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Smartphone Addiction and Subjective Withdrawal Effects: A Three-Day Experimental Study

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Abstract

Smartphones have arguably become a common necessity in modern society. While they can be used for many practical purposes, their many features increase the risk of overuse, a key element in behavioral addiction. The present study examined withdrawal-related scores on the Smartphone Withdrawal Scale, the Fear of Missing Out Scale, and the Positive and Negative Affect Schedule during a smartphone restriction period, lasting 72 h. In total, 127 participants were randomly assigned either to a condition without smartphone access or to a control condition. The scales were administered three times a day during the restriction period and smartphone addiction scores were assessed on Day 1. The results showed that participants with the highest scores on smartphone addiction in the restricted condition were significantly more negatively affected by the restriction (compared to those with lower scores). This appears to indicate that being restricted from using smartphones can generate significant withdrawal symptoms, especially for those at risk of smartphone addiction.

Plain Language Summary

Smartphones have arguably become a common necessity in modern society. While it can be used for many practical purposes, its many features increase the risk of overuse, a key element in behavioural addiction. The present study examined withdrawal-related symptoms during a smartphone restriction period, lasting 72 hours. The participants were divided in to two groups where one group was without access to their smartphone, while the other group was allowed to keep their smartphone and use it as they normally would. All participants had to complete a number of questionnaires that were administered three times a day during the restriction period and smartphone addiction scores were assessed on Day 1. The results showed that participants with the highest scores on smartphone addiction in the restricted group were significantly more negatively affected by the restriction (compared to those with lower scores). This appears to indicate that being restricted from using smartphones can cause significant withdrawal symptoms, especially for those at risk of smartphone addiction.

Keywords

smartphone, addiction, smartphone addiction, withdrawal symptoms, experimental

Introduction

Smartphones have a large worldwide user base and provide users with immediate access to many real time applications, such as social networking sites (SNSs; Chóliz et al., 2016; Valderrama, 2014). Although the advantages of smartphones for most people far outweigh the disadvantages, there are many factors that can lead to smartphone overuse (e.g., portability, accessibility, wide

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Data Availability Statement included at the end of the article

variety of applications, etc.). Studies indicate that such overuse is associated with a range of detriments, including psychological problems, sleep-related problems, and musculoskeletal ailments, to name a few (Derakhshanrad et al., 2020; Ng et al., 2020; Ozkaya et al., 2020; Zirek et al., 2020).

Research examining behavioral addictions (Griffiths, 1996) that do not involve the ingestion of a psychoactive substance (e.g., addictions to gambling, gaming, exercise, sex, and work), have received increased recognition over the past two decades. Technological addictions, including smartphone addiction, are regarded as a specific subcategory of behavioral addictions (Griffiths, 1995). Although smartphone addiction is not currently recognized as a disorder in the fifth Diagnostic and Statistical Manual of Mental Disorders (DSM-5), the body of research on this topic is steadily growing. Many characteristics of smartphones may be related to the development of addictive behavior, such as usage and software applications ("apps").

There are many different terms that have been used in the literature when describing problematic smartphone use (e.g., overuse, excessive use, disordered use, dependence, addiction). However, arguably the two most common and interchangeable terms used in the extant literature relating to smartphones are "problematic use" and "addiction."Billieux et al. (2015) attempted to distinguish different type of usage in the integrated pathway model. The model describes three different way of problematic smartphone use; the excessive reassurance pathway, the impulsive pathway, and the extraversion pathway. These pathways imply different types of problematic smartphone use that can affect whether a behavior becomes an addiction. Due to the inter-changeable nomenclature used in this area, as well as the inclusion of the term "withdrawal" in the present paper, for consistency, the term "smartphone addiction" is used.

Social networking site (SNS) applications function as facilitators of relatedness for users because individuals' friends and their posts are always only a click away (Kuss & Griffiths, 2017). The constant flow of information keeps users updated on what is shared. This is presumed to facilitate and/or stimulate the feeling of being connected and attached and serve as positive reinforcement to the user (Griffiths, 2018). Listening to music, podcasts, or watching video clips on a smartphone could also give rise to rewarding emotions and can act as reinforcers. Smartphone usage can also involve negative reinforcement because apps may distract from stressful events, dysphoric states, and/or boredom (Bandura, 1991; Ferster & Skinner, 1957; Robinson & Berridge, 2003). What makes the smartphones a particularly potent addictive stimulus for some individuals is its size and portability, in addition to the wide array of applications and activities they provide access to (e.g., gaming, gambling, pornography use, online shopping, social media use).

However, there is an ongoing discussion whether behavioral addictions primarily reflect coping behaviors rather than being genuine addictions. In this regard it has been argued that existing research regarding behavioral addiction does not always take into account the complexity of processes involved in problematic outcomes (e.g., Kardefelt-Winther, 2017). However, it can be argued that even substance use addiction (e.g., addictions to alcohol) can initially involve coping behaviors, where the withdrawal factor maintains the addictive behavior over time (Solomon & Corbit, 1974). There has also been a debate whether individuals' smartphone addiction concerns addiction to the smartphone or addictions on the smartphone (e.g., social media use, gaming) (e.g., Griffiths et al. 2016). Kuss and Griffiths (2017) claimed that individuals are "*no more addicted to their phones than alcoholics are addicted to bottles*" (p.8). Moreover, some researchers have discussed whether problematic or excessive smartphone use should be considered an addiction (Billieux et al., 2015). However, irrespective of whether the behavior can be classed as an addiction, most scholars agree that smartphone use can be problematic to a minority of addictions, therefore it is still of value to acquire additional insight into the interplay between problematic smartphone use and withdrawal symptoms.

The concept "fear of missing out" (FoMO) comprises a constant concern of exclusion from enjoyable social interaction (Przybylski et al., 2013). Individuals with high levels of FoMO may be more prone to interaction on SNSs (via smartphone) because this provides immediate access to social interaction, making an association between FoMO and smartphone more likely (Gugushvili et al., 2020; Scott & Woods, 2018). Restriction from an object of addiction is assumed to cause withdrawal symptoms. However, research on such symptoms related to smartphone addiction is scarce (Fernandez et al., 2020).

Although there is some evidence of physical withdrawal symptoms in behavioral addictions, particularly gambling addiction (Griffiths & Smeaton, 2002; Rosenthal & Lesieur, 1992), most evidence suggests that behavioral addictions mainly produce psychological withdrawal symptoms (Parlak & Eckhardt, 2014). These effects include irritability, uneasiness, feeling of craving, and difficulty concentrating (Griffiths, 2005). For instance, a study investigating the impact of social media abstinence found that the participants reported significantly stronger feelings of craving during the restriction period compared to baseline (Stieger & Lewetz, 2018). Regarding withdrawal symptoms and trends, there are inconsistent findings across different types of addictions

(Javitz et al., 2012; Piper et al., 2011). A study on gaming addiction suggested that withdrawal symptoms are negatively linear in shape, with the largest decline within the first 24 h (Kaptsis et al., 2016).

Some research suggests that problematic use can result in withdrawal symptoms following abstinence. However, it has been argued that the measurements used to assess such symptoms are only indirect evidence of withdrawal, and that such evidence is typically self-report in the form of psychological distress (e.g., increased moodiness, irritability, frustration, etc.) which may stem from a wide range of contextual and individual factors. Consequently, there is no consensus on the best way to assess smartphone withdrawal (Billieux et al., 2015). Experimental studies have been called for to compare different degrees of addiction/problematic use in situations of restriction (both psychological and physical), in order to further validate and investigate the role of withdrawal symptomatology (Billieux et al., 2015).

The present study builds on a former study published in 2018, using the same dataset (Eide et al., 2018). The study found higher levels of withdrawal symptoms among the smartphone restriction group compared to the control group. However, that study did not investigate the role of smartphone addiction. Against this backdrop, it was hypothesized that participants with high scores on problematic smartphone use scales will be more negatively affected (as assessed by the Smartphone Withdrawal Scale [SWS; Eide et al., 2018], Fear of Missing Out Scale [FoMOS; Przybylski et al., 2013], and Positive Affect and Negative Affect Schedule [PANAS; Watson et al., 1988]) in a smartphone-restricted condition than in a control condition, compared to those with lower scores on problematic smartphone use scales. Therefore, a significant interaction effect (level of addiction × condition) was expected (H_1). As withdrawal symptoms have been suggested to subside over time, it was further expected that there would be a larger drop in withdrawal symptoms (as assessed by the SWS, FoMOS, and PANAS) over time for participants with higher scores on smartphone addiction scales, compared to those with lower scores, in the smartphone-restricted condition. Consequently, a significant interaction effect (level of addiction × time) was expected (H_2).

Method

Participants and Procedure

In total, 127 participants, primarily full-time students attending a higher education institution in Bergen (Norway), participated in the study. In order to fulfill the inclusion criterion, a minimum of 1 h daily smartphone usage was required. Recruitment was conducted by advertisement on *Facebook*, and posters at the university, as well as personal appeal. The experiment took place over 10 weekends between October 2016 and February 2017.

The participants were all assigned a unique ID number before being randomized into the restricted or control condition (see Figure 1). An online randomizer calculator (Urbaniak & Plous, 2015) was used to allocate the participants into one of the two conditions. All participants

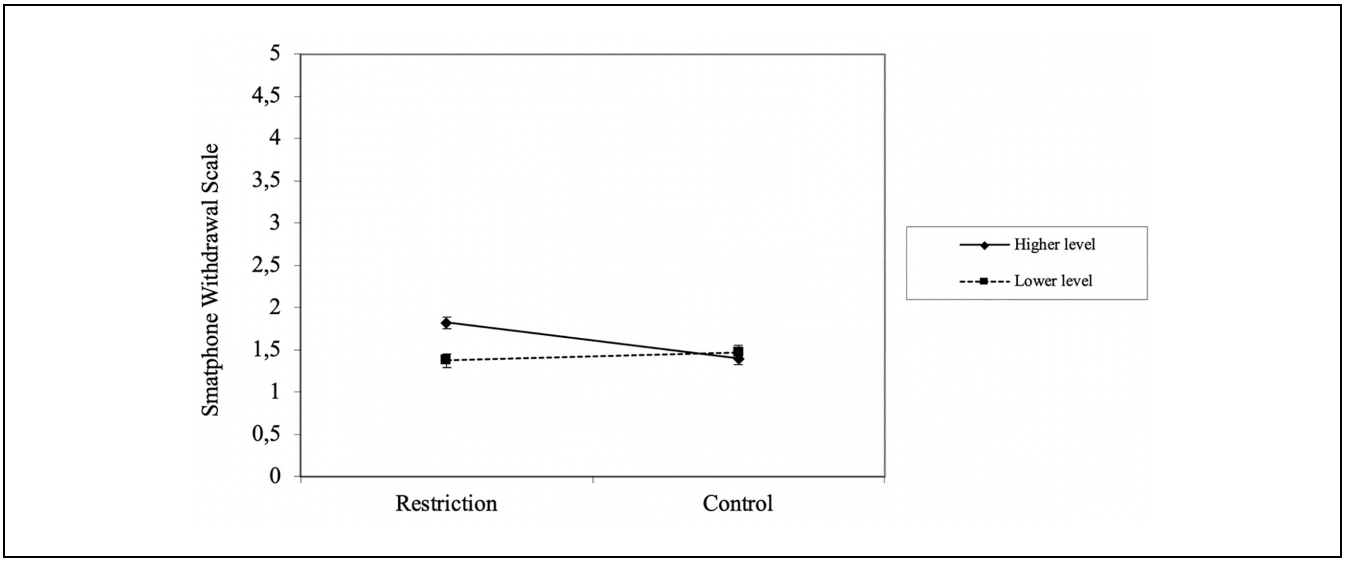

Figure 1. Estimated marginal means for the Smartphone Withdrawal Scale divided by level of addiction between the restriction and control group.

Note. Higher level = higher level of addiction scores. Lower level = lower level of addiction scores. The error bars represent standard error of the mean.

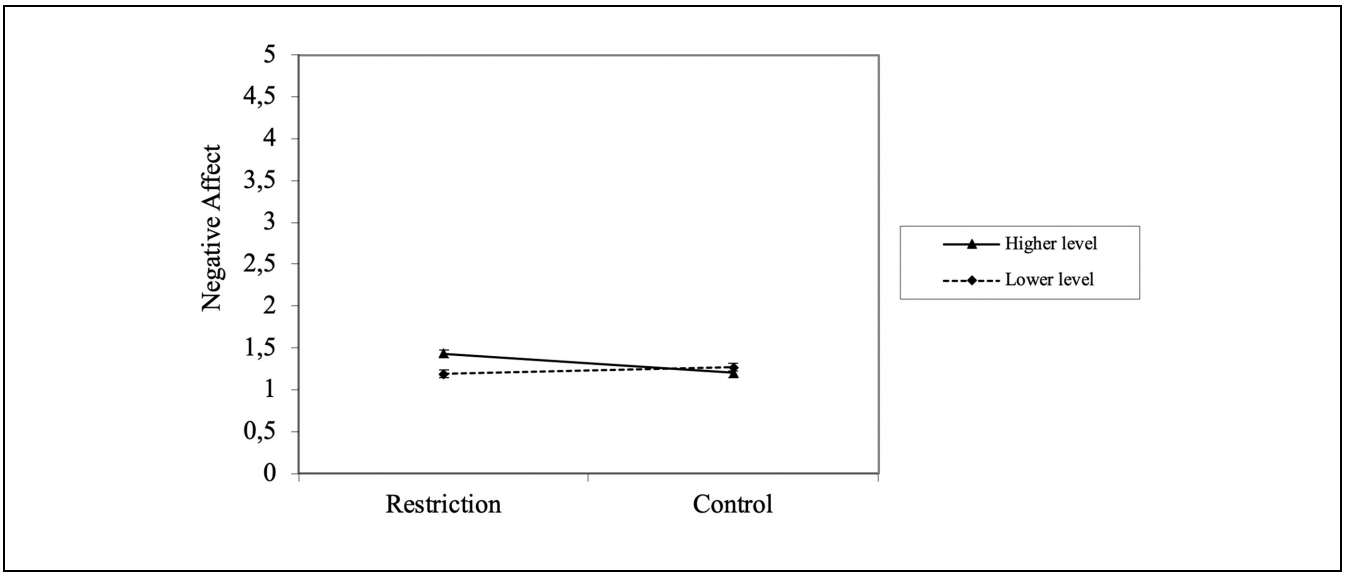

Figure 2. Estimated marginal means for Negative Affect (measured with Positive Affect and Negative Affect Schedule) divided by level of addiction between the restriction and control group.
Note. Higher level = higher level of addiction scores. Lower level = lower level of addiction scores. The error bars represent standard error of the mean.

had to complete a web-based survey including questions regarding smartphone usage and demographics on the Monday prior to the weekend the experiment started (Friday-Monday; see Figure 2). On the first day of the experiment weekend, the participants in the restricted condition were required to hand in their smartphones. The smartphones were kept in a secure locked cabinet until data collection on Day 4 of the experiment was completed. Those allocated to the control condition were instructed to use their smartphones as usual. The participants in both conditions completed psychometric scales on smartphone addiction and received a battery of instruments assumed to be sensitive to withdrawal symptoms (SWS, FoMOS, and PANAS). The instruments had to be completed three times a day throughout the 72 h restriction period. Additionally, the participants were also asked to complete items asking for information about their gender, age, student status, and relationship status. At the end of the experiment (Day 4) the participants in the restricted condition collected their smartphones. All participants received 500 NOK (~$US55) as compensation.

Instruments

Smartphone Frequency and Use. Smartphone frequency and use (Valderrama, 2014) were assessed by five items comprising use characteristics, duration, and frequency of smartphone use (e.g., "*Please estimate the average number of hours you spend each day using your smartphone*") (Supplemental Appendix A).

Smartphone Addiction. The Mobile Phone Involvement Questionnaire (MPIQ; Walsh et al., 2010) comprises eight items (e.g., "*I lose track of how much I am using my mobile phone*") scored from 1 (*strongly disagree*) to 7 (*strongly agree*). Each item reflects the user's involvement with their mobile phone and addictive components such as loss of control. Higher scores indicate higher degree of involvement. The scale showed very good reliability in terms of internal consistency (Cronbach's $\alpha = .85$).

The Mobile Phone Problem Usage Scale (MPPUS; (Bianchi & Phillips, 2005) has 27 items (e.g., "*I lose sleep due to the time I spend on my mobile phone*") scored from 1 (*not true at all*) to 10 (*extremely true*). The items reflect different components of addiction (e.g., craving) and a higher total score indicates higher levels of problematic use. The scale showed excellent reliability (Cronbach's $\alpha = .91$).

The Smartphone Addiction Scale Short Version (The SAS-SV; Kwon et al., 2013) comprises 10 items (e.g., "*Feeling impatient and fretful when I am not holding my smartphone*") scored from 1 (*strongly disagree*) to 6 (*strongly agree*). Higher scores indicate higher levels of smartphone addiction. The scale showed very good reliability (Cronbach's $\alpha = .82$).

Smartphone Withdrawal Assessment. The Smartphone Withdrawal Scale (SWS; Eide et al., 2018) was used in the present study to assess the degree of withdrawal symptoms related to smartphone restriction and was based on a modified version of the Cigarette Withdrawal Scale (CWS; Etter, 2005). Even though the CWS

originally concerned cigarette withdrawal there is substantial overlap between symptoms which are also relevant for behavioral addictions (American Psychiatric Association, 2013). The scale originally included 21 items and consisted of six subscales (Depression-Anxiety, Craving, Irritability-Impatience, Difficulty concentrating, Appetite-Weight gain, and Insomnia). The "Appetite-Weight Gain" and "Insomnia" subscales were deemed less relevant for smartphone addiction and therefore not included in the present study. In addition, four items that were specific to the use of cigarettes on the "Craving" subscale were modified to make them more relevant for smartphone withdrawal. Furthermore, the scale was adapted from a trait to a state format. This was done by rewording the items from a general state to a specific state (e.g., from "*hard to concentrate*" to "*It is hard to concentrate right now*"). The modified SWS scale comprised 15 items (e.g., "*I feel an irresistible need to use my smartphone right now*"; see Supplementary Material in Eide et al., 2018). All items are scored on a 5-point Likert scale, ranging from 1 (*totally disagree*) to 5 (*totally agree*). The score on 15 items is added together creating a composite score with higher scores indicating higher levels of withdrawal symptoms. The scale showed very good to excellent reliability across all nine assessment time points in the present study (Cronbach's α = .88–.92), as applied in Eide et al. (2018).

The Positive and Negative Affect Schedule (PANAS; Watson et al., 1988) was used to assess self-reported mood and describes different affective states (e.g., hostile, excited, guilty). The PANAS comprises 20 items, with the Positive Affect (PA) Schedule consisting of 10 items and the Negative Affect (NA) Schedule consisting of 10 items. Participants rate each item based on their present state, using a 5-point Likert scale ranging from 1 (*very slightly* or *not at all*) to 5 (*extremely*). The scale showed good to excellent reliability across all nine assessment time points for both PA (Cronbach's α = .87–.92) and NA (Cronbach's α = .77–.85).

The Fear of Missing Out Scale (FoMOS; Przybylski et al., 2013) comprises 10 items (e.g., "*In this moment, it bothers me when I miss an opportunity to meet up with friends*") and was used to assess FoMO. All items are rated on a 5-point Likert scale from 1 (*not at all true of me*) to 5 (*extremely true of me*). In the present study the scale was adapted from a trait measure to a state measure by rewording the items from a general state to a present state (e.g., from "*I fear others have more rewarding experiences than me*" to "*I fear in this moment, that others have more rewarding experiences than me*"). The scale showed very good reliability across all nine assessment time points (Cronbach's α = .80–.87).

Ethics

The study recieved ethical approval from the Norwegian Data Protection Authority (Project no. 49769). All procedures were conducted in accordance with the Declaration of Helsinki. All participants were 18 years or older and provided electronic informed consent. They were assured that all their data would be anonymous and confidential.

Data Analyses

The statistical analyses were conducted using SPSS (version 25.0). A linear mixed model approach was applied to examine differences between the conditions and smartphone addiction levels regarding the outcome of withdrawal symptoms. The method allows for inclusion of both fixed and random effects/factors. Additionally, it enabled analyses of both the main effects and interaction effects. It also tolerates missing values better than other similar statistical approaches (e.g., ANOVA), which enabled an inclusion of participants with missing data. More specifically, the SWS, FoMOS, PA, and NA were fitted as dependent variables. Between-participants factors reflected condition (restricted vs. control) and smartphone addiction (median split based on the overall z-score of MPPUS, MPIQ, and SAS-SV, dividing the participants into higher and lower levels of smartphone addiction). Time comprised a within-participants factor. Condition, smartphone addiction, and time were all modeled as fixed factors, whereas participants were included as a random factor in the analyses. A Cohen's *d* of 0.50 (moderate effect size) was expected, based on similar prior studies (Skierkowski & Wood, 2012). A power-analysis suggested that the sample size was adequate to obtain statistical power at the recommended 0.80 level, and an expected correlation coefficient between repeated measures of .5 (Hedeker et al., 1999).

Missing Data

Missing data for SWS was 4.4%, for the FoMOS 4.2%, PA scale 4.5%, and the NA scale had 4.2%. The missing data for the smartphone addiction scales comprised 2.4% for MPPUS and 0.8% for both MPIQ and SAS-SV.

Results

Descriptive Analysis

The sample comprised 72.4% females (n = 92) and had mean age of 25 years (SD = 4.5, range 18–48 years). In total, 79.5% were full-time students (n = 101) attending a higher education institution in Bergen (Norway). In the

Table 1. Estimated Marginal Means and Standard Error of the Mean on Withdrawal Scores (SWS, FoMOS, and PANAS) for Level of Smartphone Addiction in the Restricted and Control Condition.

	SWS	FoMOS	PA	NA
Experimental				
°High	1.82 (.07)	2.18 (.09)	2.53 (.09)	1.43 (.05)
°Low	1.37 (.08)	1.59 (.09)	2.59 (.10)	1.19 (.05)
Control				
°High	1.40 (.08)	1.96 (.10)	2.77 (.10)	1.20 (.06)
°Low	1.47 (.08)	1.45 (.09)	2.56 (.09)	1.27 (.05)

Note. SWS = Smartphone Withdrawal Scale; FoMOS = Fear of Missing Out Scale; PANAS = Positive Affect and Negative Affect Schedule.

restricted condition, subjectively assessed smartphone usage at baseline was 2.79 ($SD = 0.85$), in comparison with smartphone usage in the control condition, 2.62 ($SD = 0.56$). An answer of 3 would indicate smartphone usage from 3 to 6 h a day. This difference between conditions was not significant ($t = 1.36$, $df = 125$, $p = .18$). See Table 1 for more detailed descriptive analysis.

Experiment Analyses

The Effect of Smartphone Addiction in the Restricted and Control Condition on Withdrawal Symptoms (SWS, FoMOS, and PANAS). There was a statistically significant interaction effect between level of smartphone addiction and condition as assessed by SWS scores ($F[1, 118.05] = 11.29$, $p < .01$) (see Figure 1) and NA ($F[1, 117.26] = 8.84$, $p < .01$) (see Figure 2). Having higher levels of smartphone addiction in the experimental group yielded a higher SWS and NA score than having a lower addiction score. In the control group the scores showed the opposite pattern between the two conditions (see Table 1 for estimated marginal means). There was no statistically significant interaction effect for level of smartphone addiction and condition as assessed using the FoMOS ($F[1, 117.82] = 0.188$, $p = .67$), and PA ($F[1, 118.04] = 1.93$, $p = .17$). Therefore the results only partially supported the first hypothesis (H1: a significant interaction effect [level of addiction × condition] was expected). See Table 1 for estimated marginal means and standard error.

The Effect of Smartphone Addiction in the Restricted Condition on Withdrawal Symptoms (SWS, FoMOS, and PANAS) Over Time. Within the restricted condition, there was no statistically significant interaction effect between level of smartphone addiction and time as assessed by the SWS ($F[8, 466] = 1.33$, $p = .22$), FoMOS ($F[8, 467] = 1.95$, $p = .05$), PA ($F[8, 469] = 1.51$, $p = .15$, and NA ($F[8, 469] = 0.76$, $p = .64$) (see Table 2). Therefore the results did not support the second hypothesis (H2: a significant interaction effect [level of addiction × time] was expected).

Discussion

The present study demonstrated that those with higher smartphone addiction scores had elevated scores on the SWS and the NA subscale of PANAS compared to the controls during the smartphone-restriction period. However, results found no support for an increase in FoMO nor a decrease in PA irrespective of level of smartphone addiction when restricting participants from smartphone access. These results partially supported the first hypothesis that participants with higher scores on smartphone addiction would be more negatively affected by a smartphone-restriction condition than by a control condition, compared to those with lower smartphone addiction scores. Furthermore, there was no significant change over time for scores on any of the smartphone withdrawal-related scales. Consequently, there was no support for the second hypothesis that there would be a large drop in withdrawal symptoms over time for participants with higher smartphone addiction scores compared to those with lower smartphone addiction scores in the smartphone-restricted condition.

The reported negative effects on the SWS and NA among those scoring higher on smartphone addiction likely reflect withdrawal symptoms are in line with studies suggesting an association between restricting smartphone access and negative effects, such as anxiety (Cheever et al., 2014; Elhai et al., 2017). In a study by Cheever et al. (2014), the effect of smartphone restriction was examined by having two conditions where the participants were asked to turn on their smartphone (control group) or turn off their smartphone (experimental group) but were allowed to keep it for the duration of the experiment. The results indicated an increase in anxiety levels during the restriction period in the experimental condition. However, this effect was limited to moderate and heavy smartphone users. Previously published research supports the notion that smartphone restriction elicits withdrawal symptoms similar to other behavioral addictions (Eide et al., 2018). Recent research suggested that individuals scoring higher on NA are more prone to smartphone addiction and have poorer sleep quality (Li et al., 2020).

It has been proposed that in initial stages, smartphone addiction may be governed by positive reinforcement but turns into negative reinforcement as the behavior (e.g., smartphone overuse) subsequently develops into compulsive use (Elhai et al., 2017; Wise & Koob, 2014). Therefore, it is possible that individuals who have higher levels of smartphone addiction utilize their smartphone in order to avoid negative emotional mood states.

Table 2. Estimated Marginal Means and Standard Error of the Mean on Withdrawal Symptoms (SWS, FoMOS, and PANAS) for Level of Smartphone Addiction in the Restricted Condition Over Time.

	SWS		FoMOS		PA		NA	
Time	High	Low	High	Low	High	Low	High	Low
1	1.98 (0.10)	1.36 (0.11)	2.34 (0.11)	1.68 (0.12)	2.66 (0.13)	2.95 (0.14)	1.47 (0.07)	1.21 (0.07)
2	1.91 (0.10)	1.40 (0.11)	2.40 (0.11)	1.65 (0.12)	2.57 (0.12)	2.69 (0.14)	1.40 (0.07)	1.22 (0.07)
3	1.86 (0.10)	1.36 (0.11)	2.30 (0.11)	1.57 (0.12)	2.58 (0.13)	2.69 (0.14)	1.53 (0.07)	1.19 (0.07)
4	1.83 (0.10)	1.38 (0.11)	2.31 (0.11)	1.58 (0.12)	2.73 (0.13)	2.51 (0.14)	1.49 (0.07)	1.19 (0.07)
5	1.79 (0.10)	1.35 (0.11)	2.11 (0.11)	1.60 (0.12)	2.52 (0.13)	2.61 (0.14)	1.38 (0.07)	1.17 (0.07)
6	1.69 (0.10)	1.41 (0.11)	2.13 (0.11)	1.57 (0.12)	2.54 (0.13)	2.39 (0.14)	1.39 (0.07)	1.18 (0.07)
7	1.79 (0.10)	1.41 (0.11)	2.07 (0.11)	1.59 (0.12)	2.26 (0.13)	2.33 (0.14)	1.42 (0.07)	1.25 (0.07)
8	1.91 (0.10)	1.31 (0.11)	2.08 (0.11)	1.56 (0.12)	2.26 (0.13)	2.62 (0.14)	1.45 (0.07)	1.14 (0.08)
9	1.65 (0.10)	1.37 (0.11)	1.91 (0.11)	1.53 (0.12)	2.62 (0.12)	2.53 (0.14)	1.30 (0.07)	1.11 (0.07)

Note. SWS = Smartphone Withdrawal Scale; FoMOS = Fear of Missing Out Scale; PA = Positive Affect; NA = Negative Affect.

Consequently, higher scores on smartphone addiction scales could be associated with higher levels of stress during a smartphone restriction period.

Additionally, smartphones provide immediate access to SNSs (Kuss & Griffiths, 2017). Several SNS platforms have also introduced instant messaging platforms to make social interactions more accessible to their users. This has caused an increase in user numbers (Petronzio, 2012), with well-known instant messaging apps like *Facebook Messenger* and *WhatsApp* being among the most used worldwide (Statista, 2021). The primary motives for using instant messaging are often of a social or planning-related nature, which is in accordance with findings reported from Eide et al. (2018) based on the same dataset as the present study. This could indicate that being restricted from using a smartphone could cause challenges regarding cessation of social interactions in terms of planning, inaccessibility, and communication. Therefore, by providing constant accessibility, SNSs have become a source of social support, thereby providing the user with a platform to fulfill fundamental human needs, such as connectedness and sociability needs (Griffiths, 2018). Consequently, smartphone restriction specifically eliminates instant and constant social connections, which blocks a basic human need emphasized by theories such as the self-determination theory (Ryan & Deci, 2000).

Predispositions such as impulsivity and sensation seeking could explain the elevated scores on SWS and NA for those with higher levels of smartphone addiction, as these traits are associated with sensitivity regarding connectedness and interdependence (Burnell & Kuther, 2016; Wang et al., 2019). In addition, these individuals could have a vulnerability toward being partly separated from activities in general society. This would indicate that the term "smartphone addiction" could be somewhat inaccurate, when individuals have a genuine need for a smartphone in order to function at an adequate level in everyday society (e.g., banking, shopping, traveling, etc.). However, these are merely speculations, and future research is needed to confirm such notions.

In the present study, it was expected there would be a change over time regarding withdrawal symptoms for participants with higher levels of smartphone addiction, but no significant decline over time was evident. A similar study on internet gaming restriction, lasting 84 h, found a decrease in withdrawal symptoms over time (Evans et al., 2018). This could indicate that smartphone addiction as a construct has different temporal implications in terms of the course of withdrawal compared to other behavioral addictions. Thus, the absence of a drop-off in withdrawal symptoms could represent an important finding, potentially indicating that this could be a diagnostic symptom.

Future studies should establish clinical cut-offs for the addiction- and withdrawal related scales in order to assess practical implications. This includes exploring different types of groupings and how they affect the data. Moreover, investigating the concept of withdrawal effects with larger samples and other age groups are necessary in order to deepen the understanding regarding the complexity of this concept.

Limitations and Strengths

Several limitations and strengths of the present study deserve mention. A cigarette withdrawal scale was modified to assess smartphone use withdrawal. When considering the distinctions between the nature of behavioral addictions and nicotine addiction, this should be considered as a potential limitation. Although the modified scale displayed a high internal consistency, it has yet to be utilized in other studies. Another limitation is the overlap between the addiction and withdrawal scales

because specific items in the addiction scale resemble withdrawal-related symptoms. This could potentially create inflated relationships between the constructs. Still, it should be kept in mind that the experimental design of the present study did not reduce the potential problematic impact of overlap between the constructs. Moreover, the potential presence of type II error is always a risk that should be considered in scientific research. However, the power analysis conducted in the present study indicated that the sample size was sufficient for detection of medium effect sizes. A further limitation of the present study is that alpha-error growth was not corrected for in multiple testing. Such correction was not undertaken because (i) the number of dependent variables and participants were limited and (ii) two-tailed significance testing rather than one-tailed significance testing was used.

The participants had access to other technological devices (e.g., tablet, laptop) during the restriction period, thereby one could argue that no actual restriction took place. However, it should be noted that the aim of the present study was to assess smartphone addiction rather than internet or SNS addiction. Also, other internet access devices are far less portable (e.g., cannot be carried in a pocket) than a smartphone. Finally, the sample consisted primarily of young adults. It could be speculated that adolescents who grew up with the technology and have never been without a smartphone since early adolescence would display more addiction symptoms and therefore be a more relevant sample to recruit in future studies.

By applying a diary design, it was possible to capture both inter- and intra-individual variations (Ohly et al., 2010). Multiple measurements of the same phenomenon over time represents a strength. Furthermore, the duration of the experimental phase exceeded the length of other similar studies (Cheever et al., 2014; van den Eijnden et al., 2017), which enabled a more comprehensive appraisal of the changes in the dependent variables. Finally, the participants' smartphones were made unavailable to them during the entire experimental phase, achieving a high level of experimental control. However, it was not controlled for if they had another smartphone which could potentially be seen as a limitation.

Conclusion

The present experimental study explored the extent to which the degree of smartphone addiction affected withdrawal-related symptoms during a 72-h smartphone restriction period. Spurred by restriction, those with higher levels of smartphone addiction reported more withdrawal-related symptoms, as assessed by SWS and Negative Affect Schedule of the PANAS, compared to those who had lower levels of smartphone addiction. The results provide tentative support for the construct of smartphone addiction within the field of behavioral addiction. Having higher levels of smartphone addiction had a greater negative impact on the individual when exposed to restriction, compared to individuals with lower levels of smartphone addiction. However, there are still ongoing debates regarding the concept of smartphone addiction and the role of withdrawal in such behavioral addictions. Future research should continue to examine smartphone addiction as a legitimate behavioral addiction, as well as the concept of withdrawal in this regard. Examining this with larger sample sizes and other age groups may provide additional insight.

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Declaration of Conflicting Interests

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Ethical Approval

The study received ethical approval from the Norwegian Data Protection Authority (Project no. 49769). All procedures were conducted in accordance with the Declaration of Helsinki. All participants were 18 years or older and provided electronic informed consent. They were assured that all their data would be anonymous and confidential.

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Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Supplemental Material

Supplemental material for this article is available online.

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