users overall consume their target apps by 57% (RQ1). Additionally, one sec enhances users' satisfaction regarding their app consumption (RQ2) and increases deliberate and purposeful digital app consumption (RQ3). We, further, find that one sec is primarily successful due to it giving users the option to dismiss their consumption attempt, while one sec's implemented friction by time delay can also be effective (RQ4).

Notably, the intervention to only provide participants with an option to skip consumption time (i.e., videos) has a stronger positive effect than the full intervention that additionally includes the deliberation message and the time delay to produce friction. We assume this to be a result of cognitive overload in the experimental setting. In the full intervention condition, participants, being presented with different interventions at the same time, were possibly overwhelmed and, as a result, less intensively engaged with the three different intervention features they were presented with. Accordingly, we deem it important to understand that the association between intervention effectiveness and complexity or sheer number is not positive linear. High complexity increases cognitive load and, hence, could reduce users' willingness to engage with the intervention. It seems that there is an advantage in simplicity of the intervention.

Longevity of the Effects. An essential part of the present results relies on longitudinal data. Hence, the argument could be made that the time span of the experiment could have been expanded (i.e., to 2 mo or half a year) to make even more informed claims about the application's positive consumption effects, specifically, its longevity. We encourage future research to expand the time span we have used for the present testing of one sec's intervention effects. However, we would like to point out that, up to date, there exist no clear-cut guidelines which a reasonable time span depending on the features of the respective experiment can be derived from.

Self-Selection. The use of self-directed mobile applications, like one sec, for controlling digital consumption presents one decisive drawback. That they are independent of the problematic environment itself (e.g., Twitter and Instagram) is their most important asset but also poses their most problematic disadvantage: Not every social media user has to use one sec. This introduces a self-selection bias. Individuals who use one sec might differ—in, for example, personality, skills, preferences, and motivation—from people who do not use the app. The bias poses two specific problems to our approach.

First, we cannot and should not be sure whether one sec shows positive effects for each and every user of mobile apps in general and social media apps specifically. While the present controlled experiment provides evidence that the basic mechanisms behind one sec show effects for randomly assigned consumers, these efforts have to be expanded to in-field assessment with users of one sec. That is, as a next step, future research ought to conduct a controlled experimental trial in the field where users are randomly assigned to either a control group not using one sec or an experimental group that uses one sec for a set number of weeks. Only by comparing these two groups would we be able to, at least mostly, disregard the self-selection bias that confounds the results of the present paper. Notably, the dropped-out participants in the study do differ on some decisive psychological dimensions from the users successfully finishing the study. We analyze these differences by Welch tests to account for identified unequal variances ($ps \leq .003$). Drop-outs evaluate their own consumption as less problematic, $\Delta M = -0.31$, $W(297.605) = -2.53$, $p = .012$, $d = -0.21$, and believe that digital consumption is less of a societal problem in general, $\Delta M = -0.41$, $W(293.172) = -4.20$, $p < .001$, $d = -0.35$. These users might, therefore, perceive less personal need for using a consumption-intervening app like one sec. Interestingly, drop-outs also indicate to spend more time on digital consumption, in hours $\Delta M = 0.45$ (i.e., 27 min), analyzed via a t-test due to no inequality of variances ($p = .107$), $t(683) = 2.03$, $p = .043$, $d = 0.19$, than the successful finishers. The drop-out seems to be the combinatory result of differing perceptions of problematic consumption, on the personal as well as the societal level, and their motivation to guard against unhealthy consumption behavior (e.g., consuming excessively).

We want to add that one sec's feature of self-selected use also grants an ethical strength. one sec, at no point, casts an intervention upon a user unwillingly. The app provides full transparency about its method to reduce app consumption, and users are free to choose which apps are targeted by one sec. In line with the concept of self-nudging it thereby does not pose a danger of paternalism, because it fosters the competence to become one's own choice architect instead of steering behavior (32).

Psychological and Physical Well-Being. Verduyn et al. (30), in their review, find that automatic or passive social media use is the type that enhances negative effects. In contrast, deliberate or active social media use creates social capital and is associated with social connectedness and well-being. Mobile apps like one sec have the unique potential to address both passive and active social media use. As we have shown, one sec reduces the former and arguably increases the latter. Apps like one sec reduce consumption rather than forbid it completely, an intervention that recently was demonstrated to produce more positive results on different levels of psychological well-being than total abstinence (22). Our findings speak to the unique possibility such mobile applications offer for productive and healthy smartphone use. We hope that our use case stimulates more future research on adaptable and self-directed applications that are independent of problematic consumption environments. Importantly, to track the effects of new interventions like one sec, researchers have to also improve their measurement quality. That is, the direct and accurate measurement of digital consumption—for example, by browser plug-ins or specifically tailored apps—is essential to generate an unbiased understanding of these new digital interventions' effects on consumption and well-being.

Advancing Self-Nudging Interventions as in one sec. With the application, one sec, we so far create friction with a pop-up message that presents the same stimulus to the user upon each activation (i.e., opening attempt of a target app). Research has shown that enriching a friction stimulus like the one from one sec with a deliberate message can increase the intervention's effectiveness (40). That is, we presumably did not find an effect of the deliberation message in the present controlled experiment due to the message being too general and unspecific. We suggest advancing this procedure even further by not just providing a personal message as a nudge but by letting people, in a self-nudge manner, personalize their own friction messages to be displayed to them. Future research ought to expand one sec's features by a set of personal nudging messages from which users can choose the ones they think work best for their individual situation to decrease app openings.

However, the present controlled experiment also demonstrates which is the most promising feature of one sec to control users' consumption, namely, the explicit option to dismiss. Providing users that are about to consume with an option to do otherwise, that is, to dismiss their consumption seems to be the most promising avenue for effective feature development. Interestingly, one sec's option to dismiss a consumption attempt that turned out to be the most effective feature is already in use in other digital spaces

to reach the exact opposite goal. Nearly all online abonnements present their prospective quitters with an option to reverse their decision (e.g., "Do you want to reconsider?"). Computer games give players the option to still dismiss their quitting intention after having indicated that they want to leave the game (e.g., "Are you sure that you want to quit?"). While in these instances the option to reconsider binds consumers or players to a specific product, one sec does the opposite by encouraging the users to reconsider and deliberate about their consumption decision. Future research should especially focus on advancing the latter use of this self-nudging feature to improve well-being of users.

Conclusion

Some interventions implemented on social media platforms have been recently developed to reduce users' mindless digital consumption and sharing, and foster more productive interactions online. However, mobile apps are little researched in this regard. They are a novel intervention tool with a high potential for self-directed change in consumption behavior. We test a mobile app to positively influence users' digital consumption in different ways: one sec. In 6 wk, one sec successfully helps users to reduce their number of target app openings by 57%. Additionally, one sec increased users' deliberate and purposeful app consumption and enhanced their reported happiness regarding their app consumption. Its effects stem primarily from changing the choice process by giving users the option to dismiss their consumption before they even start. Mobile apps are a promising alternative and meaningful complementary method to interventions directly installed within problematic environments like Twitter or Instagram. Both intervention approaches should be combined to help people more effectively with their digital consumption and regain their autonomy in the digital environment.

Materials and Methods: Field Experiment

The Application. one sec is a mobile phone app available for iOS and Android (https://one-sec.app). one sec intercepts opening attempts of configured target apps and displays a full-screen breathing intervention (*SI Appendix*, Fig. S1) to introduce friction in the process of opening the target app. The pop-up also provides feedback about the number of opening attempts within the last 24 h. This is triggered by app-automations in Apple's Shortcuts app (https://apps.apple.com/de/app/shortcuts/id915249334?l=en) which have to be set up by the participant. After facing the pop-up for a few seconds (breathing in and out), the participant can decide to continue to consume the app or dismiss opening it.

Participants. We recruited N = 719 anonymous and voluntary iOS users of one sec through digital messaging in one sec itself. The participants were new users; all participants had just installed the app on their smartphones and were beginning to use it for their targeted apps. We did not assess sociodemographic data like age and sex to indefinitely prevent the identification of individuals.* 280 participants used one sec throughout all 6 wk of the observation.

Procedure. New users of the app were sent a popup-message asking them to participate in a study regarding one sec. If users indicated to be interested, they were forwarded to the preintervention survey. Respondents, in total, filled out two surveys, the first before the field study and the second afterward. After participants had given their informed consent in this survey, their activity with one sec was monitored for 6 wk. If participants deleted the app within this time period or decided to terminate the study early, data were collected only up to this point but excluded from the main analysis.

Measurements. Given the design of our study, we collected two different types of data: digital behavioral data in the form of participants' activities with one sec collected continuously throughout the 6 wk and self-report data collected on two fixed occasions, namely, the two administered surveys before and after the intervention weeks, respectively.

Behavioral data. For digital behavioral data, we assessed four different measurements from all users that participated in the experiment. First, we recorded timestamps of when a user had started using the app and when they had completed the first survey. Second, we recorded, for each instance, which target social media app users tried to open, and when exactly they opened it. Third, we assessed people's self-reported reasons for using the target app whenever opening it. Fourth and most importantly, we monitored participants' actions after the intervention. That is, we recorded whether they still opened the target social media app or actually dismissed opening it after one sec had intervened.

Self-Report data. In the two surveys, we assessed six self-reports about users' app consumption, namely, problems with their own app usage and the goals they wanted to reach by using one sec, the hours they believe they spend consuming apps, how problematic they perceived their consumption and the consumption of others, how happy they are with their consumption, and how well they think they handled app consumption compared to others. In the survey after 6 wk, we had also asked participants about their progress with the app. Specifically, respondents reported to what degree they had already solved their indicated problems and reached their goals, and how much progress they had made with the help of one sec. The full list of self-reported variables is outlined in *SI Appendix*, SI1. In the survey prior to the use of one sec, we assessed the aspects outlined above from all new users that participated in the experiment. In the post-experiment survey, we measured the aspects for only these new users that had used one sec for the full 6 wk. The two surveys are openly accessible on the paper's project page on OSF, Open Science Framework: https://osf.io/p4wy6/?view_only=f31949eb91084e46929486b08cc38407.

Materials and Methods: Controlled Experiment

Participants. We recruited 500 participants from Prolific, consisting of 249 (49.8%) female, 244 (48.8%) male, and 6 (1.2%) nonbinary respondents while one (0.2%) did not want to specify. Age ranged from 18 to 76 (M = 28.48; SD = 9.54). All respondents indicated to be fluent in English.

Procedure. After giving their consent, participants were presented with three viral videos from the internet that they watched successively. Afterward, they were randomly assigned to one of five conditions. In the control condition (N = 100), respondents watched four other viral videos but had, at all times, the option (by the click of a displayed button) to skip the video without further consequences. The next three conditions each implemented one of the three psychological features of one sec. Condition 2 (N = 100)

*This seemed especially relevant as we already collected other sensitive information about the users' reasons to open a target app and their app consumption problems and goals they wanted to address with one sec.

displayed a message for 3s before each video. Condition 3 (N = 101) implemented a friction intervention, displaying a moving screen for 10s (as in one sec) before each of the four videos. Condition 4 (N = 99) gave participants the option to skip a video before it started playing. In Condition 5 (N = 100), respondents were presented with the full intervention, that is, the combination of all three psychological features of one sec. The skipping button while the video was playing remained in all conditions as in the control group. After having watched all videos, participants were asked general questions about their app consumption and sociodemographics and were debriefed about the study's purpose afterward.

Ethics Declaration. The study was approved by the IRB committee of the MaxPlanck Institute for Human Development. All experiments followed the IRB guidelines, and all participants provided their informed consent before participating in the study.

Data, Materials, and Software Availability. Anonymized csv.-files data have been deposited in Application Use to Reduce Digital Consumption and Increase Awareness of Consumption: The Case of one sec (https://osf.io/p4wy6/). All study data are included in the article and/or *SI Appendix*.

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