Unplug from Your Distractions: The effect of smartphone screen time intervention on sleep quality, hedonic and eudaimonic well-being

Diana Zamfirova

SNR: 2059001

Master thesis 2021/2022

School of Humanities and Digital Sciences

Communication and Information Sciences

New Media Design

Tilburg University, Tilburg

Supervisor: Dr. Mincheol Shin

Second Reader: Hendrik Engelbrecht

January 2021

Abstract

Smartphones play an important role in our lives. People become more and more reliant on them, and in the past several years screen time interventions started emerging. Previous research has tested the effects of such interventions; however, this is an emerging field of research and it has not been so extensive so far. The current study aimed to understand the effects of two different screen time interventions versus no use of intervention on participants' sleep quality (SQ), hedonic (HWB), and eudaimonic (EWB) well-being. Additionally, trait impulsivity was explored as a possible moderator of these effects. The interventions used were: (a) Unpluq device (a physical USB key, which only when inserted into the phone allows the normal use of it), and (b) Unpluq Premium Application (where people have to shake their phones for 3 seconds to unlock the wanted app and use it). It was expected that (1) screen time interventions would have a significant effect on SQ, HWB, and EWB, (2) Unpluq device would have significantly better effects on participants SQ, HWB, and EWB compared to the Unpluq premium application, and (3) impulsivity would moderate those effects. In total, 78 participants were recruited through SONA human subjects pool in TSHD and took part in the 2-week experiment. They were divided into three groups. It was found that screen time interventions significantly increased HWB. Additionally, the notions that screen time interventions increase EWB, and that Unpluq device increased HWB in comparison with Unpluq premium applications were marginally supported. All other hypotheses were not accepted, including the moderation effects. These results imply that screen time interventions may have a good effect on people's well-being. Implications, limitations, and future recommendations are discussed in the paper.

Keywords: screen time intervention, application, physical device, sleep quality, hedonic well-being, eudaimonic well-being, impulsivity

Introduction

Mobile technologies, namely smartphones, are now taking an important part in our everyday lives. On average, people spend 4 hours on their mobile phone screens per day (Elhai et al., 2018). While the use of smartphones is known to often improve the autonomy of individuals in their daily life (e.g., work while travelling; Vanden Abeele, 2020), Chóliz (2010) argued that people may rather lose their autonomy by getting addicted to their smartphones. Based on the notion, the study of "smartphone addiction" has started to gain much attention from mobile communication researchers (e.g. Grant et al., 2019).

Human attention has become the most valuable currency, and it is a vital factor of a successful business, thus is known as attention economy (Davenport & Beck, 2001, Chapter 1). Vanden Abeele (2020) demonstrates that the attention economy influenced by problematic smartphone uses can steal individual's autonomy by distracting them from their main tasks and goals and subsequently influence their digital well-being (i.e., the quality of life and life satisfaction of an individual influenced by the use of digital technologies; Burr et al., 2020). In line with this notion, scholars have found that the amount of smartphone screen time is negatively associated with people's sleep quality and well-being (e.g., Ha et al., 2008; Yang et al., 2020). For example, the study of Jenaro et al. (2007) found that problematic smartphone use can lead to a higher level of anxiety and insomnia. In addition, Guo et al. (2020) found that smartphone use was negatively associated with participants' hedonic and eudaimonic well-being.

Given the societal issues generated by the problematic use of smartphones, researchers have started to examine whether constraining screen time via digital intervention tools (e.g., smartphone applications) will reinstate problematic smartphone users' sleep quality (Lanaj et al., 2014) and digital well-being (Monge Roffarello & de Russis, 2019). On the one hand, Liao

(2019) conducted a two-week experiment, which showed that the intervention improved sleep quality of people with mild to moderate depression and anxiety levels. In support of the idea, Schmuck (2020) has also found that using a digital detox application has a positive effect on participants' well-being. On the other hand, there has been another line of research which demonstrates that screen time interventions via digital intervention tools might not be as effective as found by previous studies (Dunican et al., 2017; Loid et al., 2020). Such findings suggest the necessity to further explore the ways to improve the effectiveness of screen time intervention after taking into account the types of intervention tools that are used by previous studies for constraining problematic smartphone use.

Perhaps, the reason why mixed findings have emerged might be pertinent to the fact that the types and levels of intervention are not clearly operationalized in previous studies. Worthy of note, most of the previous studies have merely focused on simply restricting smartphone use via artificial experimental manipulations without considering the utility of available intervention tools on the current market (Dunican et al., 2017; Hughes & Burke, 2018). Furthermore, even when software app tools available on the current market are used for operationalizing screen time intervention in past studies (Brown & Kuss, 2020; Schmuck, 2020), it merits notice that the degree to which an intervention tool imposes restrictions is barely taken into account. Such an artificial experimental manipulation of screen time intervention and unclear operationalization of intervention level in the past studies call into question the validity of their findings.

Another reason for finding mixed results might pertain to the fact that smartphone users' individual traits have not been sufficiently taken into account when examining the effectiveness of screen time intervention. Of numerous individual-level factors that might moderate the effects of screen time intervention on sleep quality and digital well-being, previous studies imply that

the impulsiveness of smartphone users may play a decisive role as a moderator. According to Moeller et al. (2001), impulsiveness is a trait that predisposes people to react quickly and fast to stimuli without considering the consequences. Previous studies demonstrate that impulsivity as a dispositional trait can consequently lead to both behavioral and substance addiction (e.g. Moeller et al., 2001; Roberts et al., 2015). In relation to the current study, it has been found that impulsivity may increase the odds of developing problematic smartphone use (Billieux et al., 2008). Given the notion, the current study urges the necessity to take into account smartphone users' impulsivity traits as a potential moderator when investigating the effects of screen time intervention on sleep quality and digital well-being.

Taken together, the current study attempts to provide a better understanding of when and how screen time intervention can be effective for improving sleep quality and digital well-being after clearly operationalizing the type and the level of screen time intervention (i.e., type of barriers: no restriction vs. software app restriction vs. software + physical device restriction) and testing the potential moderating role of smartphone users' impulsivity level. For this, the current study conducted a 2-week micro-longitudinal field experiment using the recently developed screen time intervention tool Unpluq (Smits et al., 2021). Unpluq is functionally a screen time intervention tool developed for helping problematic smartphone users exercise digital detoxing (i.e., the act of restructuring or taking a break from a digital technology for a certain amount of time; Syvertsen & Enli, 2019). Intriguingly, Unpluq provides two different type of services: 1) the Unpluq software application with physical device (i.e., a special USB key that needs to be plugged in to activate the use of self-restricted apps) and 2) the Unpluq Premium software application (i.e., users can simply shake their phones for three seconds to activate self-restricted apps). The current research defines the Unpluq software application with a physical device as a

higher level of screen time intervention (i.e., strongest barrier) as compared to the Unpluq Premium software application based on a theoretical justification. Based on the justification, this study examines whether screen time intervention will improve users' sleep quality and well-being (RQ1) depending on the users' impulsivity level (RQ2), and which type of intervention will better perform (RQ3).

Theoretical Framework

Digital detoxing, sleep quality, and well-being

Sleep quality and well-being are known to be the important factors that determine the quality of people's daily life (Lawson et al., 2020). While recent digital technologies are developed to help and guide us throughout our daily life (e.g., using our phone to set alarms, call others, provide guidelines and reminders for living a healthy life), previous studies demonstrate that the use of such technologies may unexpectedly incur negative consequences on the quality of users' sleep and well-being (Heath et al., 2014; Oka et al., 2008; Twenge and Campbell, 2018).

With respect to sleep quality, several studies have provided some explanations of why and how the use of digital technologies can engender negative outcomes. For example, a study conducted by Oka et al. (2008) showed that the use of the internet, phone, and computer before bedtime hours can disrupt the sleep pattern of individuals by making them constantly engage with the behaviors (i.e., the indiscreet use of such media technologies). Another study suggests that hyperarousal may potentially harm the quality of sleep (Pigeon & Perlis, 2006). Hyperarousal refers to the process of being aroused by the consumption of stimulating media contents (e.g., playing interesting games) that could induce the failure of self-regulation (Pigeon

& Perlis, 2006). A failure to self-regulate their technology use gives a premise for procrastinating bedtime. In these situations, people go to sleep much later than it is healthy to and do not get enough sleep, resulting in lower quality of their sleep. Furthermore, the exposure to the light of screens during bedtime hours was found to harm the sleep quality by making the level of melatonin fail to increase (Heath et al., 2014). These studies consistently demonstrate that the use of digital technologies before bedtime can make users suffer from insomnia, which could harm the quality of their sleep.

As already mentioned, well-being refers to the quality of life and life satisfaction of an individual influenced by the use of digital technologies (Burr et al., 2020). In relation to this construct, previous academic research shows mixed results. For example, George et al. (2020) studied digital technology use in relation to adolescents' well-being. Specifically, they did find out that there was an association between the two determinants, such as using digital technologies increases stress levels and spillover effects in adolescents' offline lives. However, all results were not significant, and the authors concluded that there is not a reliable connection between digital technology use and adolescents' well-being (George et al., 2020). On the other hand, several studies have shown significant results. Overall, after examining children and adolescents in concern with technology use and well-being, Twenge and Campbell (2018) have found that participants who are heavy users of technology have reported lower levels of psychological well-being. This leads to an inability to self-control, finish tasks, poor emotion regulation, and lower curiosity levels. Additionally, the authors found out that adolescents who are high users are twice more likely to be associated with depression and anxiety symptoms (Twenge & Campbell, 2018). In support of this notion, it has been found that Facebook use negatively relates to people's well-being (Shakya & Christakis, 2017). This means that people

who use the social media platform have reported significantly lower levels of well-being. Based on all the above, although quite inconclusive, previous research seems to suggest that digital technology affects the well-being levels of individuals. The effects of this translate, for example, into lower self-regulation abilities, inability to complete tasks, feeling of unhappiness, sadness, anxiety, and depression.

Within the current study, well-being is looked at as two separate constructs - the hedonic and eudaimonic. Hedonic well-being refers to 'the view that wellbeing consists of pleasure or happiness' (Ryan & Deci, 2001, p. 143). Eudaimonic well-being means that 'well-being consists of fulfilling or realizing one's daimon or true nature' (Ryan & Deci, 2001, p. 143). Although separate, these constructs have been viewed as units of the general well-being (Ryan & Deci, 2001). Therefore, there is an emphasis on the correlation between happiness and meaning (King & Napa, 1998). In support of this notion, Compton et al. (1996) stressed the importance of a more holistic approach in measuring overall well-being. The authors conducted a study among 338 individuals where they found out that both hedonic and eudaimonic views are important factors in measuring mental health and well-being.

Given such issues, the concept of digital detox (i.e., the restriction and non-use of digital technology for a particular amount of time; Anrijs et al., 2018) has started to receive much attention from both researchers and practitioners. In recent years, various types of digital detox applications have been developed (e.g., Forest, Quality time). Numerous studies have been conducted to test the effectiveness of using such applications for improving the quality of life. For example, in the study of Liao (2019), it was examined whether smartphone intervention will enhance the well-being and sleep quality of people with depression and anxiety. Their study lasted two weeks. Notably, the findings of this study posit that sleep quality and well-being

levels significantly improve in people who have a mild to moderate level of depression and anxiety (Liao, 2019). In line with the finding, the study of Hughes and Burke (2018) also found that a decrease in screen time during bedtime hours and the absence of a smartphone in a bedroom can significantly improve sleep quality and well-being. Furthermore, the study of Schmuck (2020) provided further evidence that the use of digital detox applications can be effective for preventing the problematic use of digital media technologies and for increasing users' well-being.

However, there also have been studies that called into question the effectiveness of digital detox. For instance, Dunican et al. (2017) conducted an experiment to test if imposing a restriction to using digital media for the duration of 48 hours will have a positive effect on the sleep quality and the performance of athletes. In contrast to what the previously mentioned studies have found, this study found no significant effects of digital detoxing on the sleep quality and the performance of athletes. In addition, Hall et al. (2019) explored the effects of 4-week abstinence from social media on participants' well-being. It was a diary study among 130 community and undergraduate students, where they were split into 5 different groups, with different restriction times ('no change in social media use, and one week, two weeks, three weeks, and four weeks abstinence from social media'; Hall et al., 2019). However, results showed no effect of this restriction.

Previous research on the effectiveness of digital detox intervention on individuals' well-being and sleep quality is quite inconclusive. One plausible explanation why there might be mixed findings in terms of the effectiveness of digital detoxing may pertain to the fact that there is an inconsistent operationalization of the intervention duration among previous studies. This could be the reason why there are such mixed findings. Studies, whose duration was or exceeded

a week, turned out to be more likely to have significant results (Hughes and Burke, 2018; Liao, 2019), compared to studies, which took less than a week of intervention (Dunican et al., 2017;). For example, in the study of Dunican et al. (2017), the restriction time was only 48 hours, and the results were non-significant. On the other hand, Liao (2019) made their participants use the restriction for a period of 2 weeks, and their experiment turned out to have an effect. Thus, if an intervention is used for a longer period of time, digital detox intervention is expected to engender significant effects on both sleep quality and well-being.

The aim of this study is to provide a better understanding of the effectiveness of digital detox interventions. This is done by testing and comparing the effects of two digital detox interventions: Unpluq Premium (psychological barrier) and Unpluq USB key (psychological + physical barrier). Thus, the following hypotheses are posited:

> H1(a/b/c). Using screen time intervention tools will improve smartphone users' 1) sleep quality b) hedonic well-being and c) eudaimonic well-being as compared to not using them.

Physical and Psychological Aspects of Digital Detox Interventions

When people perform an act a certain amount of times, it can easily become automatic behavior. This automatic behavior poses both positive and negative effects. Positive effects include being able to execute tasks easily, without consuming extra resources for the task (Wood & Neal, 2007). Negative effects imply that the attention is guided by other factors, rather than more conscious and particular goals (Wood & Neal, 2007). Just the existence and presence of our phones trigger this automatic behavior (Oulasvirta et al., 2011). Excessive smartphone use can cause problematic outcomes, closely connected to losing self-control. Thus, they are regarded as addictive (Oulasvirta et al., 2011). Bayer and Campbell (2012) have studied whether

automaticity predicts the frequency of texting while driving among students. The results show that indeed people are unaware of their actions when driving. Additionally, this behavior is considered an automatic one (Bayer and Campbell,2012). In addition, Oulasvirta et al. (2011) collected the data from three longitudinal studies to investigate and explain what motivates the process of habit formation. Results have shown that notifications (e.g., quick access to information) induce habit-formation (checking behavior). Consequently, they increase the time spent on the phone (Oulasvirta et al.,2011). On the whole, this habitual behavior poses a big problem for the majority of people and their general well-being.

This automaticity can be formed with the help of relevant cues, which in time become triggers for the habits (Orbell & Verplanken, 2010). For example, smokers were found to experience stronger attentional bias towards cues that remind them of smoking cigarettes (Orbell & Verplanken, 2010). However, in order to break the habit, the exposure to the relevant cues needs to be discontinued. The authors also showed that people who combine their goal and implementation intentions (e.g., an 'if-then' situation) are more likely to actually reach their aim, but also form new habits through breaking the cues. In the end, Orbell and Verplanken (2010) concluded that a change in the context provides a 'window of opportunity' (p. 381), where a chance to start an intervention of breaking the habits is given. This could also lead to creating new, better habits. An example is a person who tries to quit smoking starts paying attention to cues to improve his health, rather than cues that remind him of the unhealthy old habit. This idea is endorsed by Gardner (2012) who explained that the process might lead to constant new behaviors because the triggers are not perceived at all.

Furthermore, an additional restriction may increase the effectiveness of a screen time intervention. Lockout tasks, for example, have been tested in relation to media restriction. In

their research J. Kim et al. (2019) investigated whether a lockout task, in the form of a 0, 10, or 30 seconds before the desired app is opened, has an effect on the media usage. They found that individuals significantly decreased their smartphone usage in all three conditions, especially in the 30-second task. They base their argumentation of the results on Uses and Gratification Theory, Expectancy-Value Theory, and Social Cognitive Theory. They argue that when individuals seek gratification and are given a task to complete beforehand, they would have time at their disposal in which system 2 (conscious, slower) of dual-process accounts of reasoning could be activated (Evans, 2003). This results in critical reflection of the action and regard to self-regulation capabilities (J. Kim et al., 2019). Hence, their research proposes that the increase of the restriction negatively influences smartphone use. With respect to previous research, it can be noticed that the constraints that the different intervention tools impose have not been considered and discussed. On the one hand, there are interventions with a simple restriction, such as turning it on or off. On the other hand, however, there are interventions with more complex restrictions, which through some small tasks increase the effort needed to turn them off.

In relation to this study, screen time interventions in the form of applications simply do not prevent the exposure to cues that endorse the automatic behavior. They do provide some information about phone usage to its users, but they are not prominent in their restrictions. Thus, leaving the user to decide for themselves exactly what to do. If people lack goal and implementation intentions, it is likely that these sorts of interventions will not work. A more explicit cue-cutting intervention is needed such as the physical Unpluq key in the current study. Through the addition of a second type of barrier (i.e., physical), the Unpluq device activates the use of self-restricted apps only when inserted into the phone. Different from the application interventions, this device evidently breaks the cues which distract people from their tasks.

Ultimately, it helps implement a more ‘goal-oriented’ use of the smartphone. Nevertheless, the Unplug Premium application only allows for the baseline type of barrier (i.e., psychological), where through a 3-second shake of the phone, users can reach their restricted apps. Hence, it is hypothesized that:

> H2(a/b/c). Using a software app with a physical device (psychological + physical barrier) for screen time intervention will improve the a) sleep quality b) hedonic well-being and c) eudaimonic well-being of smartphone users as compared to using a software app (psychological barrier).

The Moderating Role of Impulsivity

Impulsive people are individuals who act without thinking of the consequences of their actions (Moeller et al., 2001), and within the current study, the personal trait impulsivity is considered as a moderator. According to Patton et al. (1995), impulsivity is a multidimensional construct that is comprised of three sub-dimensions: motor (acting without thinking), attention (inability to focus on the assigned work), and non-planning (inability to plan and think conscientiously). Impulsivity is often considered a main feature in several disorders, such as attention-deficit/hyperactivity disorder (ADHD), substance dependence, and personality disorders (Moeller et al., 2001). For example, Nandagopal et al. (2011) investigated the difference in impulsivity in people with ADHD, bipolar disorder (BD), and healthy people, where individuals with ADHD and BD scored higher in impulsivity in relation to healthy people. Moreover, McGowan and colleagues studied the effects of sleep behavior and physical rhythm during the day of healthy participants through actigraphy, where participants were separated in high and low impulsivity groups (McGowan & Coogan, 2018). Higher impulsivity was

associated with less sleep and lower sleep duration, efficiency, and quality. These results are supported by other literature on ADHD (Coogan & McGowan, 2017).

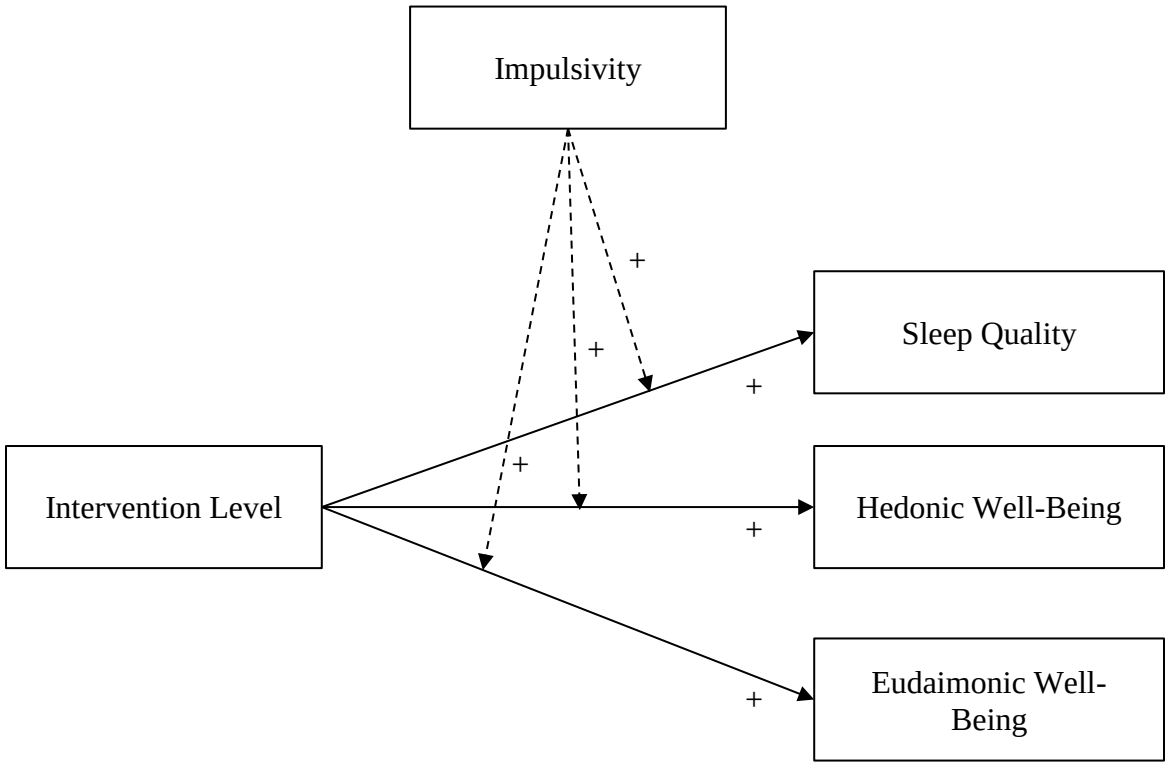
Several scholars have investigated impulsivity in relation to problematic smartphone use. Impulsive traits are positively connected with problematic smartphone use (Billieux et al., 2008). In this regard, a study conducted with students in the United States (Roberts & Pirog, 2013) showed that impulsivity could increase problematic smartphone use (PSU). In support of this notion, Li et al. (2020) conducted a meta-analysis of 350 articles, and the results show that excessive phone use leads to poor sleep quality. This effect is stronger for people with high impulsivity scores. This, in turn, is closely connected to the suggestion that individuals with higher reward addiction and impulsivity are more prone to PSU (Kim et al., 2016). Impulsivity levels are generally considered high when people cannot concentrate on a particular task, because of having irrelevant thoughts (Billieux, 2012). Consequently, these thoughts, and possible boredom, can be rewarded through phone activities such as scrolling on social media. Hence, impulsivity is a crucial personal trait in PSU (Roberts et al., 2015). Within another investigation, Zhu et al. (2019) found that self-control and impulsivity are negatively linked, thus, lower self-control leads to higher levels of impulsivity. Impulsive people are more prone to exercise impulsive behavior and make impulsive decisions (Schulz Van Endert & Mohr, 2020).

In the current study, it is expected that a screen time intervention will have better effects (on sleep quality, hedonic and eudaimonic well-being) for impulsive people. Additionally, it is predicted that the positive effects of the intervention will be stronger for more impulsive people. This is due to the expected lower levels in autonomy and the increased self-regulation resources. Consequently, it is hypothesized that:

H3(a/b/c). Impulsivity will moderate the effects of screen time intervention on a) sleep quality, b) hedonic well-being and c) eudaimonic well-being in such a way that the effects will become stronger when smartphone users' impulsivity level is high.

Figure 1

Conceptual model



Method

Design and Participants

Within the current study, a 3 x 2 factorial mixed-ANOVA design was implemented, with a between-subjects factor (Type of intervention: Unpluq Premium application, Unpluq micro-USB key, and control group with no intervention) and a within-subjects factor (Time: before and after the experiment). The goal was to investigate the effect of (1) digital detox interventions in

comparison with the absence of such, and (2) digital detox Unpluq Premium application in comparison with Unpluq physical key on the sleep quality and well-being of participants.

The participants were all students at Tilburg University and were recruited through SONA human subjects pool in TSHD, thus a convenience sampling method was used. In order to be eligible to take part in the experiment, participants had to adhere to several inclusion criteria as follows: (1) to be older than 18 years old, (2) own an Android smartphone, (3) their smartphone should be capable to run the Unpluq Premium application, (4) participants should not be limiting their phone usage with this or other screen time applications close to/or prior the study, (5) they had to volunteer and be able to restrict their smartphone use for a period of three weeks. Participants who did not adhere to the inclusion criteria were excluded from the final analysis. Hence, the final sample comprised 78 participants from which 36 (46.2%) were female and 40 (51.3%) were male, with a mean age of 23 years old (*SE* = .41). Moreover, 2 (0.7%) of the participants did not disclose their sex.

Apparatus and stimuli

For the experimental conditions, Unpluq digital detox systems (Unpluq Premium application and micro-USB key) were implemented. First, the Unpluq Premium application represents the ‘psychological barrier’, and in essence, participants could only use their restricted applications after shaking their smartphones for three seconds, other than that they were free to use their smartphones as usual. The application does not lock their phone or force this disconnection in any other way. On the other hand, the Unpluq micro-USB key stands for the ‘physical + psychological barrier’ within this study. When inserted into the phone allows users to use their ‘Normal mode’ (all apps included and notifications are included) for a predefined amount of time. In the other time when the key is not inserted, the phone goes into a ‘Focus

mode' where only non-distracting apps are being shown, and there are not any notifications. Unpluq collects personal data and information, such as password, email address, and more, after activating the interventions. The full privacy policy can be found in Appendix A. It is important to note that the researchers do not have any access to this data, and it is not used in the data analysis for this study. Such details are further explained in the information letter (Appendix B).

Procedures

To begin with, participants were welcomed at Tilburg university for their first intake session, where first they were asked to read the information letter (Appendix B) and sign the consent form (see Appendix C). Afterward, participants were randomly assigned to one of the three groups, followed by a session that instructs them on how to: (1) install the Unpluq Premium application (all groups), (2) report the data collected through it (all groups), (3) place time limit for the desired apps (experimental group 1), (4) install Unpluq micro-USB key (experimental group 2). Next, participants in the two experimental groups were asked to choose three apps among their top 10 most used applications that they find distracting and would like to use less often. The data from the selected apps were stored in an encrypted folder. Consequently, they were given questionnaires. Only at baseline, they were asked about their age, gender, English proficiency (Appendix D), and trait impulsivity. Sleep quality and well-being self-reported data were also collected. Then, participants used the assigned to their group apparatus for a period of two weeks. At the end of the experiment, participants were invited to campus again, where they brought back the given equipment and filled in the same set of questionnaires as in the beginning of the experiment, regarding their sleep quality and well-being levels. Finally, they were debriefed about the study goals and thanked for their participation.

Measures

One of the dependent variables within the current study is sleep quality, it was measured both before and after the two week intervention, in order to check whether and how it changes. In order to measure it, Pittsburgh Sleep Quality Index (PSQI) was used (Buysse et al., 1989). It entails nine quotations in total measuring participants' sleep quality for the past two weeks. The first four questions require participants' input. There, they are asked to write down the most accurate answer to questions such as "During the past 2 weeks, what time have you usually gone to bed at night?", and "During the past 2 weeks, how long (in minutes) has it usually taken you to fall asleep each night? ". The consequent three items ask participants to answer on a 4-point Likert scale going from *Not during past three weeks* to *Three or more times a week*. The first question entails ten statements, such as "During the past three weeks, how often have you had trouble sleeping because you cannot go to sleep within 30 minutes" and "During the past three weeks, how often have you had trouble sleeping because you feel too cold". The eight-question asks " During the past 2 weeks, how much of a problem has it been for you to keep up enough enthusiasm to get things done?" and the answer ranges on a 4-point Likert scale going from *No problem at all* to *A very big problem*. And the last question asks "During the past 2 weeks, how would you rate your sleep quality overall?", and the answer ranges from *Very good* to *Very bad*, again on a 4-point Likert scale. For the full questionnaire see Appendix E. The reliability of the scale was good for both pre-intervention ($\alpha = .73$), and post-intervention scales ($\alpha = .77$).

The second and third dependent variables are hedonic and eudaimonic well-being. They were also measured before and after the intervention with the aim to obtain data showing the tendencies regarding these aspects. For this goal, a self-constructed questionnaire, with 16 items, was created. With respect to the current study, only the items for hedonic and eudaimonic well-being were taken into account. There were 4 questions regarding hedonic well-being (e.g. "In the

past two weeks my smartphone entertained me", "In the past two weeks my smartphone helped me relieve boredom"), and 4 questions regarding eudaimonic well-being (e.g. "In the past two weeks my smartphone helped me organize life", "In the past two weeks my smartphone let me experience meaningful things"). All items were measured on a 7-point Likert scale, ranging from *Strongly disagree* to *Strongly agree*). For the full questionnaire see Appendix F. The reliability of the hedonic well-being scale was very good both before ($\alpha = .83$) and after the intervention ($\alpha = .82$). The eudaimonic scale, however, did not show good reliability. Consequently, the first item of both scales was deleted, and the scales became good (pre-intervention, $\alpha = .75$; post-intervention, $\alpha = .71$).

Finally, the moderator within the current study was impulsivity, and it was measured through the BIS-15 scale (Spinella, 2007), which includes 15 statements for three types of impulsivity as follows: (1) Motor (e.g. "I say things without thinking"), (2) Non planning (e.g. "I save regularly"), (3) Attention (e.g. "I don't pay attention"). It ranges from 1 to 4 (*Rarely/never*, *Occasionally*, *Often*, *Almost always*), and the final score represents all the scores of the given answers added, thus the higher the score is, the higher the levels of impulsivity are. For the full questionnaire see Appendix G. The reliability of the scale was initially relatively good, but after deleting the first item it became good, $\alpha = .78$.

Data analysis

For the data analysis, a factorial Mixed ANOVA was used, in order to investigate the effects of intervention type (Unpluq Premium vs. Unpluq micro-USB key vs. and no intervention) and the time the measurement was taken (pre- vs. post-intervention). Additionally planned contrasts were executed, in order to test the specific hypotheses, and moderation

analyses were performed, using the PROCESS v3.5 tool by Andrew F. Hayes. All analyses were performed in IBM SPSS Statistics version 27.

Results

Before testing the hypotheses, a two-way mixed ANOVA was conducted. With respect to sleep quality, results from a two-way mixed ANOVA indicated that sleep quality did not significantly change after the two weeks of intervention, $F(1, 75) = .22$, $p = .64$, $\eta_p^2 = .00$ (see Figure 2). The results of Box's test for sleep quality was not significant, $F(6, 136450.12) = .95$, $p = .46$. In regards to hedonic well-being, the mixed ANOVA analysis showed that hedonic well-being did change significantly after the intervention, $F(1, 75) = 47.34$, $p < .001$, $\eta_p^2 = .39$ (see Figure 3). Additionally, there was also a significant interaction effect between the time of measurement and the type of intervention, $F(2, 75) = 6.58$, $p < .05$, $\eta_p^2 = .15$. The Box's test results were non-significant, $F(6, 136450.12) = 1.50$, $p = .17$. Finally, a mixed ANOVA test showed non-significant results with regards to eudaimonic well-being, $F(1, 75) = 2.65$, $p = .11$, $\eta_p^2 = .03$, and the Box's test results were non-significant as well, $F(6, 136450.12) = .20$, $p = .98$ (see Figure 4).

Next, a planned contrast was conducted to test the main hypotheses. For H1, each group was coded as: USB key = [1], App = [1], and Control = [-2]. H1 stated that using an intervention will improve participants' a) sleep quality, b) hedonic well-being and c) eudaimonic well-being. With regards to sleep quality, planned contrast showed that together participants from Unpluq USB key group ($M = -.68$, $SD = 3.65$) and Unpluq Premium Application group ($M = -.50$, $SD = 3.86$) did not significantly differ from the control group ($M = .63$, $SD = 2.76$), $t(75) = -1.49$, $p = .14$, $d = .37$. Thus, H1a was not supported. With respect to hedonic well-being , planned contrast

test showed that together participants from the Unpluq USB key group (M = -1.09, SD = 1.02) and Unpluq Premium Application group (M = -.67, SD = .80) did significantly differ from the control group (M = -.23, SD = .72), $t(75) = -3.20$, $p < .05$, d = .79. Therefore, H1b was accepted. With respect to eudaimonic well-being , a planned contrast showed that together participants from Unpluq USB key group (M = -.52, SD = .96) and Unpluq Premium Application group (M = -.10, SD =.86) did not significantly differ from the control group (M = .09, SD = 1.01), $t(75) = -1.78$, p = .08, d = .42. Therefore, H1c is not supported by the data.

For H2, each group was coded as: USB key = [1], App = [-1], and Control = [0]. The second hypothesis of the current research states that the Unpluq USB key (psychological + physical barrier) would improve a) the sleep quality, b) the hedonic well-being and c) the eudaimonic well-being of the participants, in comparison with the Unpluq Premium Application (psychological barrier). With regards to sleep quality, a planned contrast showed that the Unpluq USB key group (M = -.68, SD = 3.65) and Unpluq Premium Application group (M = -.50, SD = 3.86) did not significantly differ, $t(75) = -.19$, p = .85, d = .05. Thus, H2a was not supported. Then, a planned contrast showed that participants from the Unpluq USB key group (M = -1.09, SD = 1.02) and Unpluq Premium Application group (M = -.67, SD = .80) did not significantly differ from each other with regards to hedonic well-being, $t(75) = -1.75$, p = .09, d = .46. Therefore, H2b could not be accepted. Finally, with regards to eudaimonic well-being, a planned contrast showed that participants from Unpluq USB key group (M = -.52, SD = .96) and Unpluq Premium Application group (M = -.10, SD =.86) did not significantly differ, $t(75) = -1.60$, p = .11, d = .46. Consequently, H2c was not supported by the data and was not accepted.

The third hypothesis expected that the personal trait impulsivity would positively moderate the effects of the screen time intervention on a) sleep quality, b) hedonic well-being

and c) eudaimonic well-being of the participants. Thus, it was expected that the higher the levels of trait impulsivity an individual has, the better the effect of the intervention would be. With regards to sleep quality, the moderation analysis showed that the model was not significant indicating that the type of intervention (*B* = 1.68, *SE* = 2.23, 95% CI [-2.76, 6.13]) and the impulsivity trait (*B* = 1.85, *SE* = 2.13, 95% CI [-2.39, 6.09]) of participants did not have a main effect on the sleep quality, and consequently H3a could not be accepted. With respect to hedonic well-being, the moderation analysis showed that the type of intervention (*B* = .58, *SE* = .55, 95% CI [-.52, 1.68]) and the impulsivity trait (*B* = -.09, *SE* = .53, 95% CI [-1.14, .96]) of participants did not have a main effect on their hedonic well-being. Thus H3b was not supported by the data. Finally, with regards to eudaimonic well-being, a moderation analysis showed that the type of intervention (*B* = -.61, *SE* = .61, 95% CI [-1.82, .60]) and the impulsivity trait (*B* = -.97, *SE* = .58, 95% CI [-2.13, .18]) did not have a main effect on participants' eudaimonic well-being, and consequently H3c was not supported.

Figure 2

Line graph, showing the relationships between the Type of Intervention, the Time of Measurement and Sleep Quality of participants.

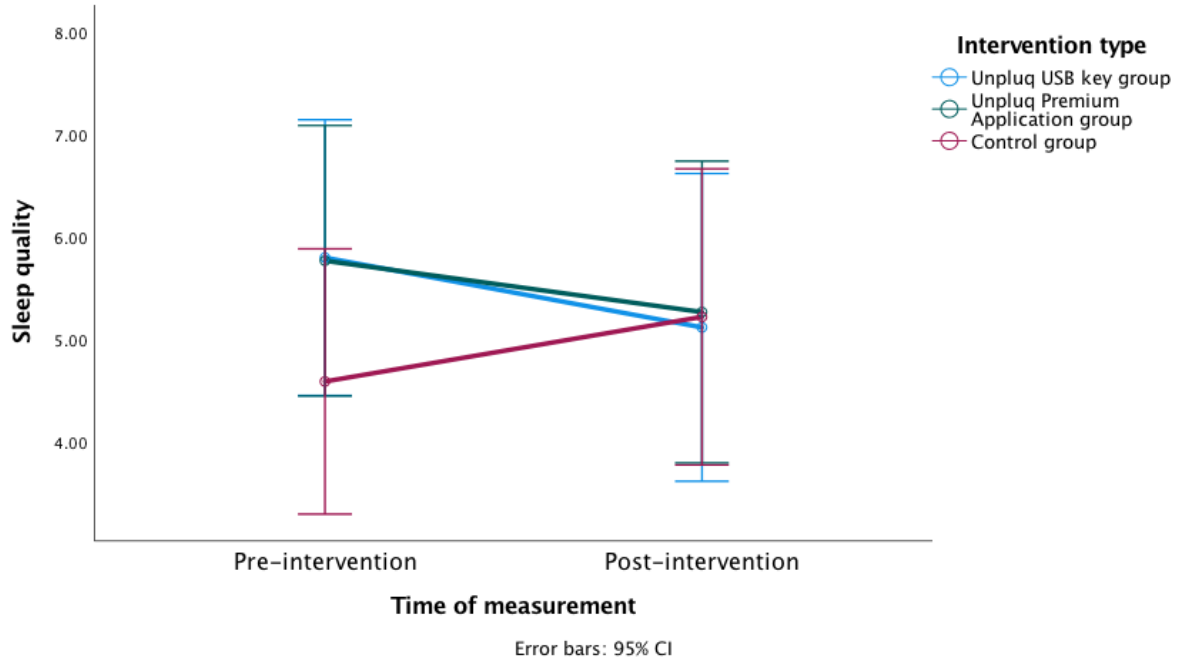


Figure 3

Line graph, showing the relationships between the Type of Intervention, the Time of Measurement and Hedonic well-being of participants.

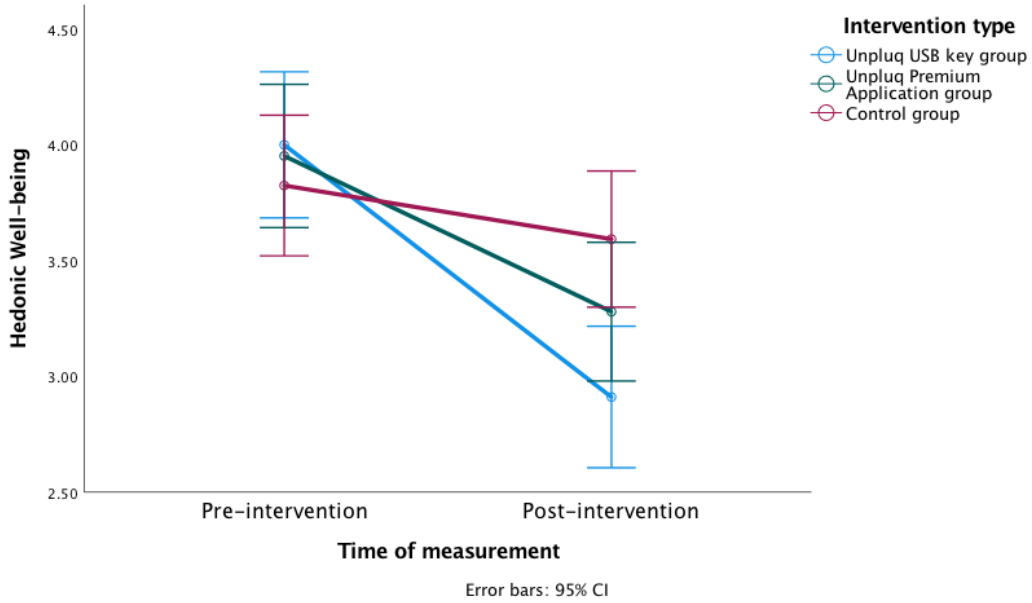
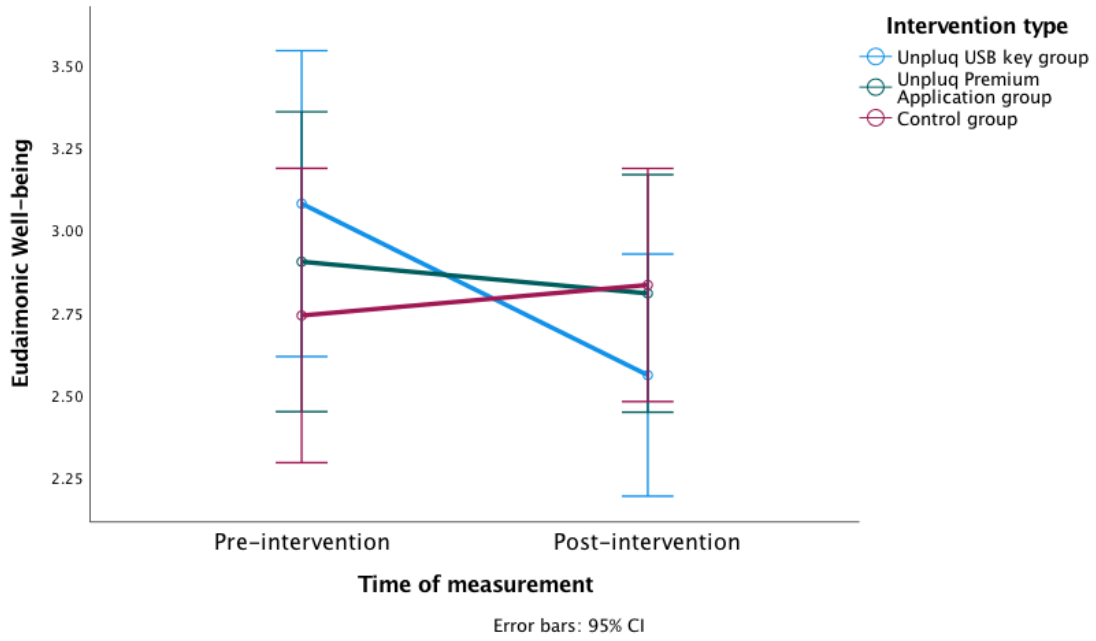


Figure 4

Line graph, showing the relationships between the Type of Intervention, the Time of Measurement and Eudaimonic well-being of participants.



Discussion

Discussion of findings

In the current research it was investigated whether two types of screen time interventions (Unpluq USB key group and Unpluq Premium Application group) had an effect on participants, sleep quality, and hedonic and eudaimonic well-being. Additionally, the trait impulsivity was included as a possible moderator, due to previous research which shows that the impulsivity trait is connected to PSU (Billieux et al., 2008), and negatively affects the sleep quality and well-being of people (Li et al., 2020; Roberts & Pirog, 2013). Two interventions are compared: a physical Unpluq USB key (psychological + physical barrier), and Unpluq Premium Application (psychological barrier).

First, the screen time interventions were compared to the use of none (control group), where it was expected that screen time interventions would have a better effect on participants' sleep quality (H1a), hedonic (H1b), and eudaimonic (H1c) well-being. Then, both screen time interventions were compared to each other in their effects on participants' sleep quality (H2a), hedonic (H2b), and eudaimonic (H2c) well-being, where it was expected that the physical aspect of Unpluq USB key would add an additional form of restriction, and therefore be more effective. Finally, trait impulsivity was explored as a moderator of those relationships, and it was expected that when in the screen time intervention groups, more impulsive participants would have significantly better effects on their sleep quality (H3a), hedonic (H3b), and eudaimonic (H3c) well-being. Specifically, the current paper focuses on the possibilities to enhance people's sleep quality, hedonic and eudaimonic well-being, through restricting their screen time with the help of intervention and explores these effects further based on participants' trait impulsivity.

The results from the statistical tests partially supported the hypotheses. Unexpectedly, sleep quality was not found significant (H1a). These results are not in line with previous research where sleep quality was found to significantly change due to the use of a screen time intervention (Hughes and Burke, 2018; Liao, 2019). However, Dunican et al. (2017) have provided arguments through their study, showing that in the course of 48-hour restriction among athletes, their quality of sleep does not change. Their results were questioned because of the short timeline of their experiment. The current study provides support for this hypothesis, by showing that even after two weeks of intervention, the results are insignificant.

One explanation of the results could be that the convenience sampling method was used for the recruitment process through SONA human subjects pool and the circle of the researchers. Consequently, most of the participants were students. The experiment was conducted close to or

during their exam periods, which can be (very) stressful for students. Some students also tend to procrastinate their academic tasks until the last moment, and this is said to lead to higher feelings of stress and anxiety (Onwuegbuzie, 2004; Schraw et al., 2007). Based on the arguments above, the sleep duration, and therefore sleep quality can be negatively affected (Lund et al., 2010). For future studies, it is recommended to conduct the experimental part after this exam period. Another reason for the non-significant results could be the sample size. The current study was an experiment, which lasted two weeks. This made it hard to recruit participants who were willing to take part in it and comply with the criteria that were given to them. In general, we had 78 participants, resulting in roughly 25 people per condition. This is the minimum in order to possibly get reliable and generalizable results, therefore in future research, the sample should be bigger.

Moreover, the statistical tests confirmed that indeed participants from both the Unpluq USB key group and the Unpluq Premium application group became significantly less reliant on their phones in terms of their hedonic well-being compared to the control group (H1b). These results are in line with previous research where it was found that using a screen time intervention was effective and did improve the well-being of their participants (Hughes and Burke, 2018; Liao, 2019). Such is the study of Schmuck (2020), where a screen time intervention had a positive effect on participants' well-being, by decreasing their PSU. As mentioned before, an additional barrier may predispose the activation of system 2 of dual-process accounts of reasoning (Evans, 2003). This, in turn, may have acted as a signal to our participants of the reasoning behind their phone usage. Another explanation of these results could be that participants signed up for the study, knowing that they would have to restrict their phone usage.

They may have already had to lower their screen time as a goal and the implementation intentions, and the study had provided them with the tools to do so.

With regards to H1c, this means that participants from both experimental groups differ from the control group. Thus, people who used the interventions managed to find meaning and purpose in life beyond their phones. In support of this notion, Tangmunkongvorakul et al. (2019) examined that university students who were considered excessive smartphone users showed lower levels of well-being. One explanation of the results could be the stress levels of the participants during the period that the experiment was conducted. In support of this notion, Chiu (2014) has found that life stress positively leads to smartphone addiction. As stated before, smartphone overuse can lead to a lower level of well-being (Schmuck, 2020). Additionally, the sample size may have also posed a problem, resulting in the marginally significant results. For future research, it is important to recruit more participants, in order to avoid marginally significant results and get more reliable and conclusive ones.

Regarding the second hypothesis, sleep quality (H2a) was found insignificant. This means that the two interventions do not differ from each other with respect to participants' sleep quality. Explanations of this result align with the explanations regarding H1a. As stated above, most of the participants were students who were either close to or in their exam period, which predisposes higher stress and anxiety levels (Onwuegbuzie, 2004; Schraw et al., 2007). This leads to lower quality of sleep (Lund et al., 2010).

In terms of H2b, the results suggest that both experimental groups might actually be different from each other with respect to hedonic well-being. Even though the statistical tests showed no significant results, they were marginally significant. After the intervention, the Unpluq USB key group manifested a decline when it came to the happiness and joy that their

phone brought them. This finding contributes to previous literature, where an additional barrier was found effective in restraining distractive smartphone use (J. Kim et al., 2019). Here, the physical aspect of the device plays this role. Consequently, less frequent use of smartphones has a positive effect on well-being (Tangmunkongvorakul et al., 2019).

Both experimental groups also did not significantly differ with regards to eudaimonic well-being (H2c). Within the current study, although it can be seen on the graph that there is some difference between the two experimental groups in favor of the Unpluq USB key group, no significant change in eudaimonic well-being levels is spotted. This is not in line with previous literature, where for example Hughes and Burke (2018) have found that physically restricting smartphones before and during sleep improves well-being levels. In a study concerning screen time, Owenz and Fowers (2020) have suggested that if screen time is replaced with other meaningful and purposeful activities (goal orientation) for kids, then their eudaimonic well-being has been shown to increase. Based on that and the results, it can be concluded that it is possible that students did not find purposeful activities to engage themselves in. This could be the reason why their eudaimonic well-being levels did not significantly change despite the measures that they have taken to improve it.

With respect to the third hypothesis and the moderation effects of trait impulsivity, the statistical tests showed no such effects on any of the dependent variables. These results are partly surprising because previous research does show that excessive phone use leads to poorer sleep quality, and this effect is stronger for people with high impulsivity scores (Li et al., 2020). Even more, with regards to well-being, Goodwin et al. (2017) has found that high impulsivity does indeed lower the overall well-being levels and lack of sleep. Within the current research a viewpoint where impulsivity and self-control are opposites was taken into account (Friese &

Hofmann, 2009; Zhu et al., 2019). Other scholars, however, have argued the exact opposite (Kalenscher et al., 2006): impulsivity and self-control are not regarded as opposites, but just as different concepts. Consequently, if the second approach is taken into account instead, the non-significant results regarding participants' impulsivity, would not account for self-control as well. Specifically, it would not mean that if participants are high in impulsivity, then automatically they lack self-control. Therefore, it could be the case that self-control is a much better and more proper variable to explore in the context of screen time interventions. This would suggest that in future research it might be better to explore self-control as a mediator of the effects instead.

Another factor that might be a better fit and interesting to explore in future research regarding this topic could be habits. Habits are defined as "a thing that you do often and almost without thinking, especially something that is hard to stop doing" (Oxford Learner's Dictionaries, n.d.). For example, Oulasvirta et al. (2011) have found that technologies are becoming pervasive, and this is due to the checking habit-formation. They argue that by regularly checking our phones for notifications, or in other words instant rewards, people start forming this habit. They start browsing their phones without a reason due to this compulsively checking behavior, leading to distracting use of the phone. Thus, it can be that habits can be a better moderator of the relationship between the type of intervention and sleep quality, hedonic and eudaimonic well-being, and it should be further explored.

Finally, most of the participants were students. This could pose a problem for the current results as well because, as said before, the experiment was conducted right before or during their exam period, which could play a role in their answers. It could be the case that the measure used in this study did gauge their current impulsiveness due to stress and anxiety, instead of their trait impulsivity.

Implications

Frequent use of technology affects us and screen time interventions have started to emerge. Scholars have studied the effects of applications aiming to understand and lower the distractive screen time of people. While some interventions have been found effective, others have not. However, this field of research is quite new, and previous research is not extensive. This study aimed to not only understand the effect of a screen time application, but also that of an intervention with an additional barrier - the physical one (Unpluq USB key). Results indicated that screen time interventions, in general, can be an effective way to lower distractive smartphone usage. Additionally, both eudaimonic and hedonic well-being levels may increase during this process.

There are several implications to this. First, screen time interventions are good tools to lower distractive smartphone use. Moreover, lowering screen time has a beneficial effect on users' well-being levels. This seems to imply that screen time interventions are useful tools that improve people's well-being. Consequently, it would be advantageous to keep on working and improving them. Another implication is that it might be practical to further develop the idea of the intervention having a second barrier, as it was found effective to a certain extent. This, however, is a topic that needs greater testing and understanding.

Limitations and future directions

The current study has several limitations and recommendations for future research, and some of them have already been mentioned above. In addition to them, several others are further discussed here. First, the Unpluq devices that were tested could only work on Android smartphones. This, in turn, made the recruitment process harder, as many other people could not sign up for the study. Moreover, during the intake session, several students were not able to

proceed with the installation process of either the Unpluq device or the Unpluq Premium application, sometimes even both. For future studies, it is recommended to study a more developed product, which can include all sorts of phone brands, and could be installed on them problem-free. Another limitation is the participants' sample, which was small, thus having an effect on the results. Namely, the participants were all young adults and the results may only be generalized for this target group (18 - 31 years old). For future research, it is recommended to recruit more diverse participants, with regards to their age. Yet another limitation of the current study is the fact that during the intervention time, participants were not followed or observed whether they used the intervention or not. It could be that some of them have stopped using the intervention after a certain amount of time. For future research, it is advised to implement some sort of check questions, through which participants can be surveyed on whether or not they use the given interventions. Finally, the study was conducted during Covid-19 times. Participants may have begun to rely more heavily on their phones because of the pandemic (Hu et al., 2022). This, in turn, could have influenced the results, such as it being harder for them to comply with the intervention. It is advised to conduct this sort of research again after the pandemic has finished and people have resumed their normal lives.

References

Anrijs, S., Bombeke, K., Durnez, W., van Damme, K., Vanhaelewyn, B., Conradie, P., Smets, E., Cornelis, J., de Raedt, W., Ponnet, K., & de Marez, L. (2018). MobileDNA: Relating Physiological Stress Measurements to Smartphone Usage to Assess the Effect of a Digital Detox. HCI International 2018 – Posters' Extended Abstracts, 851, 356–363. https://doi.org/10.1007/978-3-319-92279-9_48

Bayer, J. B., & Campbell, S. W. (2012). Texting while driving on automatic: Considering the frequency-independent side of habit. Computers in Human Behavior, 28(6), 2083–2090. https://doi.org/10.1016/j.chb.2012.06.012

Billieux, J., van der Linden, M., & Rochat, L. (2008). The role of impulsivity in actual and problematic use of the mobile phone. *Applied Cognitive Psychology*, 22(9), 1195–1210. https://doi.org/10.1002/acp.1429

Billieux, J. (2012). Problematic Use of the Mobile Phone: A Literature Review and a Pathways Model. Current Psychiatry Reviews, 8(4), 299–307. https://doi.org/10.2174/157340012803520522

Brown, L., & Kuss, D. J. (2020). Fear of Missing Out, Mental Wellbeing, and Social Connectedness: A Seven-Day Social Media Abstinence Trial. *International Journal of Environmental Research and Public Health*, 17(12), 1–18. https://doi.org/10.3390/ijerph17124566

Burr, C., Taddeo, M., & Floridi, L. (2020). The Ethics of Digital Well-Being: A Thematic Review. *Science and Engineering Ethics*, 26(4), 2313–2343. https://doi.org/10.1007/s11948-020-00175-8

Buysse, D. J., Reynolds, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research. *Psychiatry Research*, 28(2), 193–213. https://doi.org/10.1016/0165-1781(89)90047-4

Cajochen, C. (2007). Alerting effects of light. Sleep Medicine Reviews, 11(6), 453–464. https://doi.org/10.1016/j.smrv.2007.07.009

Chiu, S. I. (2014). The relationship between life stress and smartphone addiction on taiwanese university student: A mediation model of learning self-Efficacy and social self-Efficacy. *Computers in Human Behavior*, *34*, 49–57. https://doi.org/10.1016/j.chb.2014.01.024

Chóliz, M. (2010). Mobile phone addiction: A point of issue. *Addiction*, 105(2), 373–374. https://doi.org/10.1111/j.1360-0443.2009.02854.x

Compton, W. C., Smith, M. L., Cornish, K. A., & Qualls, D. L. (1996). Factor structure of mental health measures. Journal of Personality and Social Psychology, 71(2), 406–413. https://doi.org/10.1037/0022-3514.71.2.406

Coogan, A. N., & McGowan, N. M. (2017). A systematic review of circadian function, chronotype and chronotherapy in attention deficit hyperactivity disorder. ADHD Attention Deficit and Hyperactivity Disorders, 9(3), 129–147. https://doi.org/10.1007/s12402-016-0214-5

Davenport, T. H., & Beck, J. C. (2001). The Attention Economy. *Reed Business Education*. https://dl.acm.org/doi/fullHtml/10.1145/376625.376626?casa_token=sBTzIk5GvcoAAAAA:SC8Fx6OzplWeyfmzfZJ5HOtiP6gZfcsAVnyuK59OLvMCEvritweHyMAlr-3ZvW-G0XKBStyEqzMBtg

Dunican, I. C., Martin, D. T., Halson, S. L., Reale, R. J., Dawson, B. T., Caldwell, J. A., Jones, M. J., & Eastwood, P. R. (2017). The Effects of the Removal of Electronic Devices for

48 Hours on Sleep in Elite Judo Athletes. *Journal of Strength and Conditioning Research*, 31(10), 2832–2839. https://doi.org/10.1519/jsc.0000000000001697

Elhai, J. D., Tiamiyu, M. F., Weeks, J. W., Levine, J. C., Picard, K. J., & Hall, B. J. (2018). Depression and emotion regulation predict objective smartphone use measured over one week. *Personality and Individual Differences*, 133, 21–28. https://doi.org/10.1016/j.paid.2017.04.051

Evans, J. S. (2003). In two minds: Dual-process accounts of reasoning. Trends in Cognitive Sciences, 7(10), 454–459. https://doi.org/10.1016/j.tics.2003.08.012

Friese, M., & Hofmann, W. (2009). Control me or I will control you: Impulses, trait self-control, and the guidance of behavior. *Journal of Research in Personality*, *43*(5), 795–805. https://doi.org/10.1016/j.jrp.2009.07.004

Gardner, B. (2012). Habit as automaticity, not frequency. The European Health Psychologist, 14(1), 32–36. https://www.researchgate.net/profile/Benjamin-Gardner-2/publication/230576965_Habit_as_automaticity_not_frequency/links/09e4150753b94afa13000000/Habit-as-automaticity-not-frequency.pdf

George, M. J., Jensen, M. R., Russell, M. A., Gassman-Pines, A., Copeland, W. E., Hoyle, R. H., & Odgers, C. L. (2020). Young Adolescents' Digital Technology Use, Perceived Impairments, and Well-Being in a Representative Sample. The Journal of Pediatrics, 219, 180–187. https://doi.org/10.1016/j.jpeds.2019.12.002

Goodwin, B. C., Browne, M., Hing, N., & Russell, A. M. (2017). Applying a revised two-factor model of impulsivity to predict health behaviour and well-being. *Personality and Individual Differences*, *111*, 250–255. https://doi.org/10.1016/j.paid.2017.02.029

Grant, J. E., Lust, K., & Chamberlain, S. R. (2019). Problematic smartphone use associated with greater alcohol consumption, mental health issues, poorer academic performance, and impulsivity. *Journal of Behavioral Addictions*, *8*(2), 335–342. https://doi.org/10.1556/2006.8.2019.32

Guo, N., Luk, T. T., Ho, S. Y., Lee, J. J., Shen, C., Oliffe, J., Chan, S. S. C., Lam, T. H., & Wang, M. P. (2020). Problematic Smartphone Use and Mental Health in Chinese Adults: A Population-Based Study. *International Journal of Environmental Research and Public Health*, 17(3), 844. https://doi.org/10.3390/ijerph17030844

Ha, J. H., Chin, B., Park, D. H., Ryu, S. H., & Yu, J. (2008). Characteristics of Excessive Cellular Phone Use in Korean Adolescents. *CyberPsychology & Behavior*, *11*(6), 783–784. https://doi.org/10.1089/cpb.2008.0096

Hall, J. A., Xing, C., Ross, E. M., & Johnson, R. M. (2019). Experimentally manipulating social media abstinence: results of a four-week diary study. Media Psychology, 24(2), 259–275. https://doi.org/10.1080/15213269.2019.1688171

Heath, M., Sutherland, C., Bartel, K., Gradisar, M., Williamson, P., Lovato, N., & Micic, G. (2014). Does one hour of bright or short-wavelength filtered tablet screenlight have a meaningful effect on adolescents' pre-bedtime alertness, sleep, and daytime functioning? Chronobiology International, 31(4), 496–505. https://doi.org/10.3109/07420528.2013.872121

Hu, Q., Liu, Q., & Wang, Z. (2022). Meaning in life as a mediator between interpersonal alienation and smartphone addiction in the context of Covid-19: A three-wave longitudinal study. Computers in Human Behavior, 127, 1–11. https://doi.org/10.1016/j.chb.2021.107058

Hughes, N., & Burke, J. (2018). Sleeping with the frenemy: How restricting 'bedroom use' of smartphones impacts happiness and wellbeing. *Computers in Human Behavior*, 85, 236–244. https://doi.org/10.1016/j.chb.2018.03.047

Jenaro, C., Flores, N., Gómez-Vela, M., González-Gil, F., & Caballo, C. (2007). Problematic internet and cell-phone use: Psychological, behavioral, and health correlates. *Addiction Research & Theory*, *15*(3), 309–320. https://doi.org/10.1080/16066350701350247

Kalenscher, T., Ohmann, T., & Güntürkün, O. (2006). The neuroscience of impulsive and self-controlled decisions. *International Journal of Psychophysiology*, *62*(2), 203–211. https://doi.org/10.1016/j.ijpsycho.2006.05.010

Kim, J., Park, J., Lee, H., Ko, M., & Lee, U. (2019). LocknType. Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, 1–12. https://doi.org/10.1145/3290605.3300927

Kim, Y., Jeong, J. E., Cho, H., Jung, D. J., Kwak, M., Rho, M. J., Yu, H., Kim, D. J., & Choi, I. Y. (2016). Personality Factors Predicting Smartphone Addiction Predisposition: Behavioral Inhibition and Activation Systems, Impulsivity, and Self-Control. PLoS ONE, 11(8), 1–15. https://doi.org/10.1371/journal.pone.0159788

King, L. A., & Napa, C. K. (1998). What makes a life good? Journal of Personality and Social Psychology, 75(1), 156–165. https://doi.org/10.1037/0022-3514.75.1.156

Lanaj, K., Johnson, R. E., & Barnes, C. M. (2014). Beginning the workday yet already depleted? Consequences of late-night smartphone use and sleep. *Organizational Behavior and Human Decision Processes*, *124*(1), 11–23. https://doi.org/10.1016/j.obhdp.2014.01.001

Lawson, L. P., Richdale, A. L., Haschek, A., Flower, R. L., Vartuli, J., Arnold, S. R., & Trollor, J. N. (2020). Cross-sectional and longitudinal predictors of quality of life in autistic

individuals from adolescence to adulthood: The role of mental health and sleep quality. Autism, 24(4), 954–967. https://doi.org/10.1177/1362361320908107

Li, Y., Li, G., Liu, L., & Wu, H. (2020). Correlations between mobile phone addiction and anxiety, depression, impulsivity, and poor sleep quality among college students: A systematic review and meta-analysis. Journal of Behavioral Addictions, 9(3), 551–571. https://doi.org/10.1556/2006.2020.00057

Liao, W. (2019). Put Your Smartphone Down: Preliminary Evidence that Reducing Smartphone Use Improves Psychological Well-being in People with Poor Mental Health (Thesis, Master of Science). *University of Otago*. Retrieved from http://hdl.handle.net/10523/9427

Loid, K., Täht, K., & Rozgonjuk, D. (2020). Do pop-up notifications regarding smartphone use decrease screen time, phone checking behavior, and self-reported problematic smartphone use? Evidence from a two-month experimental study. *Computers in Human Behavior*, *102*, 22–30. https://doi.org/10.1016/j.chb.2019.08.007

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep Patterns and Predictors of Disturbed Sleep in a Large Population of College Students. Journal of Adolescent Health, 46(2), 124–132. https://doi.org/10.1016/j.jadohealth.2009.06.016

McGowan, N. M., & Coogan, A. N. (2018). Sleep and circadian rhythm function and trait impulsivity: An actigraphy study. Psychiatry Research, 268, 251–256. https://doi.org/10.1016/j.psychres.2018.07.030

Moeller, F. G., Barratt, E. S., Dougherty, D. M., Schmitz, J. M., & Swann, A. C. (2001). Psychiatric Aspects of Impulsivity. *American Journal of Psychiatry*, *158*(11), 1783–1793. https://doi.org/10.1176/appi.ajp.158.11.1783

Monge Roffarello, A., & de Russis, L. (2019). The Race Towards Digital Wellbeing. Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, 1–14. https://doi.org/10.1145/3290605.3300616

Nandagopal, J. J., Fleck, D. E., Adler, C. M., Mills, N. P., Strakowski, S. M., & DelBello, M. P. (2011). Impulsivity in Adolescents with Bipolar Disorder and/or Attention-Deficit/Hyperactivity Disorder and Healthy Controls as Measured by the Barratt Impulsiveness Scale. Journal of Child and Adolescent Psychopharmacology, 21(5), 465–468. https://doi.org/10.1089/cap.2010.0096

Oka, Y., Suzuki, S., & Inoue, Y. (2008). Bedtime Activities, Sleep Environment, and Sleep/Wake Patterns of Japanese Elementary School Children. Behavioral Sleep Medicine, 6(4), 220–233. https://doi.org/10.1080/15402000802371338

Onwuegbuzie, A. J. (2004). Academic procrastination and statistics anxiety. Assessment & Evaluation in Higher Education, 29(1), 3–19. https://doi.org/10.1080/0260293042000160384

Orbell, S., & Verplanken, B. (2010). The automatic component of habit in health behavior: Habit as cue-contingent automaticity. Health Psychology, 29(4), 374–383. https://doi.org/10.1037/a0019596

Oulasvirta, A., Rattenbury, T., Ma, L., & Raita, E. (2011b). Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing*, *16*(1), 105–114. https://doi.org/10.1007/s00779-011-0412-2

Owenz, M. B., & Fowers, B. J. (2020). A Goal-Theoretic Framework for Parental Screen-Time Monitoring Behavior. *Journal of Family Theory & Review*, *12*(3), 335–349. https://doi.org/10.1111/jftr.12384

Oxford Learner's Dictionaries. (n.d.). *habit noun - Definition, pictures, pronunciation and usage notes | Oxford Advanced Learner's Dictionary at OxfordLearnersDictionaries.com*. Retrieved December 31, 2021, from https://www.oxfordlearnersdictionaries.com/definition/english/habit

Patton, J. H., Stanford, M. S., & Barratt, E. S. (1995). Factor structure of the barratt impulsiveness scale. Journal of Clinical Psychology, 51(6), 768–774. https://onlinelibrary.wiley.com/doi/abs/10.1002/1097-4679(199511)51:6%3C768::AID-JCLP2270510607%3E3.0.CO;2-1

Pigeon, W. R., & Perlis, M. L. (2006). Sleep homeostasis in primary insomnia. Sleep Medicine Reviews, 10(4), 247–254. https://doi.org/10.1016/j.smrv.2005.09.002

Roberts, J. A., & Pirog, S. F. (2013). A preliminary investigation of materialism and impulsiveness as predictors of technological addictions among young adults. *Journal of Behavioral Addictions*, *2*(1), 56–62. https://doi.org/10.1556/jba.1.2012.011

Roberts, J. A., Pullig, C., & Manolis, C. (2015). I need my smartphone: A hierarchical model of personality and cell-phone addiction. *Personality and Individual Differences*, *79*, 13–19. https://doi.org/10.1016/j.paid.2015.01.049

Roberts, J. A., Pullig, C., & Manolis, C. (2015). I need my smartphone: A hierarchical model of personality and cell-phone addiction. Personality and Individual Differences, 79, 13–19. https://doi.org/10.1016/j.paid.2015.01.049

Ryan, R. M., & Deci, E. L. (2001). On Happiness and Human Potentials: A Review of Research on Hedonic and Eudaimonic Well-Being. Annual Review of Psychology, 52(1), 141–166. https://doi.org/10.1146/annurev.psych.52.1.141

Schmuck, D. (2020). Does Digital Detox Work? Exploring the Role of Digital Detox Applications for Problematic Smartphone Use and Well-Being of Young Adults Using Multigroup Analysis. *Cyberpsychology, Behavior, and Social Networking*, *23*(8), 526–532. https://doi.org/10.1089/cyber.2019.0578

Schraw, G., Wadkins, T., & Olafson, L. (2007). Doing the things we do: A grounded theory of academic procrastination. *Journal of Educational Psychology*, *99*(1), 12–25. https://doi.org/10.1037/0022-0663.99.1.12

Schulz Van Endert, T., & Mohr, P. N. C. (2020). Likes and impulsivity: Investigating the relationship between actual smartphone use and delay discounting. PLOS ONE, 15(11). https://doi.org/10.1371/journal.pone.0241383

Shakya, H. B., & Christakis, N. A. (2017). Association of Facebook Use With Compromised Well-Being: A Longitudinal Study. American Journal of Epidemiology, 185(3), 203–211. https://doi.org/10.1093/aje/kww189

Smits, T., Rigter, J., B, D. O., Rigter, J., B, D. O., B, D. O., Rigter, J., & Rigter, J. (2021, July 21). *Home*. Unpluq. https://unpluq.com/

Spinella, M. (2007). Normative data and a short form of the Barratt Impulsiveness Scale. *International Journal of Neuroscience*, 117(3), 359–368. https://doi.org/10.1080/00207450600588881

Syvertsen, T., & Enli, G. (2019). Digital detox: Media resistance and the promise of authenticity. *Convergence: The International Journal of Research into New Media Technologies*, 26(5–6), 1269–1283. https://doi.org/10.1177/1354856519847325

Tangmunkongvorakul, A., Musumari, P. M., Thongpibul, K., Srithanaviboonchai, K., Techasrivichien, T., Suguimoto, S. P., Ono-Kihara, M., & Kihara, M. (2019). Association

of excessive smartphone use with psychological well-being among university students in Chiang Mai, Thailand. PLOS ONE, 14(1), 1–13. https://doi.org/10.1371/journal.pone.0210294

Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. Preventive Medicine Reports, 12, 271–283. https://doi.org/10.1016/j.pmedr.2018.10.003

Vanden Abeele, M. M. P. (2020). Digital Wellbeing as a Dynamic Construct. *Communication Theory*, 1–43. https://doi.org/10.1093/ct/qtaa024

Wood, W., & Neal, D. T. (2007). A new look at habits and the habit-goal interface. Psychological Review, 114(4), 843–863. https://doi.org/10.1037/0033-295x.114.4.843

Yang, J., Fu, X., Liao, X., & Li, Y. (2020). Association of problematic smartphone use with poor sleep quality, depression, and anxiety: A systematic review and meta-analysis. *Psychiatry Research*, *284*. https://doi.org/10.1016/j.psychres.2019.112686

Zhu, J., Jiang, Y., Chen, Y., Huang, L., Bao, Z., & Zhang, W. (2019). High impulsivity, low self-control and problematic mobile phone use: The effect of poor sleep quality. Current Psychology, 40(7), 3265–3271. https://doi.org/10.1007/s12144-019-00259-0

Appendix A

Privacy Policy (Last update: 15-09-2020)

Welcome to our Privacy Policy

It is Unpluq's policy to respect your privacy regarding any information we may collect while operating our app. This Privacy Policy applies to the Unpluq launcher (hereinafter, "us", "we", "The Unpluq Launcher" or "app"). We respect your privacy and are committed to protecting personally identifiable information you may provide us through the app. We have adopted this privacy policy ("Privacy Policy") to explain what information may be collected in our app, how we use this information, and under what circumstances we may disclose the information to third parties. This Privacy Policy applies only to information we collect through the app and does not apply to our collection of information from other sources.

This Privacy Policy, together with the Terms of service posted on our app, set forth the general rules and policies governing your use of our app. Depending on your activities when using our app, you may be required to agree to additional terms of service, which are listed under "Extra gathered data"

We only ask for personal information when we truly need it to provide a service to you. We collect it by fair and lawful means, with your knowledge and consent. We also let you know why we're collecting it and how it will be used, and ask for your permission to collect it.

We only retain collected information for as long as necessary to provide you with your requested service. What data we store, we'll protect within commercially acceptable means to prevent loss and theft, as well as unauthorised access, disclosure, copying, use or modification.

We don’t share any personally identifying information publicly or with third-parties, except when required to by law.

Our app may link to external sites that are not operated by us. Please be aware that we have no control over the content and practices of these sites, and cannot accept responsibility or liability for their respective privacy policies.

You are free to refuse our request for your personal information, with the understanding that we may be unable to provide you with some of your desired services.

Your continued use of our app will be regarded as acceptance of our practices around privacy and personal information. If you have any questions about how we handle user data and personal information, feel free to contact us.

Standard gathered data

Like most app developers, Unpluq collects non-personally-identifying information. Unpluq’s purpose in collecting non-personally identifying information is to better understand how Unpluq’s visitors use its app. From time to time, Unpluq may release non-personally-identifying information in the aggregate, e.g., by publishing a report on trends in the usage of its app.

When using unpluq the user is required to create an account, the following data

is collected:

- Email address
- Password
- Activation code

Extra gathered data

When you download the app, you will be asked if you want to help improve Unpluq.

You can decide whether to allow this or not. There are two topics:

1. Unpluq usage (time, focus apps)

2. Other app usage (app name, time)

The following extra data is collected and stored in our database for these topics:

1. Unpluq usage (time, focus apps)

- Time when Unpluq is launched
- Which apps are installed on your phone
- Which apps you select as “Focus apps”

2. Other app usage (app name, time)

- The daily usage statistics for each app
    - Amount of time you use each app daily
    - App status: Focus app or Normal app

How we use the gathered data

The data collected will be used to:

- Improve the Unpluq app and other Unpluq services (e.g. giving recommendations for certain apps);

- Contact you with information about the app (e.g. updates and new offerings);
- Personalise the app and the content we deliver to you;
- Conduct research and analytics about how you use and interact with the app, to analyse how well Unpluq works;
- Show how using Unpluq changes your smartphone usage behaviour in marketing campaigns;

Note that Unpluq will not sell this data to anyone, or use this data for targeted,

personalized marketing.

Unpluq may display this information publicly or provide it to others. However, Unpluq will never disclose your personally-identifying information (name, email address, password) along with this data.

Security

The security of your Personal Information is important to us, but remember that no method of transmission over the Internet, or method of electronic storage is 100% secure. While we strive to use commercially acceptable means to protect your Personal Information, we cannot guarantee its absolute security.

Privacy Policy Changes

Although most changes are likely to be minor, Unpluq may change its Privacy Policy from time to time, and at Unpluq's sole discretion. Unpluq encourages visitors to frequently check this page

for any changes to its Privacy Policy. Your continued use of this site after any change in this Privacy Policy will constitute your acceptance of such change.

GDPR Data Protection Rights

We would like to make sure you are fully aware of all of your data protection rights.

Every user is entitled to the following:

- The right to access – You have the right to request copies of your personal data. We may charge you a small fee for this service.

- The right to rectification – You have the right to request that we correct any information you believe is inaccurate. You also have the right to request that we complete the information you believe is incomplete.

- The right to erasure – You have the right to request that we erase your personal data, under certain conditions.

- The right to restrict processing – You have the right to request that we restrict the processing of your personal data, under certain conditions.

- The right to object to processing – You have the right to object to our processing of your personal data, under certain conditions.

- The right to data portability – You have the right to request that we transfer the data that we have collected to another organization, or directly to you, under certain conditions.

If you make a request, we have one month to respond to you. If you would like to exercise any of these rights, please contact us.

Credit & Contact Information

If you have any questions about our Privacy Policy, please contact us via the contact page or sent an email to info@unpluq.com

This privacy policy is effective as of 15 September 2020.

Appendix B

Information Letter

Dear participant,

You are invited to participate in the study “Unplug Your Distraction” that is being carried out by Tilburg University. This information letter describes the purpose and procedure of this study, along with explanation of your rights as a participant. Participation in the study is completely **voluntary,** so you are not obliged to participate. If you have any questions after reading this letter, please contact the researcher (contact details are at the bottom of this letter).

What is the purpose of the study?

Smartphones can be an important source of distraction in daily life. Frequent smartphone notifications may affect your study performance, cause stress or lead to problematic smartphone use. However, students may differ in how smartphones affect them. The purpose of this study is to investigate the usability and effectiveness of different tools that might be helpful to reduce smartphone distraction.

Who can participate?

You can participate if you:

- are a student of 18 years or older.
- have an Android phone. The Unpluq device is not compatible with iOS devices.
- are able to run the built-in Android feature named ‘Digital Wellbeing’

- do not already actively restrict your smartphone use with this feature or another screen time app.
- are willing to restrict your smartphone use for a duration of three weeks.

What does participation in the study entail?

As soon as you sign up for this study you will be asked to activate the Digital Wellbeing (‘Digitaal Welzijn’) feature built into the Android operating system, which you can find under Settings. You will be invited for an intake session on campus, where you will digitally sign the informed consent form and receive further instructions. However, please note that the intake session might be organized online due to the Covid-19 measures.

At the start of the study, all participants will be asked to fill out an online questionnaire that includes questions that address personal traits, behavior regarding smartphone usage, and your well-being. In addition, you will be asked to report the logged data in the “Digital Well-Being” application, such as the number of screen unlocks, number of notifications and the average usage time of applications. You may withdraw from the experiment if you are not willing to disclose such information. You can do so without providing any explanation, and without any negative consequences. We ensure that the information will be only used for academic research.

If you participate, you will be randomly assigned to the ‘Unpluq group’, ‘Screen time limit group’ or ‘Control group’.

Unpluq group

If you’re in the Unpluq group, you will be using the smartphone control aid device ‘Unpluq’ for

three weeks. After three weeks, you will be asked to report the logged data again and fill out a similar online questionnaire, which additionally includes questions that address your experiences with using the Unpluq device. After the experiment, you have to return the device to the researcher.

The smartphone usage control aid device ‘Unpluq’ is a combination of hardware (the Unpluq USB key) and software (the Unpluq launcher). By plugging the Unpluq key in or out of your phone, the Unpluq launcher will switch between the ‘Focus mode’ and the ‘Normal mode’. In the Focus mode (=key plugged out), only apps of your choice will be available and notifications of all other apps will be blocked. In the Normal mode (=key plugged in), you will have access to your entire phone’s functionality and you will receive all missed notifications. You can decide whether you want to be free of distraction, by plugging the Unpluq key in or out.

Unpluq may be most effective if you restrict the use of the most distracting apps in the Focus mode. Therefore, you are encouraged to select at least 3 out of your top 10 apps you spent most time on. We recommend to use Focus mode on a daily basis during activities that require your full attention, such as studying, driving or cycling, and social conversations.

Screen time limit group

If you’re in the Screen time limit group, you will be using the Digital Wellbeing feature for three weeks to set time limits to the use of applications. After three weeks, you will be asked to report the logged data again and fill out a similar online questionnaire, which additionally includes questions that address your experiences with using the time limits.

Setting time limits may be most effective if you restrict the use of the most distracting apps.

Therefore, we encourage you to select at least 3 out of your top 10 apps you spent most time on. We recommend to use time limits on a daily basis. You are free to choose your own time limits.

Control group

If you are in the control group, you are expected to use your phone as usual. After three weeks, you will be asked to report the logged data again and fill out a similar online questionnaire.

What are the benefits and risks of participating in this study?

There is minimal risk in participating in this study. However, there could be situations where you may find the experimental conditions to be discomforting.

First of all, the fact that some smartphone apps are temporarily disabled (in the Focus mode or if time limits are exceeded) may cause some discomfort. However, you are allowed to choose for yourself which apps will be temporarily disabled and you may withdraw from the experiment at any time. Secondly, there is the risk of losing the Unpluq key. There is a built-in feature to access all functionality of your phone again if this happens, but it will involve a delay of several minutes. Additionally, it is not possible to plug in the key in and charge your phone at the same time, so charging might require some planning.

Please let the researchers know if you experience any discomfort or lose the Unpluq key during the experiment via the email addresses listed below. You may always withdraw at any time.

There is no direct benefit to you for participating in this study. However, by taking part, you will contribute to the knowledge in the field of social sciences. Participants in the Unpluq and Screen

time limit group may experience a distraction-free environment as pleasant. Participants in this study are entitled to earn 3 credits upon completion of the experiment.

What will happen to your data?

We are committed to protecting your privacy as much as possible. We ensure that we will keep the confidentiality of the collected research data. All research data obtained will be processed anonymously. These data will be anonymously coded by providing all participants in this study with a three-digit random code number. We link this number to your answers. So we don't know who gave which answers. All research data obtained will be processed in a manner that your personal data cannot be traced back. Only the main researchers have access to to the key file. The coded data can be shared with other researchers, but your personal data (such as your name and email address, which will be registered by SONA, the participant pool system to reward you course credits) will never be disclosed to anyone outside of the group of researchers. The file that contains data from this study will be encrypted with a password which will be shared only among the researchers of this study. You have the right to request access to or rectification, erasure or restriction of your personal data for as long as the data collection is ongoing. All the personally identifiable data will be deleted once the study has ended. Your anonymous research data will be kept for at least 10 years. The research data is intended for scientific research. The results obtained are published in scientific journals. This concerns general results for the entire group, whereby the results can never be traced back to individual persons.

What information will be collected by the Unpluq app?

The Unpluq app collects personally-identifiable, yet minimal, information. During the installation of Unpluq, you are required to create an account. The following data is collected: email address,

password, activation code. When you install the app, you will be asked if you want to help improve Unpluq. You can decide whether to allow this or not. If you choose to allow this, the following data is collected and stored in the database of Unpluq:

1. Unpluq usage: time when Unpluq is launched, which apps are installed on your phone, which apps you select as "Focus apps"
2. Other app usage: the daily usage statistics for each app, amount of time you use each app daily, app status (Focus app or Normal app)

Importantly, Unpluq will not have access to the research data collected by Tilburg University. Additionally, Tilburg University will not have access to the user information that is being collected by Unpluq.

Please follow the link to see the full privacy policy of Unpluq:

https://drive.google.com/file/d/1W5JNaPsmv7e2F4JlxXSTppZTFTcAc_zH/view?usp=sharing

Do you have questions?

If you have any questions about the research please contact:

Dr. Mincheol Shin (m.shin@tilburguniversity.edu), Assistant Professor at Tilburg University

Dr. Anouk Vermeij (A.Vermeij_1@tilburguniversity.edu), Postdoctoral Researcher at Tilburg University

Do you have a complaint?

This study has been approved by the Ethical Review Board of Tilburg School of Humanities and Digital Sciences. If you have any remarks or complaints regarding this research, you may also

contact the “Research Ethics and Data Management Committee” of Tilburg School of Humanities and Digital Sciences via tshd.redc@tilburguniversity.edu.

Appendix C

Consent form

By checking "Yes", I acknowledge the following statements:

I am at least 18 years old

I have read the information letter about the study. I have been able to ask questions about the study and I have been able to think long enough about whether I want to participate in the study.

I know that participation in the study is voluntary. I can withdraw from the study at any time, without it having negative consequences and without having to tell why I want to stop.

I know that my research data is processed confidentially. The research data is coded as explained in the information letter. Only the researchers have access to the key file containing my personal data (e.g., my name and e-mail address). This key file is stored in a secure place, with a password. The key file will be deleted once the investigation has ended, after which only a fully anonymous data set will remain.

I know that I have the right to request access, rectification, erasure or restriction of my personal data, up until the moment the key file is deleted.

I know that the anonymous research data can be used for scientific research now and in the future. The anonymous data is examined for all participants at the same time, and not separately for me.

I know that only the anonymous research data can be shared with other researchers. My personal data (for example my name, date of birth and my e-mail address) will never be shared with other researchers.

I know that the coded (anonymous) research data will be kept for at least ten years.

Yes ☐ No ☐

Name participant:	Name researcher:
Date:	Date:
Signature:	Signature:

Upon your request, the researchers of this study will send you a copy of the informed consent. Please allow us up to 72 hours of processing time after you request a copy.

Appendix D

Demographics

1. Age: ( )
2. Gender: Male ( ) Female ( ) Other ( )
3. Are you a native speaker of English? Yes ( ) No ( )

Appendix E

Sleep quality: Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past 2 weeks only. Your answers should indicate the most accurate reply for the majority of days and nights in the past three weeks. Please answer all questions.

1. During the past 2 weeks, what time have you usually gone to bed at night?

_____

2. During the past 2 weeks, how long (in minutes) has it usually taken you to fall asleep each night? _____

3. During the past 2 weeks, what time have you usually gotten up in the morning?

_____

4. During the past 2 weeks, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.) _____

5. During the past three weeks, how often have you had trouble sleeping because you..	Not during past three weeks	Less than once per a week	Once or twice a week	Three or more times a week
a. Cannot go to sleep within 30 minutes	1	2	3	4

b. Wake up in the middle of the night or early morning	1	2	3	4
c. Have to get up to use the bathroom	1	2	3	4
d. Cannot breathe comfortably	1	2	3	4
e. Cough or snore loudly	1	2	3	4
f. Feel too cold	1	2	3	4
g. Feel too hot	1	2	3	4
h. Have bad dreams	1	2	3	4
i. Have pain	1	2	3	4
j. Other reason(s), please describe:	1	2	3	4
6. During the past 2 weeks, how often have you taken medicine to help you sleep (prescribed or “over the counter”)?	1	2	3	4
7. During the past 2 weeks, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?	1	2	3	4

	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
8. During the past 2 weeks, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	1	2	3	4
	Very good	Fairly good	Fairly bad	Very bad
9. During the past 2 weeks, how would you rate your sleep quality overall?	1	2	3	4

Appendix F

Digital well-being scale: self-constructed

Instructions: Below are sixteen statements about how you experienced your smartphone in the past three weeks. Using the 1 – 7 Likert scale below, indicate your agreement with each statement (A 7-point Likert Scale: Strongly disagree to Strongly agree).

In the past 2 weeks…

Hedonic

1. My smartphone entertained me	1	2	3	4	5	6	7
2. My smartphone helped me relieve boredom	1	2	3	4	5	6	7
3. My smartphone was a source of joy	1	2	3	4	5	6	7
4. My smartphone made me happy	1	2	3	4	5	6	7

Eudaimonic

5. My smartphone helped me organize life.	1	2	3	4	5	6	7
6. My smartphone supported me in making decisions.	1	2	3	4	5	6	7
7. My smartphone let me experience meaningful things.	1	2	3	4	5	6	7
8. My smartphone made my life interesting.	1	2	3	4	5	6	7

Loss of control

9. My smartphone checking habits annoyed me.	1	2	3	4	5	6	7
10. My smartphone wasted my time.	1	2	3	4	5	6	7
11. My smartphone use was out of control.	1	2	3	4	5	6	7
12. My smartphone distracted me more than I want it to.	1	2	3	4	5	6	7

Problems

13. My smartphone was a source of stress	1	2	3	4	5	6	7
14. My smartphone made me feel bad about myself	1	2	3	4	5	6	7
15. My smartphone interfered with activities that I find important in life	1	2	3	4	5	6	7
16. My smartphone caused conflict in my social relationships	1	2	3	4	5	6	7

Appendix G

Impulsivity BIS-15 scale

Instructions: Below are fifteen statements about how your impulsivity levels. Using the 1 – 4 scale below, indicate your agreement with each statement (A 4-point Scale: Rarely/never to Almost always).

	Rarely/Never	Occasionally	Often	Almost always
Motor impulsivity				
1. I act on impulse. *	1	2	3	4
2. I act on the spur of the moment.	1	2	3	4
3. I do things without thinking.	1	2	3	4
4. I say things without thinking.	1	2	3	4
5. I buy things on impulse.	1	2	3	4
Non planning impulsivity				
6. I plan for job security. *	1	2	3	4
7. I plan for the future. *	1	2	3	4
8. I save regularly. *	1	2	3	4
9. I plan tasks carefully. *	1	2	3	4

10. I am a careful thinker. *	1	2	3	4
Attention impulsivity				
11. I am restless at lectures or talks.	1	2	3	4
12. I squirm at plays or lectures.	1	2	3	4
13. I concentrate easily. *	1	2	3	4
14. I don't pay attention.	1	2	3	4
15. Easily bored solving thought problems.	1	2	3	4

*inverse score