Smartphone Restriction and its Effect on Subjective Withdrawal Related Scores

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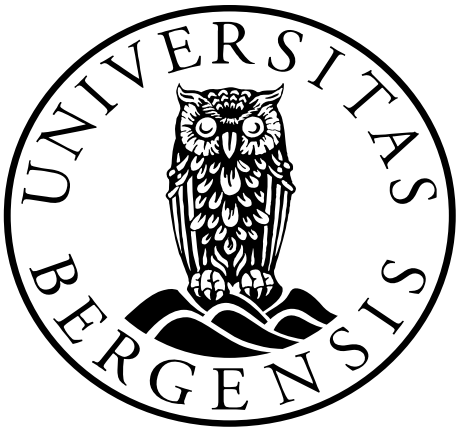

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Abstract

Smartphone overuse is associated with a number of negative consequences for the individual and the environment. In the right end of the distribution of smartphone usage, concepts such as smartphone addiction seem warranted. An area that so far lacks research concerns the effect of smartphone restriction generally and specifically on subjective withdrawal related scores across different degrees of smartphone usage. The present study examined withdrawal related scores on the Smartphone Withdrawal Scale (SWS), the Fear of Mission Out Scale (FoMOs) and the Positive and Negative Affect Schedule (PANAS) scale during a smartphone restriction period, lasting 72 hours. In all, 127 participants were randomly assigned into one of two conditions; a restricted condition (n= 67) or a control condition (n= 60). During the restriction period, the aforementioned scales were completed three times a day by the participants. The results revealed a significant difference in scores between the restricted condition and the control condition on the SWS. Further, the participants with higher scores on smartphone addiction in the restricted condition were, compared to those with lower scores on smartphone addiction, significantly more negatively affected by the smartphone restriction condition, according to the SWS and the PANAS (Negative Affect) than those with higher and lower addiction scores in the control condition. This indicates that being restricted from one's smartphone could cause significant withdrawal symptoms for an individual and that this effect is stronger among individuals with higher levels of smartphone addiction.

Keywords: Smartphone, addiction, restriction, withdrawal, SWS, FoMOs, PANAS scale

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Table of Contents

Abstract I

Acknowledgement II

Table of Contents III

Appendix V

Figure List VI

Table List VI

Introduction 1

- Diagnostic Manuals and Addiction 3
- Introducing Behavioural Addiction 4
- Theoretical Framework 6
  - A Component Model of Addiction 6
  - A Syndrome Model of Addiction 8
- Behavioural Addiction 10
- Withdrawal 12
- Technological Addiction 13
- The Smartphone 14
  - Terminology 15
  - Negative Effects of Excessive Use 16
  - Addictive Features 17
- Research Topic 19
- Hypotheses 20

Method 21

- Participants 21
- Instruments 21
- Pre-Test Data 21

Demographic Item 21
Frequency and Usage Tracker Apps 21
Smartphone Frequency and Use Items 21
The Mobile Phone Involvement Questionnaire 21
Phase one 22
Mobile Phone Problem Usage Scale 22
The Smartphone Addiction Scale Short Version 22
Phase two 22
Smartphone Withdrawal Scale 22
The Positive and Negative Affect Schedule Scale 23
The Fear of Missing Out Scale 23
Design 23
Procedure 24
Ethics 25
Data Analysis 25
Results 27
Descriptives 27
Missing Data 28
Hypothesis-Analysis 28
Effects on Smartphone Withdrawal Scale for those in the restricted and control condition 28
Effects on Fear of Missing Out Scale for those in the restricted and control condition 28
Effects on Positive Affect and Negative Affect Schedule for those in the restricted and control condition 28
Effects on Smartphone Withdrawal Scale for those scoring higher or lower on level of smartphone addiction within each condition 29

Effects on Fear of Missing Out scale for those scoring higher or lower on level of smartphone addiction within each condition 31
Effects on Positive and Negative Affect for those scoring higher or lower on level of smartphone addiction within each condition 33
Discussion 37
Summary of Findings 37
Effects of Withdrawal 40
Stress 41
Connectedness 42
The Social Aspects 43
Social Networking Sites 43
Self-Determination Theory 44
The Extended Self 45
Why Do Someone Develop Smartphone Addiction? 46
Individual Predispositions 46
Integrative Pathway Model for Problematic Mobile Phone Usage 47
Utility Value 48
Methodological Considerations 50
Strengths 50
Limitations 51
Theoretical Implications 53
Practical Implications 53
Conclusion 55
References 57

Appendix

Appendix A – Modified Smartphone Withdrawal Scale (SWS) 70

Figure List

Figure 1. The Addiction Syndrome 9
Figure 2. Progression Model 23
Figure 3. Mean scores for SWS across the four groups within condition and level of smartphone addiction, over time 30
Figure 4. Mean scores for FoMO across the four groups within condition and level of smartphone addiction, over time 32
Figure 5. Mean scores for Positive Affect across the four groups within condition and level of smartphone addiction, over time 34
Figure 6. Mean scores for Negative Affect across the four groups within condition and level of smartphone addiction, over time 35

Table List

Table 1. The Mean and ICC for SWS, FoMO, Positive Affect and Negative Affect Schedule Scale at Time 1-9 on Condition 29
Table 2. The Effects of Condition and Level of Smartphone Addiction on SWS Score by LMM 31
Table 3. The Effects of Condition and Level of Smartphone Addiction on FoMO Score by LMM 33
Table 4. The Effects of Condition and Level of Smartphone Addiction on Positive Affect and Negative Affect Score by LMM 35
Table 5. The Mean for SWS, FoMO, Positive Affect and Negative Affect Schedule Scale at Time 1-9 on Level of Smartphone Addiction 36

Introduction

The term addiction is derived from the Latin verb *addicere,* which refers to binding of one person to another. Later on, it was used to describe devotion and attachment related to an activity (Maddux & Desmond, 2000). The term developed through the late 18th and into the early 19th century. By the beginning of the 19th century loss of control was added as a descriptor to the already existing term. At this point, the term primarily revolved around substance use such as alcohol. By the 19th, century it was acknowledged both in Europe and in the USA that cessation of persistent opiate use led to withdrawal. Nevertheless, physical dependence was not used as a term until the 1920s (Maddux & Desmond, 2000).

The terminology of addiction received attention again in the 1950s when a distinction between *addiction* and *habituation* was drawn. Addiction was conceived of as an uncontrollable desire to continue a behaviour that eventually would lead to the development of tolerance, in addition to psychological and physical dependence. Later, this state was termed *dependence* rather than addiction even though the content remained much the same. Cognitive, physiological, and behavioural aspects characterised the content, where the use of a substance, a group of substances or a specific behaviour is key. The individual prioritises this use or behaviour over other types of behaviour that held great value at a previous point in time (World Health Organization, 2016).

Today, addiction is commonly characterised as a pleasure-inducing behaviour that through repeated exposure gradually lead to loss of control and negative consequences. Definition and conceptualisation of the term remains complex and several researchers have tried to develop a definition that covers several integrated components. One well established definition regards addiction as a type of behaviour where the individual experiences diminished control, together with harmful consequences due to the behaviour in question (Cottler, 1993; West, 2001). Marlatt, Baer, Donovan, and Kivlahan (1988) regard addictive behaviour as a repetitive behaviour associated with increased risk of harmful effects, such as diseases and social and personal problems. They regard the notion of loss of control as a component of addictive behaviour, together with the behaviour being reoccurring despite attempts to quit or reduce it. This pattern of behaviour is characterised by short-term reward and long-term cost, where the individual typically experience high relapse rates. These definitions cover both addictions related to substance use and non-substance use. However, they vary somewhat in terms of the components that are involved. Impaired control or loss of control is regarded as highly involved in the different definitions, together with harmful

effects. There exist some differences in reference to how scholars regard the effects of reinstatement and relapse.

Still, these rather broad definitions provide room for an expansion of the field by opening to acknowledge that addiction in principle may include several drugs and behaviours, this being of benefit to both researchers and sufferers of addiction. Dependence has traditionally been coined as a term describing physical dependence. This refers to the process of adaptation that is involved in withdrawal symptoms due to substance or drug cessation (O'Brien, Volkow, & Lie, 2006). Thus, adhering to this term exclusively, several components assumed to be involved in addiction are disregarded.

By comparing the terms dependence and addiction it seems that the latter covers the psychological spectrum such as behavioural, social, cognitive, and emotional, as well as the physical aspect. Dependence on the other hand is related solely to the physical aspects, such as withdrawal symptoms. For this reason, it is important to distinguish between the two and know that they can occur independently of each other. An individual can for instance be dependent on morphine without engaging in addictive behaviour, like compulsive use, of morphine. On the other hand, individuals can display addictive patterns of behaviour without being physically dependent. An example of latter concerns non-substance use addiction like, Pathological Gambling (Shaffer, 1996).

It is evident that the construct of addiction includes more than just substance related effects. The focus on non-substance use addiction is growing, but despite of this Pathological Gambling is currently the only one included in formal diagnostic manuals (American Psychiatric Association, 2013; World Health Organization, 1999). For these reasons, addiction is regarded as the most adequate use of terminology in the present study. Use of the term dependence refers solely to physical dependence.

There are a number of different models trying to explain the nature of addiction, all trying to answer the same fundamental questions. One is how to explain the development of addiction behaviour, both in the individual as well as in the society. Another is how to understand and explain the underlying mechanisms associated with change and prevention of addiction behaviour.

Two main types of models that attempt to explain the nature of addiction are conditioning-based and cognitive model of addiction. Conditioning-based models can be characterised as models that regard addiction as an unconscious reaction to a stimulus. The withdrawal model, subsumed under the conditioning-based models, holds that drug use initially is conditioned through positive reinforcement due to pleasurable experience with the

drug. Furthermore, it states that the addiction develops by transforming the underlying motivation from positive reinforcement to a negative reinforcement (avoiding withdrawal symptoms). On a long-term bases, the desire to use may therefore arise from either withdrawal symptoms and unconditioned responses due to lack of drugs, or it can arise from cues in the environment associated with drug use (Ryckman, 2012, Skinner, & Aubin, 2010; Wikler, 1948). The basic premises of the cognitive models refer to a desire to engage in substance usage that arises from the information processing systems and operations within it. The cognitive processing model poses that desire to use is a product of the substance use becoming a habit coupled with withstanding use of the substance in question. Tiffany (1999) further states that the system that causes the desire is separate from the system that controls choice. Internal or external cues can trigger these habitual patterns of behaviour and can lead to addiction. Interpretation and perception of the obstacle to access the drug according to this model will affect the level of desire and relapse (Tiffany, 1999). These are just two of many models trying to explain the basic mechanisms behind addiction. The conditioned-based model represents a learning aspect in which it explains how conditioned behaviour can develop into an addiction. Through positive and negative reinforcement, it illustrates how these basic learning mechanisms may lead to addiction development. The cognitive model describes the processes at system level. Addiction being a phenomenon that can develop both with and without substance intake, illustrates that the cognitive aspect is especially relevant.

Diagnostic Manuals and Addiction

Addiction was defined in the Diagnostic and Statistical Manual of Mental Disorders-III-R (DSM-III-R; American Psychiatric Association, 1987) as a compulsive use of drugs (Potenza, 2014). In the latest version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013) different types of addiction are subsumed under the category “Substance-Related and Addictive Disorders”. These are divided in two subsections “Substance-Related Disorders” and “Non-Substance-Related Disorders”. The disorders labelled “Substance-Related and Addictive Disorders” are characterised by a cluster of symptoms, including cognitive, behavioural, and physiological symptoms. This indicates that the individual continues to use the substance despite experiencing significant problems as a result. Some of the general criteria that are relevant for all the disorders under this heading are impaired control, social impairments, risky use of the substance, and pharmacological reactions. Pharmacological reactions can include both tolerance and withdrawal (American Psychiatric Association, 2013). The International Classification of Diseases-10 (ICD-10; World Health Organization, 1999) describes addiction

under the subheading “Mental and behavioural disorders due to psychoactive substance use” similarly to the DSM-5.

However, during recent decades it has been argued that a number of different behaviours have the potential to become addictive and the focus on non-substance addiction has increased (Griffiths, 1995). Pathological Gambling is the first and so far only non-substance use disorder to be included in DSM-system (American Psychiatric Association, 1980) as well as the ICD-system (World Health Organization, 1999). Initially, Pathological Gambling was regarded as an impulse control disorder, but in DSM-5 it was reclassified under the subsection “Non-Substance-Related Disorders”, and was renamed “Gambling Disorder” (American Psychiatric Association, 1980, 2013; Potenza, 2014). In the ICD-10, Pathological Gambling is listed under “Disorders of Adult Personality and Behaviour” in the subsection labelled “Habit and Impulse Disorders”. Similar criteria to those used by both manuals to classify substance use addictions have been used to classify Pathological Gambling.

Nevertheless, even though Pathological Gambling is the only non-substance addiction specified in the DSM-5, others have been considered. Beside Pathological Gambling, another non-substance addiction that has received much attention lately is Internet Gaming Disorder, which is now included in the DSM-5 under the heading “Conditions for Further Study”.

Introducing Behavioural Addiction

The term addiction was originally associated with drug ingestion and alcohol consumption. However, there is an ongoing change in the field that opens up to regarding a number of behaviours as potentially addictive. The initiative is led by Griffiths (1996), who gave the new branch its name: behavioural addiction. The term refers to addictions that are non-chemical or non-substance related in nature and, prior to his article, were often termed non-substance use addiction. A subset of behavioural addiction is technological addiction, which in addition to being non-substance related, involves human-machine interaction. At the present time, this group of addictive behaviours is not well represented in either the DSM-5 or the ICD-10, although a large number of scientists have acknowledged their existence. Despite their absence now, it is likely that additional behavioural addictions may be included in the future revisions of the DSM and ICD, as more knowledge in the area accumulates (American Psychological Association, 2013; Griffiths, 1996; Potenza, 2014; World Health Organization, 1992).

One challenging aspect regarding behavioural addiction is where to draw the line between excessive behaviour and addiction (Billieux, Schimmenti, Khazaal, Maurage &

Heeren, 2015). Some of the arguments against using the term addiction in this context are related to the fact that it is hard to distinguish addiction from high involvement. This is due to subjective components like euphoria, tolerance and cognitive salience that may be present in both. Wood (2008) claims that it should be left to the individual who is engaging in the behaviour, rather than family and friends, to assess whether the behaviour has a negative effect on his/her own life. He further argues that the consequences of engaging in certain behaviours for a large amount of time is not comparable to the negative consequences of other addictions, such as alcohol addiction. As time loss has been argued to be one of the primary negative consequences in these behavioural addictions (Wood, 2008), it becomes harder to distinguish it from other hobbies. This is a challenge especially related to technological addictions, like Internet Addiction, where it can be argued that the negative consequences caused by such behaviours are not as severe as the consequences that follow addictions to substances such as drugs and alcohol (Kuss & Griffiths, 2011; Steele & Josephs, 1990; Verster, Brady, & Galanter, 2012; Young, 2004). Substance use addictions may appear more intrusive compared to behavioural addictions. In contrast, there are arguments for considering excessive video gaming and other behaviours as addictions. Griffiths (2008) argues that a hobby and excessive engagement add something positive to life, while addictions take away from daily life. He further argues that negative aspects of the addictive behaviour can be measured without resorting to subjective reports from the addicts. Ignoring basic needs (e.g. sleep) or neglecting work to engage in the behaviour are examples of objective indicators of an addiction (Griffiths, 2008). This discussion illustrates the complexity within the field. However, there have been developments in the field that point towards Griffiths' view. One example is findings indicating that certain personality traits are present in addiction, but not in engagement (Charlton & Danforth, 2010).

Scholars have compared components in behavioural addictions and substance use addictions and have identified several commonalities: Psychological, sociological, and cultural. Suggested *psychological commonalities* are the ability for the activity or substance to act as a reinforcer, the acquirement of tolerance, withdrawal, and the potential of the activity or substance to operate as an unconditioned stimulus. In addition, both behavioural addictions and substance use addictions can be influenced by factors such as stress, arousal, and pain (Donegan, Rodin, O'Brien, & Solomon, 1983; Griffiths, 1996). The *sociological commonalities* include age, where most addictions are associated with young adults (18-25 years) and one typically sees a decline with age. Further, there seems to be a commonality regarding social impact, including testing limits and rebellion. Early introduction to a

potential addictive agent yields a higher probability of developing an addiction. In addition, attitudes and lifestyles of those addicted to behavioural addictions and substance use addiction seem to be similar, including weaker school performance and a lower degree of social conformity. Studies suggest that factors such as criminal behaviour, impulsivity, and low degree of parental supervision prove to be common across both substance use- and behavioural addiction (Brenner & Collins, 1998; Griffiths, 1996; Kandel & Maloff, 1983; Vitaro, Brendgen, Ladouceur, & Tremblay, 2001). Another sociological commonality is related to multiple addictions. Engaging in one type of problem behaviour seems to increase the likelihood of engaging in others, which increase the chances of engagement in several addictions across the spectrum (Caetona, Shaffer, & Cunradi, 2001; Shaffer & Hall, 2002; Shaffer & Korn, 2002). The last aspect of commonalities is related to *culture*. Such commonalities refer to the activity or substance use sometimes being prohibited and other times causing stigma. This is because excessive use is stigmatised, whereas limited use is generally accepted (Griffiths, 1996; Walker & Lidz, 1983).

The evidence and aspects of commonalities stresses the relevance of the concept of behavioural addictions. It illustrates its importance as a part of the overarching addiction field. There seem to be similarities across the different addictive disorders, as well as with disorders regarded as behavioural addictions. This may reflect similar underlying mechanisms between substance use- and behavioural addiction. A few frameworks have emerged in the past two decades that can help to establish the behavioural aspect of the field, such as the addiction components model (Griffiths, 2005) and the syndrome model of addiction (Shaffer et al., 2004).

Theoretical Framework

The following theories portray addiction as a state that incorporates substance use- and behavioural addictions.

A component model of addiction. Brown (1993) compiled a list of components that were likely to be involved in addiction. The components in this list were salience, relief, tolerance, withdrawal, conflict, loss of control, and relapse and reinstatement. Based on these elements, Griffiths (2005) proposed that addiction was composed out of six components, these including salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse. He referred to it as a component model of addiction. These components were designed to cover both addictions related to substance use and behavioural addiction, but are especially connected to the behavioural aspect.

Salience refers to the amount of space and time the particular activity takes up in the individuals' conscious mind. This specific activity dominates the individuals' cognition, emotional life and behaviour, through preoccupation, distortion, feelings of craving, and impairment of social behaviour (Griffiths, 1996; 2005). *Mood modification* refers to the individuals' self-reported experience as a result of engaging in the particular activity. This experience is often described on one side of the continuum as a "high" or a "buzz", while on the other side it is described as distressing, numbing, and/or an escape. According to Griffiths, the same activity may be able to alter someone's mood in opposite directions at different points in time: thus, it serves to both arouse and relaxing. For instance, nicotine can cause a rush in the morning and at the same time be calming in the evening. This is assumed to be related to a psychological process rather than a physiological process and thus functions as a self-medication or modification. The *tolerance* component refers to the process where the individual requires an increased amount of the distinct activity to get the same initial effect. This is commonly observed in drug addicts who need a larger dosage to achieve the same rush they originally experienced. The same effect has also been observed in gamblers, whereby an increase in bet size is necessary to experience the same mood-modifying outcome as with the bets in the initial phase (Griffiths, 1996; 2005). The *withdrawal symptoms* component refers to the unpleasant psychological and physiological effects, which occur as a consequence of discontinuance of the particular activity. The dominating withdrawal effect may vary for each individual in terms of psychological and physiological outcomes. Psychological withdrawal symptoms refer to effects such as moodiness, irritability, and anxiousness, while physiological withdrawal symptoms include sweats, nausea, insomnia, headaches, and so on. These effects have been well documented in substance use addiction (Orford, 2001), and there is now a growing body of evidence also suggesting that withdrawal symptoms exist in behavioural addictions, such as Pathological Gambling (Griffiths, 2004). Findings from an American study indicate that pathological gamblers when attempting to stop, compared to substance use addicted groups, experience more withdrawal symptoms in terms of physical effects. The reported side effects included heart racing, headaches, and insomnia (Griffiths, 2005; Rosenthal & Lesieur, 1992). The *conflict* component refers to what happens between the addicted individual and those close to him/her (interpersonal), as well as within the individual (intrapsychic). The encounter between short-term pleasure and long-term consequence often implies that the addict ends up compromising a number of aspects in their life. Personal relationships, work, and/or academic life, in addition to social and recreational activities, are often regarded as aspects of

the addict's life that are impacted by the addictive behaviour. Conflicts within the individual may also be related to the gap between knowing that the activity they engage in is damaging and being unable to curtail the behaviour, thus experiencing impaired control (Griffiths, 1996; 2005). *Relapse* refers to the tendency for former behavioural patterns to recur after a period of cessation, often to the same excessive level as before the cessation. This includes activities in which the individual has been extremely engaged and that may have led to harmful outcomes, such as drug use or smoking. Such relapses are also common in behavioural addictions such as Pathological Gambling (Griffiths, 2002).

A syndrome model of addiction. Different addictive behaviours have commonly been treated as distinct disorders, such as alcoholism and Pathological Gambling. Research within the field of neurobiology indicates that these distinct addictions might not be as independent after all, and that all these uniquely expressed addictions may reflect the same underlying syndrome. A broader conceptualisation of addiction is now emerging and the separation between substance use- and behavioural addiction may not be adequate to capture fully the nature of and fundamental processes in addiction. For this reason, Shaffer et al. (2004) proposed an understanding of addiction as a syndrome with numerous possible expressions and manifestations (see figure 1). Evidence indicates that addiction can be regarded as a syndrome because of the many commonalities appearing across the different addictions and their shared underlying manifestations and sequelae.

According to Shaffer et al. (2004) the distal antecedents of the addiction syndrome include individual vulnerabilities and predispositions such as neurobiological and psychosocial elements. Neurobiological elements refer to predispositions such as genetic risks and neurological system risks. The psychosocial risk elements include components such as social support, religiosity, and networks. An interaction between the subject and object becomes more likely with increased access and exposure to the potentially addictive object. At-risk individuals are typically more likely to eventually become addicted to the object after interacting with it. This is due to the neurobiological consequences that are prevalent across the distinct objects of addiction, like activation of reward circuitry and those unique to the particular addictive object. The immediate neurobiological effect results in a shift in what is subjectively desirable. Whether the shift takes place depends on the individual's predispositions in terms of whether it increases the likelihood of the individual developing an addiction or not.

The model further states that for an individual to develop an addiction, he or she has to be exposed to an object (e.g. cigarette) and interact with it (e.g. smoke it). When this

occurs, the development of addiction enters the premorbid phase of addiction syndrome. Proximal antecedents such as biopsychosocial events, together with a repeated object interaction will contribute to addiction development. The specific addictions have their own characteristic expressions like smoking, drinking and Pathological Gambling that lead to unique manifestations and sequelae such as pulmonary carcinoma, liver cirrhosis, and gambling debts. Despite these individual characteristics, there are also some manifestations and sequelae that affect all the different types of addictions, like neuroadaptation and depression. The main idea of this model is that all the different types of addiction share the same core processes, including biological, psychological, and social cluster as well as natural history, treatment non-specificity, and object substitution (Shaffer et al., 2004).

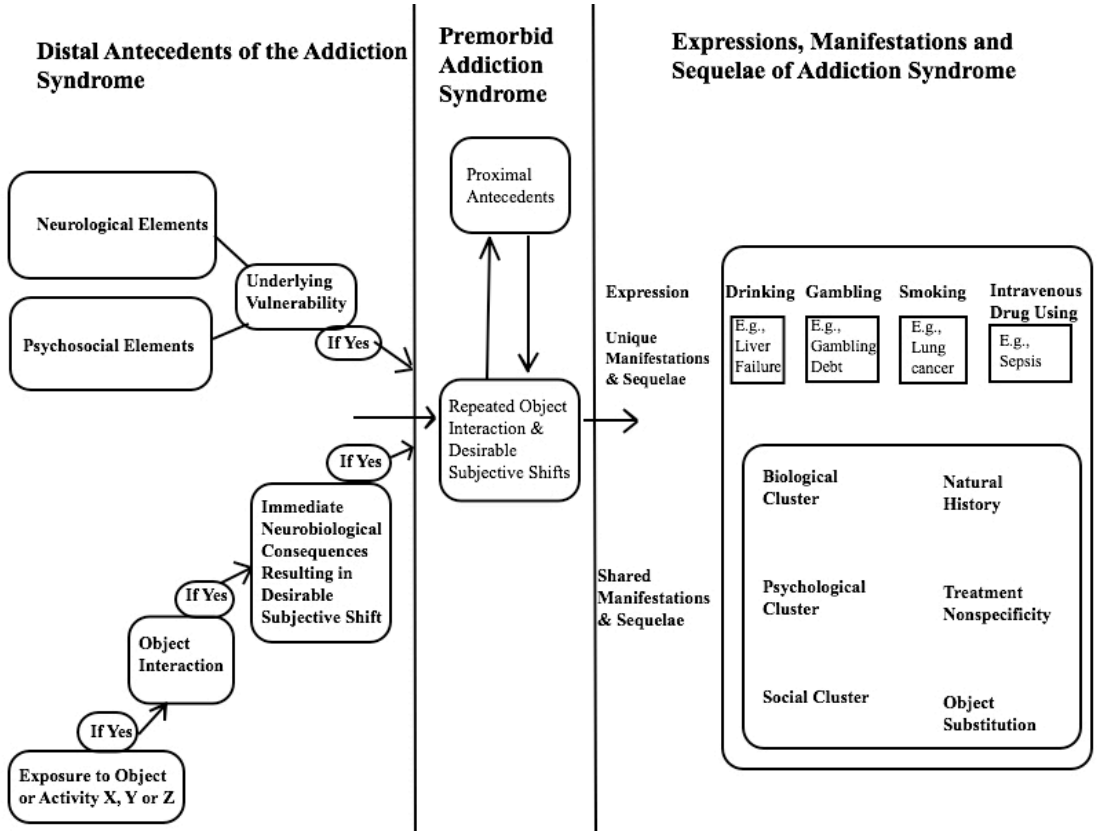

Figure 1. The Addiction Syndrome (Shaffer et al., 2004)

Both of the aforementioned models fill the conceptual gap that has existed and to some extent still exists between substance use- and behavioural addictions. By identifying the underlying structures and elements that are common across the spectrum of addictive behaviour, it is easier to view them as different expressions of the same underlying syndrome.

Behavioural Addiction

The concept of behavioural addictions started gaining popularity in the 1990s after the DSM and ICD had both included Pathological Gambling as an addiction during the early 1980s. Nevertheless, there has been some debate about which behaviours and activities that should be included as behavioural addictions.

Pathological Gambling is currently the most established construct of behavioural addiction. As mentioned above, it is the only behavioural addiction included in the DSM and ICD. Both the DSM-5 and ICD-10, in their classification of Pathological Gambling, have similar criteria for the disorder. Both diagnostic manuals state that the disorder includes recurrent and persistent problematic gambling that negatively dominates aspects of the individual's life. These aspects can include work, social, financial and other significant relationships. The DSM-5 also includes a few more specific criteria for Pathological Gambling, such as the individual must have made repeated attempts to stop the behaviour, increasing bets to be able to maintain the same excitement, chasing losses, and often being preoccupied with the thought of gambling (American Psychiatric Association, 2013).

Internet Gaming Disorder, which was included under the "Condition for Further Study" section of the DSM-5, could be argued to be the second most established behavioural addiction at this point (American Psychiatric Association, 2013). The fact that Internet Gaming Disorder has been included and given a set of specified diagnostic criteria should be considered a big advance towards including behavioural addictions in the DSM (Potenza, 2014). This can help advance research in this field. One of the current issues is the lack of a standard definition of Internet Gaming Disorder, which makes it difficult to retrieve prevalence data. The number of empirical studies published is also insufficient as a source of data. The DSM-5 work group was able to find some similarities between Internet Gaming Disorder and Pathological Gambling Disorder, as well as some similarities to substance use addictions. The literature on Internet Gaming Disorders has included central aspects of addiction, such as tolerance, withdrawal, relapse, salience, euphoria/mood modification, and conflict. All of these have been included in the specific diagnostic criteria that have been proposed for Internet Gaming Disorders in the DSM-5.

Some other behavioural addictions that have gathered some support are Internet Addiction (IA) and shopping addiction. The Internet has become an important tool for people to communicate, conduct academic research, be entertained, or to swap information (Byun, et al., 2009). In 2002, it was estimated that more than 600 million people globally had regular

access to the Internet (Thatcher & Groolam, 2005). However, along with confirmation of the benefits of the Internet, there has also been mounting evidence suggesting that usage of the Internet has become excessive and/or abusive (Griffiths, 2003). It has been suggested that as many as 9 million Americans could potentially fall under the category of being addicted to the Internet (Byun et al., 2009). There has been a lot of research into Internet addiction and although it has not been included in the DSM-5, it is still considered relevant in addiction research. However, the big debate related to Internet addiction is whether the Internet is merely a medium used to feed a specific addiction (e.g. social media or pornography) or if one can be addicted to the Internet in itself.

Young is one of the pioneers within the field of Internet addiction and was the first to propose diagnostic criteria for addiction to Internet use in 1996 (Cash, Rae, Steel, & Winkler, 2012). Further, Young, Pistner, O'Mara, and Buchanan (2000) argued that Internet Addiction consisted of five different subtypes: cybersexual addiction, cyber-relationship addiction, net compulsions, information overload, and computer addiction. However, the term Internet Addiction has been criticised for being too generic, and not taking the content into consideration (Griffiths, Kuss, Billieux, & Pontes, 2016).

During the last decade, shopping addiction has received increasing attention within behavioural addiction research. It has been suggested that it shows some similarities to other behavioural addictions; some of these features include mood elevation, loss of control, deception, self-neglect, and overindulging in the activity, unintentionally or repeatedly (Clark & Calleja, 2008; Hartston, 2012). However, despite several studies reporting findings suggesting that compulsive shopping entails severe negative consequences for the individual, it has still not been included as a part of the DSM. This is mainly due to the fact that there has not been sufficient research regarding this potential disorder, in addition to there being no consensus regarding definitions of shopping addiction seem to exist (Maraz, Úrban, Griffiths, & Demetrovics, 2015).

Some behavioural addictions that have not received as much support as the aforementioned behavioural addictions include overeating and social media addiction. Blaszczynski (2015) argues that there is an increasing, borderline obsessive, tendency in society to label behaviours that are being performed excessively as being addictive disorders. This, however, fails to consider alternative causes of the excessive use. He further argues that this trend will potentially impair the credibility of behavioural addictions as valid addictions on the same level as other types of addictions. Blaszczynski (2015) highlights this potential pitfall where one treats every behaviour blindly on taxonomy. However, as previously

mentioned, researchers have found evidence suggesting that there is a clear difference between excessive use and addiction (Charlton & Danforth, 2010; Griffiths, 2005; 2008).

Withdrawal

When an individual is restricted from an object of addiction or engagement in addictive behaviour, withdrawal symptoms will occur. Withdrawal is a central part of addiction and is one of the components in Griffiths' (1996) model of behavioural addiction. In the model, withdrawal is described as negative symptoms that occur due to cessation of the addictive activities. The symptoms can be divided into physiological and psychological effects. The psychological effects are symptoms such as irritability, uneasiness, feeling of craving, and difficulty concentrating. Some of the physiological effects are insomnia, shivering, nausea, and headache. The psychological symptoms are largely the same across the spectrum of addictions, while the physiological are more specific to the substance use-related addictions (Etter, 2005; Griffiths, 1996; Shiffman & Jarvik, 1976). Research indicates that the further the addiction has developed, the more difficult it will be for the individual to handle the cessation period. It varies whether the dominating effect is psychological or physiological. However, some of the literature regarding withdrawal in behavioural addiction has found evidence of the occurrence of mainly psychological symptoms (Parlak & Eckhardt, 2014; Alavi, Ferdosi, Jannatifard, Eslami, Alagheman, & Setare, 2012; Griffiths, 1996). Several studies have used anxiety measures as a means for investigating individual experience during a restriction period. Because of this, the anxiety component and the related negative affect are deemed important aspects when looking at effects of behavioural restriction. These measures have similarities with psychological withdrawal symptoms such as restlessness, uneasiness, and irritability (Clayton, Leshner, & Almond, 2015; Cheever, Rosen, Carrier, & Chavez, 2014; Przybylski, Murayama, DeHaan, & Gladwell, 2013; Skierkowski & Wood, 2012; Etter, 2005; Brown, Irwin, & Schuckit, 1991).

Studies of substance addiction withdrawal have shown that there are certain trends regarding symptom development. Knowledge about these effects can be highly useful as the issue of withdrawal symptoms in behavioural addictions has yet to be sufficiently researched. Shiffman and Jarvik (1976) studied smokers who abstained from cigarettes over a certain period. The results indicated that the symptoms had a U-shaped function, whereby the symptoms were more salient in the beginning and towards the end of a restriction period. However, a study on alcohol withdrawal found the symptoms to have an inverted U-curve (Sellers & Kalant, 1976). These findings indicate that there might be some differences across the various addictions regarding the temporal shape of the withdrawal symptoms. In addition,

Hughes, Keely, and Naud (2004) performed a systematic literature review where they studied smokers who quit without the help of any treatment by looking at their relapse curves and long-term abstinence. The results from the review indicated that 3–5% of smokers who quit on their own abstained from smoking 6-12 months after their last cigarette. However, it is worth mentioning that most of the relapses happened within the first eight days. Thus, it could be argued that there should be greater clinical focus on the first week of restriction periods (Hughes et al., 2004). There is little research done on withdrawal in behavioural addiction. In order to investigate the processes related to behavioural addictions, substance use withdrawal scales are usually adapted and used. Nevertheless, there is a need for withdrawal scales solely based on behavioural addictions.

Technological Addiction

There has been increasing focus recently on technological addiction, probably in light of the fact that behavioural addictions have begun to be more widely studied. Technological addiction shares some characteristics and shows similarities with several other established types of behavioural addiction and could be seen as a subcategory of behavioural addiction (Griffiths, 1996; Lapointe, Boudreau-Pinsonneault, & Vaghefi, 2013). Widyanto and Griffiths (2006) defines technological addiction as "non-chemical (behavioural) addictions that involve human-machine interaction" (p.31). Technological addictions can subsequently be defined as an interaction between an individual and a technological device, where the individual becomes dependent on this device due to positive consequences and a reduction in negative affective states (Griffiths, 1996, 1999; Shaffer, 1996).

There are two types of technological addiction. One is passive, such as watching television, as opposed to active, such as Internet use and playing computer games (Griffiths, 2000). As these types of activities often have features that are either inducing or reinforcing in nature, they may also contribute to addictive tendencies (Griffiths, 2000). A theory that has been used to explain technology addiction is the theory of optimal flow (Csikszentmihalyi, 2008), which suggests that the flow of information technology can cultivate addiction. Experiencing information technology, such as scrolling on Facebook or on a smartphone, can be so satisfactory that it creates a state or environment an individual will try to remain in, despite the potential high cost (Csikszentmihalyi, 2008).

However, when discussing technological addictions, it is subject to much debate whether they involve being addicted to the medium itself or whether the medium is merely a vehicle for or promoter of other addictions. There are three main views regarding this issue: 1) one can be addicted to the medium itself; 2) one could be addicted to the medium, because

it grants access to different types of content that is accessible only through the medium; and 3) one is only addicted to the content the medium makes accessible and not to the medium itself. These views have all been presented when particularly discussing Internet Addiction. For instance, Young (1998) has suggested that the Internet itself is generally not considered addictive, but specific applications play an important role in developing pathological Internet use. However, Young (1998) argues that the medium is what causes addiction due to the fact that the content would not be accessible without it.

Nonetheless, Griffiths et al. (2016) argue that the medium itself is not addictive, but the medium is used as a platform/source that promotes addictions. For example, an individual addicted to online shopping would not be considered addicted to the Internet, but would rather use it as a medium to carry out specific addictive behaviour (in this case, shopping addiction). This argument has received support among several other researchers as well (e.g. Starcevic, 2013; Young, 2009). Stracevic (2013) have compared Internet Addiction to be the equivalent of saying that someone is suffering from casino addiction, when in fact suffering from Pathological Gambling.

Nevertheless, some findings from case studies have indicated that a few individuals seem to be addicted to the Internet itself. These individuals often use the Internet for chat rooms and activities that are accessible only through the Internet (Griffiths et al., 2016). This argument has also been used to describe people that seem to be addicted to social media and social networking sites (SNSs), (Griffiths et al., 2014; Kuss & Griffiths, 2011). SNSs can be defined as an online service that enables the user to create public profiles that can be used to connect with a selected group of individuals within a bounded system (Boyd & Ellison, 2008). These arguments can be used in support of the first view, claiming that one could potentially be addicted to the medium and not the content. Nonetheless, it can be difficult to distinguish between the use of Internet as a medium and as an activity.

The Smartphone

Smartphones have become increasingly popular and more advanced over the last decade. They dominate sales of communication devices globally and have become a crucial part of peoples' daily lives (Roberts, Yaya, & Manolis, 2014). According to the Norwegian Media Barometer, in 2015, 85% of the population in Norway own a smartphone (Statistics Norway, 2016). Smartphones have been developed to possess advanced computing capabilities (Chóliz et al., 2016). A smartphone is no longer a device that can be used exclusively for calling and sending messages, but can also be used to access the Internet, take pictures, use it as an alarm clock and as a gaming console, as along with many other different

kinds of multimedia functions (Chóliz et al., 2016). These functions enable users to be constantly connected and have access to an uninterrupted flow of real-time data from SNSs (Valderrama, 2014), such as Facebook, Instagram, and Twitter. Smartphones have become a crucial component in peoples' lives, with 73% reporting that they would feel panic if they had misplaced their phone (Lookout, 2012). A study conducted in the USA found that within 15 minutes of waking, as many as eight out of ten adults would reach for their phone, whereas nine out of ten younger adults would do the same (International Data Corporation, 2013). This indicates that people rely heavily on their smartphones, so much so that it is the first thing they check when waking up in the morning.

The smartphone has become such an important part of people's lives that 58% of all smartphone users report checking their phone at least once every hour (Lookout, 2012). According to a European study that was conducted by the Swiss Federal Statistics Office in 2012, many European countries have a larger amount of mobile phone subscriptions than inhabitants (Billeux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015). There may be several reasons for this, such as having one mobile phone for work purposes in addition to a private mobile phone. Another possible explanation could be that people who live abroad for either work or education purposes often have two mobile phone subscriptions, one for the country they are currently living in and one for their home country.

Terminology. There are different terminologies in use describing various issues such as problematic smartphone usage (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015; Valderrama, 2014), overuse of wireless devices (Cheever et al., 2014), mobile phone dependence (Chóliz et al., 2016), and smartphone addiction (Akin, Altundag, Turan, & Akin, 2014; Al-Barashdi, Bouazza, & Jabur, 2015). Other terms, such as excessive use, are related to the smartphone but are merely seen as one aspect within an addiction (Chóliz et al., 2016). Some of the more frequently mentioned notions in the field are problematic smartphone use and smartphone addiction, which are more difficult to distinguish from one another. Intuitively, one might assume the difference is related to severity. Problematic smartphone use could then refer to what can be characterised as an early stage of addiction, while smartphone addiction refers to what occurs when the smartphone use is associated with something negative, uncontrolled and long-term. Nevertheless, some scholars in the field are using these terminologies interchangeably

Problematic mobile phone or smartphone usage has been coined a behavioural addiction that includes several components of addictive behaviours. These include components such as mood modification, loss of control, tolerance, withdrawal, cognitive

salience, conflict, and relapse (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015). Smartphone addiction is being characterised with the same components, in addition to being compared with Internet addiction (Chotpitayasunondh & Douglas, 2016). The small and usually negligible difference in terminologies between problematic smartphone use and smartphone addiction, is the reason for using the term *smartphone addiction* in the present study.

Negative effects of excessive use. Excessive smartphone usage has potentially harmful effects, and research indicates that overuse can lead to undesired outcomes for both the individual and their surroundings. As one aspect of smartphone addiction, excessive use is therefore highly relevant. Results indicate that excessive use is one of several characteristics of behavioural addictions, which makes excessive smartphone usage of significant concern for public health (Tossell, Kortum, Shepard, Rahmati, & Zhong, 2015; van Deursen, Bolle, Hegner, & Kommers, 2015).

Harmful effects can be divided into individual effects and effects impacting their surroundings. Results from studies regarding individual effects indicate that excessive smartphone use is related to musculoskeletal effects, such as neck pain (Xie, Szeto, Dai, & Madeleine, 2016) thumb movement pain (INal, Demirci, CetInturk, Akgönül, & Savas, 2015), and poor academic performance (Lepp, Barkley, & Karpinski, 2014). Elhai, Levine, Dvorak, and Hall (2016) revealed that smartphone addiction was associated with anxiety. A Turkish study on students indicated that depression, anxiety and then, indirectly, sleep quality were associated with smartphone addiction (Demirci, Akgönül, & Akpinar, 2015). Studies related to effects on surroundings found that excessive use is related to distraction for pedestrians and drivers (Cazzulino, Burke, Muller, Arbogast, & Upperman, 2014). A Norwegian study revealed that 55% of drivers sometimes use their smartphone when they drive. In all, 19% reported experiencing dangerous situations on the road due to their own smartphone usage, while 71% reported experiencing dangerous situations due to other drivers' smartphone usage (Sagberg, 2016).

When discussing negative effects of increasing use of smartphones and the time spent on smartphones, it is also worth mentioning phubbing. Phubbing is a term coined to define the act of snubbing by using one's smartphone rather than interacting with others, while in a social setting with one individual or more (Chotpitayasunondh & Douglas, 2016; Roberts & David, 2016). This behaviour has become quite common in society today. One can observe the act of phubbing happening in cafés, restaurants, at parties and it is even prevalent in the users' own home. For example, it is not uncommon to see friends or a couple sitting in a

coffee shop where one of them is paying attention mainly to their smartphone, while the other person is waiting or trying to get the other persons' attention.

Several studies have focused on the effects of restricting access to smartphones. A study revealed that restricting participants from using their smartphone made them significantly more anxious over time. However, this effect was found only in individuals who are heavy or moderate users of smartphones (Cheever et al., 2014). Being unable to answer incoming calls on ones' smartphone was found to cause increased heart rate and blood pressure, as well as feelings of anxiety, and unpleasantness (Clayton et al., 2015).

These findings support the construct of smartphone addiction. With all the reported adverse effects of smartphone usage on both the individual and the general population, one cannot deny that this as an area that warrants attention. Furthermore, the large proportion of the population that have access to and use a smartphone makes this a topic that cannot be ignored.

Addictive features of a smartphone. Several aspects of a smartphone may be involved in addictive behaviour, like usage and software applications (apps). How individuals use their smartphones can be divided into two different types of usage, social usage and process usage. Social usage refers to when people use their smartphones to interact with others and maintain relationships, by using SNSs (van Deursen et al., 2015). Process usage on the other hand, refers to smartphone usage where one consumes and processes information for relaxation, entertainment and informative purposes (van Deursen et al., 2015). The latter can reflect everything from reading the news to playing a mobile game or listening to music. There has been some debate as to whether women are more likely to use their smartphone for social usage, while men are more likely to use their smartphone for process usage. In a study by van Deursen et al. (2015), their results partially supported this assumption. Their results indicated that women are more likely than men to use their smartphone for social purposes, but they were not able to find any supporting evidence for men using their phones more for process-oriented purposes than women (van Deursen et al., 2015). Nevertheless, other studies have suggested that men are more likely to use their smartphones to play video games and for media sharing (Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013), which can be considered forms of process usage.

Especially regarding social usage apps, social networking sites (SNSs) may function as facilitators of relatedness for the user, since one's friends and their posts are always only a click away. The constant flow of information keeps the user updated on what everyone shares at all times, which could emphasise the feeling of being connected and attached. This could

serve as positive reinforcement for the individual user in terms of experiencing the reward of socially relevant emotions. Experiencing reinforcements and rewarding emotions could also be related to process usage such as listening to music or watching a video clip. Here the reinforcement is associated with positive emotions produced by an enjoyable video clip or listening to the favourite song. A sense of comfort and joy might be triggered by the immediate access one has to the device. Another possibility is that smartphone usage can function as a negative reinforcement whereas the apps, those related to both social and process usage, may be a distraction from other stressful events or simply boredom. The activities in which the individual engages on the smartphone in these cases are not as important, as long as they serve as a distraction from aversive aspects of daily life. Findings indicate that SNSs are more prone to addiction compared to other apps. These apps have also been reported to be more difficult to control in terms of time spent, although they are reportedly easier to withdraw from compared to other features of the smartphone (Bandura, 1991; Chou & Hsiao, 2000; Ding, Xu, Chen, & Xu, 2016; Ferster & Skinner, 1957).

It becomes evident that SNSs play an essential role of the smartphones composition and represent a large portion of the addictive properties related to smartphone usage. An integrated topic is the phenomenon termed Fear of Missing Out (FoMO), which denotes an overhanging concern that one is excluded from taking part in or sharing enjoyable experiences others might be having (Przybylski et al., 2013). Participation in SNSs might be particularly attractive due to the immediate access to information about friends and events, where individuals with high FoMO might gravitate toward these channels. Hence, aspects of smartphone addiction could be related to FoMO due to a constant need to check the different SNSs with ones' smartphone in order to avoid missing out. This is supported by findings indicating that FoMO is related to continual smartphone overuse as well as smartphone addiction (Carbonell, Oberst, & Beranuy, 2013; Cheever et al., 2014; Clayton et al., 2015; Elhai et al., 2016; Hong, Chiu, & Huang, 2012; Lepp et al., 2014; Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013; Rosen, Whaling, Rab, Carrier, & Cheever, 2013).

The society is also gravitating towards the use of smartphones for various applications. For instance, in Norway the need for a smartphone is evident when you want to access your social security pages, transfer money to friends, access your bus ticket, or simply to show your student-ID. These features are all primarily available through apps.

What makes the smartphone different from the other behavioural addictions is its portable function together with the unlimited and immediate access to various platforms through the Internet. It can be accessed not only at home or at school, but everywhere you

take your smartphone. This could facilitate multiple reinforcement pairings associated with the stimuli, which in this case is the smartphone, which rapidly may instigate an addictive behavioural pattern.

In order to investigate smartphone withdrawal symptoms during a restriction period, the present study focuses on FoMO, positive and negative affect, as well as a on a modified measure of smartphone withdrawal. This modified smartphone withdrawal scale is used to cover both the psychological and physiological aspect of smartphone withdrawal symptoms, here included symptoms of anxiety. It also includes the materialistic or tangible facet of the smartphone, like holding it or reaching for it. Based on the research, it appears likely that smartphone users may experience withdrawal symptoms, especially psychological, when separated from their device. In this regard, anxiety about missing out on ones' social connections and networks (e.g. FoMO) is likely to be an important component in these mechanisms. The present study will also investigate whether these effects will lead to more negative affect and less positive affect. In addition, Hughes et al. (2004) have suggested that there should be more focus on the first week of withdrawal in terms of behavioural addictions.

Research Topic

The aim of this study is to examine if and how the subjective withdrawal scores vary during a smartphone restriction period. Withdrawal as a component will be measured by using three different scales. The modified Smartphone Withdrawal Scale (SWS) has two functions in this study. It covers the established elements in withdrawal known from other substance-related addiction, as well as including the tangible component similar to cigarette withdrawal. A similarity between cigarette and smartphone is the association with tangible properties. The FoMO scale contains the anxiety component, which in this context is related to the individual being cut-off from events that other participate in both online and offline. Anxiety is regarded as an essential part of withdrawal. Smartphones are one of several media used to avoid these negative effects associated with FoMO, which in turn indicates that restriction from these devices could provoke FoMO. The Positive and Negative Affect Schedule (PANAS) scale (Watson, Clark, & Tellegen, 1988) will be used to measure affect. A decrease in positive affect and an increase in negative affect could indicate higher levels of stress and anxiety, which in turn can be related to the withdrawal component.

The present study will examine whether there exists a difference between the restricted and control condition, as well as groups with higher and lower levels of smartphone addiction, in regard to the scores related to withdrawal as well as. For this reason, our

research topic is if smartphone restriction affects the subjective withdrawal scores in terms of SWS, FoMO, and PANAS scores.

Hypotheses

Hypothesis one. Participants who are restricted from using their smartphone will score significantly higher on the SWS, and therefore experience more withdrawal symptoms in terms of craving, depression/anxiety, irritability/impatience, and difficulty concentrating during the restriction period compared to the controls on the SWS.

Hypothesis two. Participants who are restricted from their smartphone will score significantly higher on the FoMO scale during the restriction period compared to the controls.

Hypothesis three. Participants who are restricted from their smartphone will score significantly higher on negative affect and lower on positive affect during the restriction period compared to the controls on the PANAS scale.

Hypothesis four. Participants with higher scores on smartphone addiction, compared to those with lower scores on smartphone addiction, will be more negatively affected (as assessed by the SWS), by the smartphone phone restricted condition than by the control condition. Thus, a significant two-way interaction effect (Level of Addiction X Condition) is expected.

Hypothesis five. Participants with higher scores on smartphone addiction, compared to those with lower scores on smartphone addiction, will be more negatively affected (as assessed by the FoMOs), by the smartphone restricted condition than by the control condition. Thus, a significant two-way interaction effect (Level of Addiction X Condition) is expected.

Hypothesis six. Participants with higher scores on smartphone addiction, compared to those with lower scores on smartphone addiction, will be more negatively affected (as assessed by the PANAS scale), by the smartphone restricted condition than by the control condition. Thus, a significant two-way interaction effect (Level of Addiction X Condition) is expected.

Method

Participants

The sample consisted of 127 participants, with 72.4% women (*n* = 92) women and 27.6% men (*n* = 35). All participants were between the ages of 18 and 48 years old, with a mean age of 25 years (SD = 4.5). In all, 79.5% (*n* = 101) of the sample were full-time students. They were recruited through advertisement on Facebook and personal appeal. Participants that did not use their smartphone for at least one hour on a daily basis were excluded. The study took place over ten weekends during the period from October 2016 to February 2017. Each participant was assigned a unique ID. Those participating during a specific weekend were regarded as one block, and participants within each block were randomised into either a restricted or a control condition by an online randomiser calculator (Urbaniak & Plous, 2015).

Instruments

Pre-test data. The pre-test was web-based and administered five days prior to the experiment, through SurveyXact.

Demographic item. The participants were asked to complete items regarding their age, gender, relationship status, employment status and student status, as well as their highest acquired degree of education.

Frequency and usage tracker apps. The iOS app "Moment – Screen Time Tracker" and the Android app "QualityTime – My Digital Diet" was used to track smartphone activity objectively. The apps tracked the frequency and duration of interaction with the smartphone. This objective measure complemented self-reported smartphone use ("On average, how much time do you spend using your mobile phone per day?").

***Smartphone Frequency and Use Items*.** Smartphone Frequency and Use Items (Valderrama, 2014) consist of five items where the participants rate themselves on topics such as frequency, duration and characteristics (e.g. "*Do you use your smartphone every day?"*) of smartphone use.

The Mobile Phone Involvement Questionnaire. The Mobile Phone Involvement Questionnaire (MPIQ; Walsh, White, & Young, 2010) was administered in order to assess the degree of involvement with mobile phone use among the participants. MPIQ consist of eight items assessing characteristics related to mobile phone involvement and addictive components such as behavioural salience ("*I often use my phone for no particular reason"*) and loss of control ("*I lose track of how much I am using my mobile phone")*. The response options are distributed over a seven-point Likert scale, 1 (*strongly disagree)* to 7 (*strongly*

agree). The reliability analysis revealed an acceptable internal consistency with Cronbach's alpha level of .85. This questionnaire was administered at three points in time (one week before, day one and day four of the study).

Phase one. The first phase of the experiment took place on day one.

Mobile Phone Problem Usage Scale. Mobile Phone Problem Usage Scale (MPPUS; Bianchi & Phillips, 2005) was applied to assess the degree of problem usage among the participants regarding mobile phones. The items reflect components of addiction such as craving, withdrawal, and social motivations. An example of an item is, "*if I don't have a mobile phone, my friend would find it hard to get in touch with me".* A 10-point Likert-scale is used, with response alternatives ranging from 1 (not true at all*)* to 10 (extremely true*)*. Reliability analysis of this scale revealed a Cronbach's alpha level at .91, which reflects excellent internal consistency.

The Smartphone Addiction Scale Short Version. The Smartphone Addiction Scale Short Version (SAS-SV; Kwon, Kim, Cho, & Yang, 2013) was used to measure the degree of smartphone addiction among the participants. SAS-SV consists of ten items containing statements related to smartphone addictive behaviour, such as *"missing planned work due to smartphone use"* and *"having my smartphone in my mind even when I am not using it"*. All items are scored on a six-point Likert scale, ranging from 1 (strongly disagree) to 6 (strongly agree). The reliability analysis of the SAS-SV found the internal consistency to be good with a Cronbach's alpha of .82.

Phase two. The second phase of the experiment, starts at day one and ends on day four.

Smartphone Withdrawal Scale. The Smartphone Withdrawal Scale was included in this study for the purpose of measuring the degree of withdrawal symptoms related to smartphone restriction. The scale represents a modified version of the Cigarette Withdrawal Scale (Etter, 2005). The Cigarette Withdrawal Scale originally consists of a total of 20 items divided into six subscales (Depression-Anxiety, Craving, Irritability-Impatience, Difficulty concentrating, Appetite-Weight gain, and Insomnia), but in the present study the "Appetite-Weight gain" and "Insomnia" subscales was not be included as they were deemed irrelevant for smartphone addiction. We modified some of the items on the "Craving" subscale that were specific to cigarette use so that they would become relevant for smartphone withdrawal. In addition, the scale was altered from a trait to state format, by wording the questions from a general to a specific state. The specific state in this alteration represents a present state. An example item is, *"the only thing I can think about in this moment, is my smartphone"*. The

modified scale consists of a total of 15 items, each rated on a five-point Likert scale, ranging from 1 (totally disagree) to 5 (totally agree). A total composite score was calculated based on the sum score of all the 15 items. The Cronbach's alpha for the SWS was shown to be very good across all the nine different times it was measured, ranging from .88 to .92.

The Positive and Negative Affect Schedule Scale. The Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) was used to measure self-reported mood. The PANAS scale consists of 20 items, ten items related to the Positive Affect Schedule (PA) and ten items related to the Negative Affect Schedule (NA). These items describe different affective states, such as *"hostile"*, *"excited"*, *"guilty"*, *"alert"*. The participants made an indication of to what extent they feel this way at the present moment for each item on a five-point Likert scale, 1 being (very slightly or not at all) to 5 being (extremely). The Cronbach alpha reliabilities for both PA and NA were shown to be good to excellent across the nine different times of measuring, PA ranging from .87 - .92 and NA from .77 - .85.

The Fear of Missing Out Scale. The Fear of Missing Out Scale (FoMOs; Przybylski et al., 2013) was used as a self-reported measure of fear of missing out. Originally, the scale was considered a trait measure, but it was adapted to become a state measure for the present study. This was done by wording the questions from a general to a specific and present state. The scale consists of ten items, such as *"I fear others have more rewarding experiences than me right now"* and *"in this moment, it bothers me when I miss an opportunity to meet up with friends"*. Each item was rated on a five-point Likert scale, 1 (not at all true of me) ranging to 5 (extremely true of me). The FoMOs demonstrated a good internal consistency across the nine different times of measuring with an alpha reliability ranging from .80 to .87.

Design

The study had a quantitative, experimental design, where the participants were measured at several different times, before and during the experimental phase (see figure 2).

Pre-test (Monday)	Day one (Friday)	Day two (Saturday)	Day three (Sunday)	Day four (Monday)
	• 4pm • 8pm	• 12pm • 4pm • 8pm	• 12pm • 4pm • 8pm	• 12pm

Figure 2. Progression model illustrating the experimental design.

Procedure

The Monday before the experimental weekend (Friday-Monday) the participant received an email containing a link to SurveyXact and links to download either the iOS app "Moment – Screen Time Tracker" or the Android app "QualityTime – My Digital Diet". The survey was used to measure smartphone frequency and usage. The participants were instructed to install one of the two apps, depending on which type of smartphone they had. The apps were used as an objective measurement of smartphone usage. All the participants had to respond to the email, confirming they had completed the survey and downloaded one of the apps, as well as confirm the time they wanted to meet on the coming Friday. Upon inclusion, all participants were given a unique, consecutively allocated id-number.

The participants were instructed to meet with a member of the research team on a Friday at their scheduled timeslot (between 7am and 8pm). When the participants arrived, they were asked to show frequency and time spent on their smartphone for Tuesday, Wednesday and Thursday (based on the app). Before this meeting, all participants were randomly divided, based on their unique number, into either a restricted or a control condition. The condition was revealed to the participants. Those allocated to the restricted condition were instructed to turn off their smartphones and hand them in. The smartphone was marked with the participants' unique number and thereafter placed in a secure locked cabinet over the weekend. Those allocated to the control condition were allowed to keep and use their smartphone as usual. Before the participants left, they were given a folder with questionnaires that they were instructed to complete during the weekend, this included the SWS, the FoMOs, and the PANAS scale.

During the three day smartphone restriction period, the participants were instructed to complete some questionnaires (the SWS, the FoMOs, and the PANAS scale) three times a day (at 12am, 4pm and 8pm). The participants were asked to provide the exact time for completing each questionnaire to ensure that the assessments took place in accordance with the instructions given.

The participants met a member of the research team on the following Monday (at the exact same time as the meeting on Friday) at which they handed in the completed questionnaires. Those in the restricted condition got their smartphones back and responded to a qualitative question regarding challenges related to the smartphone restriction period. All participants received remuneration for taking part in the study; the amount was undisclosed in advance.

Ethics

An application for approval was sent the Norwegian Data Protection Authority/NSD prior to the data collection (project no. 49769) and permission was granted. There was no form of deception in the study and all data were stored on password protected computers and USB sticks, the latter were kept in a locked cabinet, approved for data material storage. All participants were recruited from the general adult (at least 18 years old) and were therefore able to give consent.

One ethical consideration in the study was that the participants in the restricted condition were without their smartphones from Friday until Monday and were therefore unable to call any emergency numbers themselves if necessary during that period. However, the participants were only restricted from their smartphone for a limited time and individuals that were dependent on receiving medical or other types of assistance were advised to stay within reach of other people during this period. All participants received 500 Norwegian kroner (NOK) in compensation for their participation.

Data Analysis

The design of the study included several different measures all having different purposes. The measures that were used to characterise the participants were administered one time. This includes measures related to characteristics regarding use, as well as smartphone addiction level. Meanwhile, a battery of withdrawal related scales were completed by each participant at nine intervals during the restriction period. These scales compiled the dependent variables in the study. Time represented the repeated measures for each participant (nine times), which enabled an investigation of intra-individual variations. Condition represented either restricted or control. Group based on scoring above and below the median on smartphone addiction comprised another independent variable in the study. In order to conduct an analysis of repeated-measures data where multiple measurements are carried out on the same subject across time, a linear mixed models analysis was applied. This type of data set can be regarded as a two-level data. Level 2 represents the subjects (ID), while the repeated measurements for each individual are represented in Level 1. The data therefore had a multilevel structure. A restricted maximum likelihood approach was used as this produces unbiased estimates of variance and covariance parameters. Random intercept was included in the models (Harville, 1977; West, Welch, & Galecki, 2014).

The dependent variables were measured at nine different times for the two conditions, restricted and control, as well as for level of addiction. Level of addiction was split in two groups, distinguishing those who scored above and below median split on a z-score based

sum score for three smartphone addiction scales (MPIQ, MPPUS, and SAS-SV). In the analysis, between-subjects factors reflected the potential difference between the individuals in the restricted condition and the control condition, as well as between those scoring above and below median split on smartphone addiction, in terms of withdrawal scores (SWS, FoMOs, and PANAS scale). ID was entered as a random effect, while time, condition, and level of addiction were fixed effects. The dependent variables included in the analysis were the withdrawal related scores, FoMOs, SWS, and PANAS scale. Based on previous studies (Skierkowski & Wood, 2012) a moderate effect size was expected (Cohens d=0.50) between conditions. Power analysis was conducted with G*Power 3.1.7 (Faul, Erdfelder, Lang, & Buchner, 2007). Power was set to .80, alpha set to .05 (two-tailed). This showed that in order to detect between-subject effects, 128 subjects should be recruited when using standard analysis of variance. For this study, 127 participants took part in the experiment, which will be regarded as an adequate sample size taken into consideration the repeated measured/linear mixed model approach.

Results

An experiment with a between-group design was conducted. Data was analysed using linear mixed models. For hypotheses one, two and three, time (Time 1– Time 9) and condition (experimental vs. control) were entered as fixed effects. For hypotheses four, five and six, a median split was calculated based on the overall z-score of three different smartphone addiction scales, dividing the participants into high and low scores on smartphone addiction within both condition. This median split variable was included as a fixed effect together with time. Random intercept was included in the models and SWS, FoMOs, and PANAS scale were entered as dependent variables in both analyses.

Descriptives

The mean deviation in time for expected survey responses was M = 15.0 (SD = 13.9). A qualitative measure was included in the experiment, where those in the restricted condition were asked to report what they experienced as most challenging when being separated from their smartphone. Based on these responses, categories were made. During the restriction phase, 49.3% of those in the restricted condition reported missing process apps and 49.3% experienced difficulties associated with social communication. Process apps are applications that provide access to bus tickets, news, Internet, and so on. Further, the participants reported challenges associated with their own inaccessibility (43.3%), planning (40.3%), lack of access to alarm clock/clock (32.8%) ,or music and/or podcast (25.4%), social networking apps (13.4%), security (10.4%), as well as the lack of something to help pass the time (6.0%). Some (6.0%) reported an increase in use of other platforms (e.g. computer) due to the restriction period.

Regarding smartphone usage, the apps showed that the participants in the restricted condition during baseline used their smartphone on average 3.0 hours (M = 180.3, SD = 86.4) per day, while the control condition used it for approximately 2.5 hours (M =151.3, SD = 73.7). However, this difference between the conditions was not significant (t = 1.96, p = n.s). A complementary subjective measurement revealed that the reported usage was 2.79 (SD = .845), in which an answer of three would indicate a smartphone usage of three to six hours a day. This corresponds to the objective measure done with the app. In the control condition, the mean smartphone usage reported was 2.62 (SD = .555). Nevertheless, this difference was not significant (t = 1.02, p = n.s).

Missing Data

On the items regarding the SWS scale during the experimental phase the missing data was 4.4%. Furthermore, the FoMO items had 4.2% missing data, the Positive Affect scale 4.5%, and the Negative Affect scale had 4.2% missing data.

Hypothesis-Analysis

Effects on Smartphone Withdrawal Scale for those in the restricted and control condition (see table 2): There was a statistically significant main effect of condition, F (1, 118.04) = 4.49, $p < .05$, and time, F (8, 895.39) = 2.52, $p < .01$ on the total score of SWS. The interaction effect between condition and time was not statistically significant, F (8, 895.39) = 0.312, p = n.s. (figure 3). Specifically, Time 7 had a statistically significant higher SWS score compared to Time 9 (t = -2.14, $p < .05$) which represented the contrast. The intraclass correlation coefficient (ICC) score was .524 (table 1).

Effects on Fear of Missing Out Scale for those in the restricted and control condition (see table 3): There was statistically significant main effect of condition, F (1, 117.83) = 3.77, p = n.s., and time, F (8, 896.59) = 8.42, $p < .001$, on the total score of FoMO. The interaction effect between condition and time was not statistically significant, F (8, 896.59) = .609, p = n.s. (figure 4). Further, Time 1 (t= 3.49 $p < .001$), Time 2 (t= 2.14, $p < .05$) and Time 3 (t= 2.16, $p < .05$) had a statistically significant higher FOMO score compared to the reference time. The ICC score was .668 (table 1).

Effects on Positive Affect and Negative Affect Schedule for those in the restricted and control condition (see table 4): There was no statistical significant main effect for condition, F (1, 118.03) = 1.20, p = n.s. However, the analysis revealed a statistical significant main effect for time, F (8, 898.01) = 3.80, $p < .001$, on the total score of Positive Affect. The interaction effect between condition and time on the Positive Affect score, F (8, 898.01) = .880, was not statistically significant (figure 5). The ICC score was .403 for Positive Affect (table 1).

The Negative Affect score had no significant main effect for condition, F (1, 117.19) = 1.65, p = n.s., nor for time F (8, 896.54) = 1.82, p = n.s. Furthermore, the interaction effect between condition and time on the Negative Affect score F (8, 896.54) = .875, p = n.s, was not statistically significant (figure 6). The ICC score was .096 for Negative Affect (table 1).

Table 1.

The mean (SD) for each condition on the SWS, FoMO, Positive Affect (PA) and Negative Affect (NA) scale at time 1-9. ICC for the SWS, FoMO, PA and NA scales are reported for both conditions in the first 4 rows.

	Restricted				Non-restricted			
Time	SWS	FoMO	PA	NA	SWS	FoMO	PA	NA
1	1.69	2.01	2.77	1.34	1.57	1.86	2.78	1.27
	(.647)	(.720)	(.713)	(.392)	(.655)	(.558)	(.737)	(.367)
2	1.68	2.05	2.61	1.32	1.53	1.76	2.67	1.29
	(.660)	(.744)	(.576)	(.422)	(.562)	(.642)	(.854)	(.405)
3	1.57	1.88	2.63	1.32	1.40	1.75	2.79	1.26
	(.561)	(.793)	(.719)	(.394)	(.552)	(.624)	(.829)	(.389)
4	1.60	1.93	2.61	1.34	1.44	1.77	2.73	1.20
	(.650)	(.754)	(.820)	(.471)	(.556)	(.631)	(.791)	(.287)
5	1.57	1.87	2.53	1.27	1.32	1.68	2.63	1.18
	(.683)	(.660)	(.699)	(.382)	(.395)	(.597)	(.775)	(.282)
6	1.54	1.81	2.47	1.27	1.37	1.59	2.71	1.24
	(.536)	(.695)	(.852)	(.421)	(.420)	(.555)	(.856)	(.360)
7	1.62	1.86	2.30	1.33	1.41	1.64	2.60	1.25
	(.576)	(.623)	(.749)	(.387)	(.528)	(.517)	(.743)	(.335)
8	1.65	1.85	2.43	1.31	1.43	1.60	2.57	1.21
	(.676)	(.682)	(.695)	(.388)	(.461)	(.586)	(.775)	(.352)
9	1.53	1.74	2.57	1.21	1.36	1.62	2.64	1.19
	(.536)	(.573)	(.665)	(.370)	(.506)	(.573)	(.787)	(.351)
ICC	.524	.668	.403	.096				

Effects on Smartphone Withdrawal Scale for those scoring higher or lower on level of smartphone addiction within each condition (see table 2 and 5). There was a statistically significant main effect for level of smartphone addiction, F (2, 212.25) = 4.16, $p < .05$. There was no statistically significant interaction effect between the level of smartphone addiction and time, F (8, 895.39) = 1.33, p = n.s. Regarding level of smartphone addiction and condition there was a significant interaction effect, F (1, 118.04) = 11.40, $p < .005$. In addition, there was a statistically significant triple interaction effect between level of

smartphone addiction, condition and time regarding SWS scores, F (8, 895.39) = 2.16, p <.05 (figure 3).

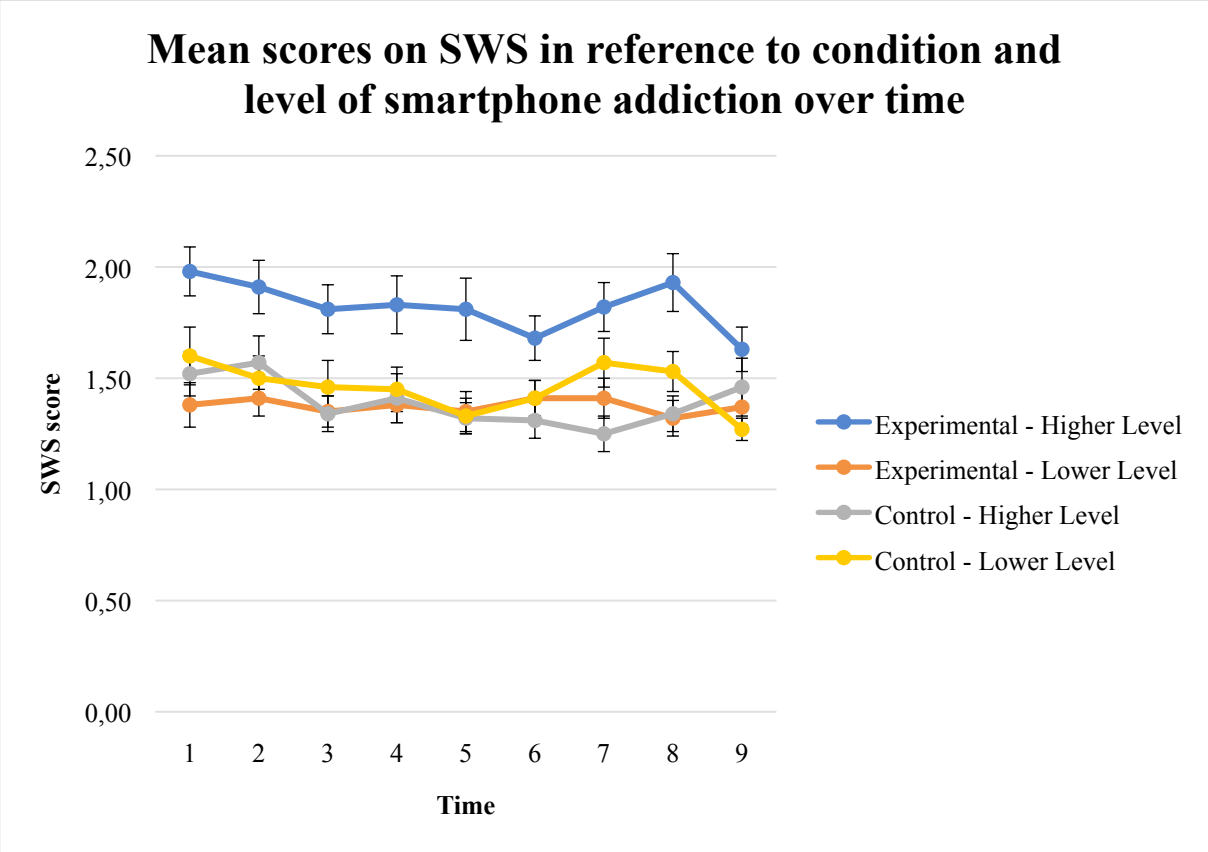

Figure 3. Mean scores for SWS across the four groups within condition and level of smartphone addiction, over time.

Table 2.

The effects of condition and level of smartphone addiction on SWS scores by linear mixed models.

Time	Estimate	St. Error	t	F	
1	.048	.106	.450		
2	.091	.106	.854		
3	- .137	.106	- 1.29		
4	- .064	.105	- 6.11		
5	- .153	.107	- 1.43		
6	- .134	.107	- 1.25		
7	- .227	.106	- 2.14	*	
8	- .133	.105	- 1.27		
9					
Level of smartphone addiction				4.16	*
Condition				4.49	*
Time				2.52	**
Level of smartphone addiction*Time				1.33	
Level of smartphone addiction*Condition				11.4	***
Condition*Time				.312	
Level of smartphone addiction*Condition*Time				2.16	*

Note. * p < .05, ** p < .01 *** p < .005, **** p < .001

Effects on Fear of Missing Out scale for those scoring higher or lower on level of smartphone addiction within each condition (see table 3 and 5): There was a statistically significant main effect of level of smartphone addiction, F (2, 214.82) = 18.26, $p < .001$,. The interaction effect between level of smartphone addiction and time on FoMO scores was statistically significant, F (8, 896.59) = 2.91, $p < .005$. There was no statistical significant interaction effect for level of smartphone addiction and condition, F (1, 117.83) = .192, p = n.s. Further, there was no significant triple interaction effect between level of smartphone addiction, condition and time regarding FoMO scores, F (8, 896.59) = 0.74, p = n.s. (figure 4).

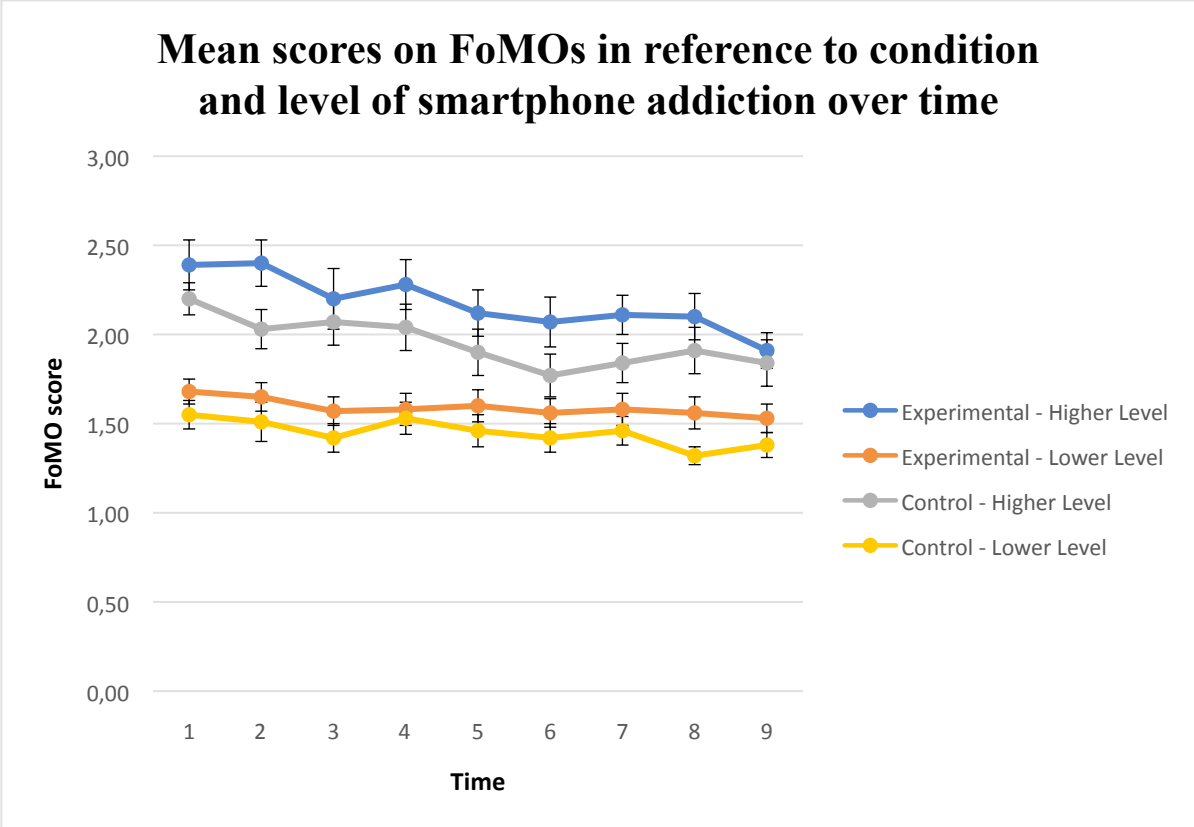

Figure 4. Mean scores for FoMOs across the four groups within condition and level of smartphone addiction, over time.

Table 3.

The effects of condition and level of smartphone addiction on FoMO scores by linear mixed models.

Time	Estimate	St. Error	t		F	
1	.328	.094	3.49	***		
2	.203	.095	2.14	*		
3	.205	.095	2.16	*		
4	.169	.094	1.80			
5	.036	.095	.381			
6	- .090	.096	- .942			
7	- .025	.095	- .267			
8	.039	.094	.415			
9						
Level of smartphone addiction					18.3	****
Condition					3.77	
Time					8.42	****
Level of smartphone addiction*Time					2.92	***
Level of smartphone addiction*Condition					.192	
Condition*Time					.609	
Level of smartphone addiction*Condition*Time					.744	

Note. * p < .05, ** p < .01, *** p < .005, **** p < .001

Effects on Positive and Negative Affect for those scoring higher or lower on level of smartphone addiction within each condition (see table 4 and 5): There was a statistically significant main effect for level of addiction, F (2, 211.12) = 3.06, $p < .05$, in Positive Affect score. However, there was no significant interaction effect for level of smartphone addiction and time, F (8, 898.01) = .935, p = n.s., nor for level of smartphone addiction and condition, F (1, 118.03) = 2.02, p = n.s. Regarding the triple interaction effect between level of smartphone addiction, condition and time in the Positive Affect scores, this was not significant, F (8, 898.01) = 1.80, p = n.s. (figure 5).

There was no statistically significant main effect of level of smartphone addiction, F (2, 210.79) = 2.87, p = n.s., in Negative Affect scores. In addition, there was no significant interaction effect for level of smartphone addiction and time, F (8, 896.54) = 0.86, p = n.s. There was a significant interaction for level of smartphone addiction and condition, F (1, 117.19) = 8.93, $p < .005$. Further, there was no triple interaction effect between level of

smartphone addiction, condition and time regarding the Negative Affect scores, F (8, 896.54) = 0.88, p = n.s. (figure 6).

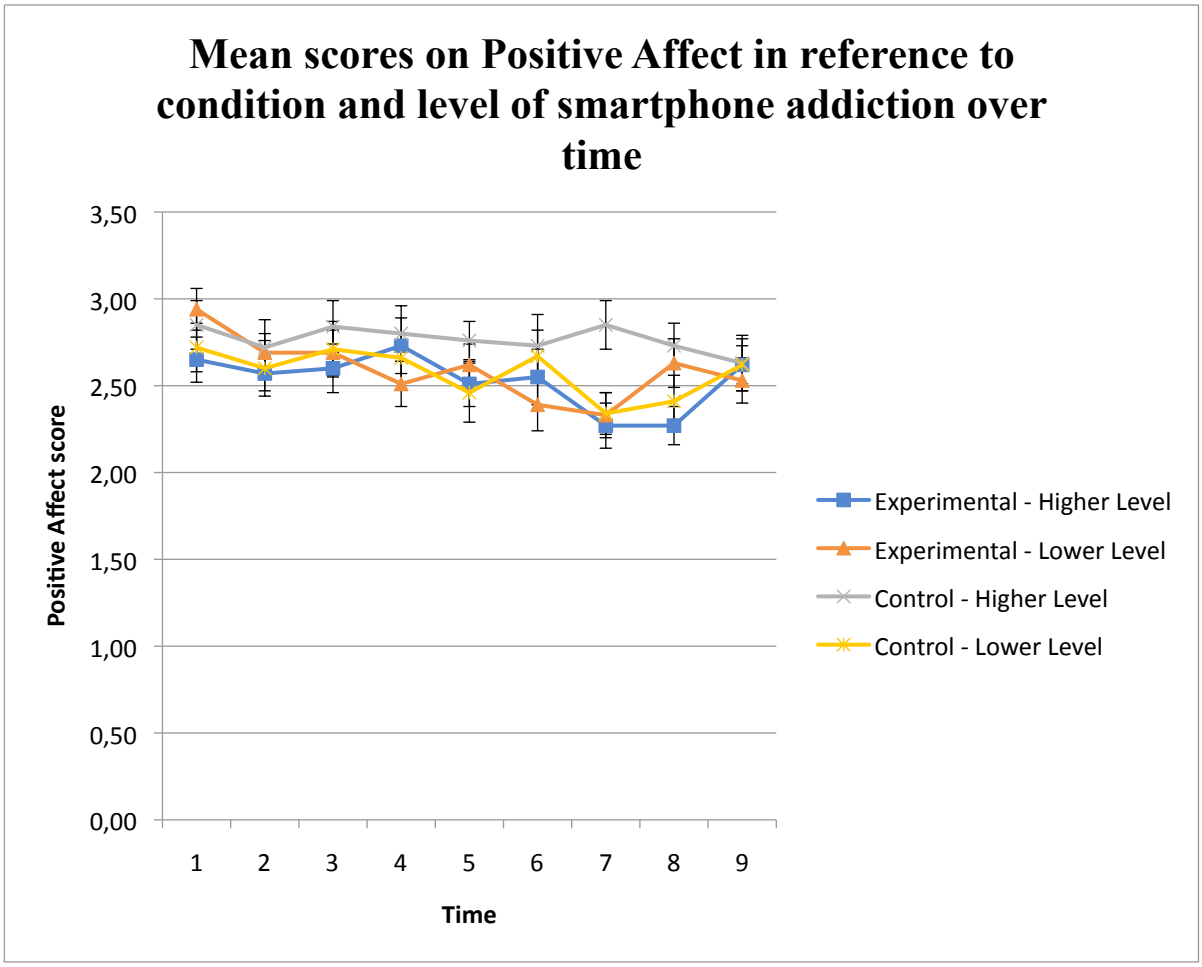

Figure 5. Mean scores for Positive Affect across the four groups within condition and level of smartphone addiction, over time.

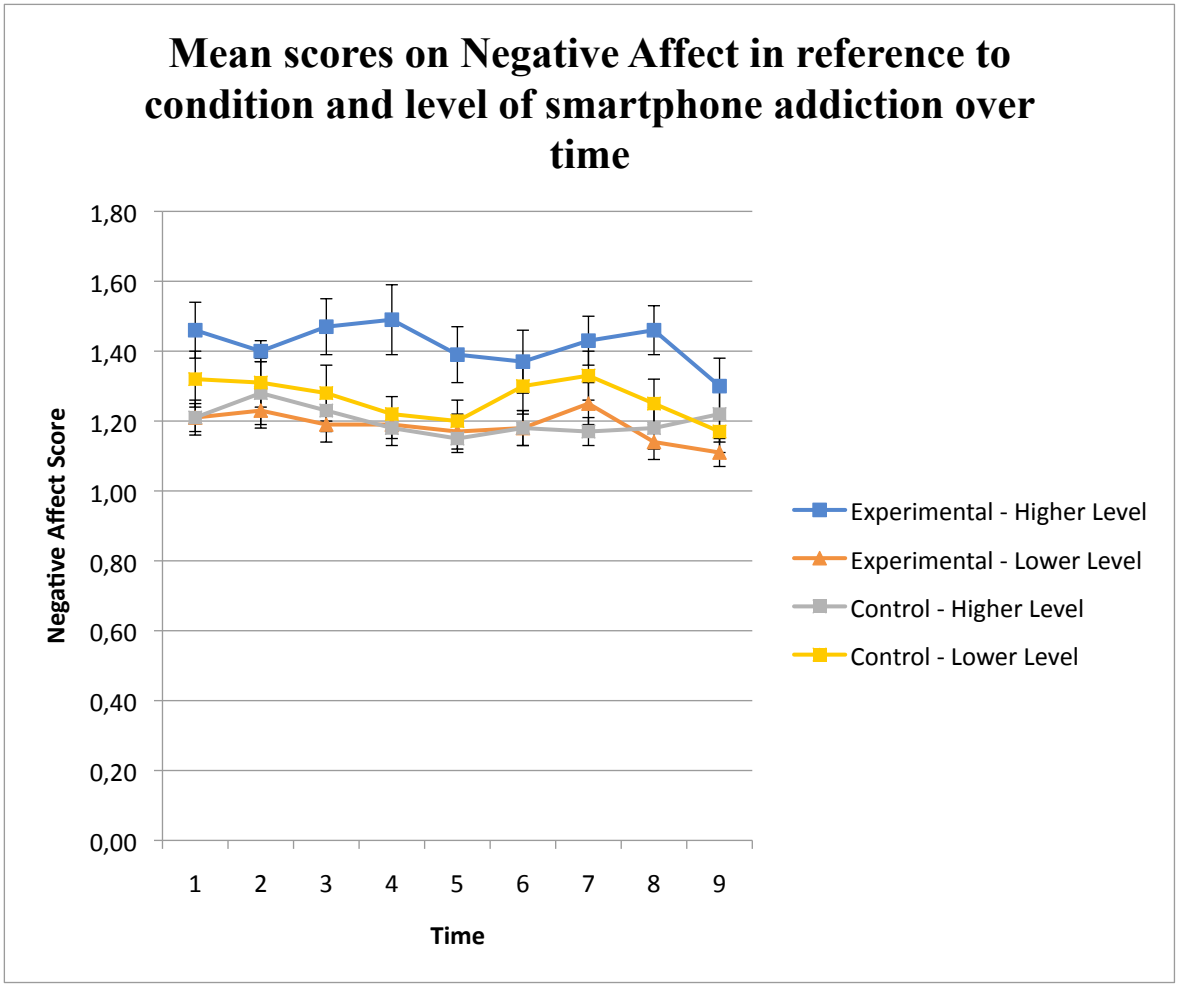

Figure 6. Mean scores for Negative Affect across the four groups within condition and level of smartphone addiction, over time.

Table 4.

The effects of condition and level of smartphone addiction on Positive Affect and Negative Affect scores by linear mixed models.

	Positive Affect		Negative Affect	
Effects	F		F	
Level of smartphone addiction	3.06	*	2.87	
Condition	1.20		1.65	
Time	3.80	****	1.82	
Level of smartphone addiction*Time	.935		.856	
Level of smartphone addiction*Condition	2.02		8.93	***
Condition*Time	.880		.875	
Level of smartphone addiction*Condition*Time	1.80		.879	

Note. * p < .05, ** p < .01, *** p < .005, **** p < .001

Table 5.

The mean (SD) for higher and lower levels of smartphone addiction on the SWS, FoMOs, Positive Affect (PA) and Negative Affect (NA) scales at time 1-9.

	Higher level of smartphone addiction				Lower level of smartphone addiction			
Time	SWS	FoMO	PA	NA	SWS	FoMO	PA	NA
1	2.00 (.671)	2.46 (.778)	2.70 (.740)	1.47 (.481)	1.41 (.502)	1.67 (.380)	2.87 (.684)	1.22 (.254)
2	1.93 (.759)	2.44 (.813)	2.52 (.589)	1.41 (.509)	1.44 (.438)	1.71 (.453)	2.72 (.555)	1.22 (.279)
3	1.82 (.623)	2.26 (.977)	2.55 (.773)	1.49 (.449)	1.38 (.412)	1.59 (.437)	2.72 (.652)	1.19 (.289)
4	1.84 (.734)	2.31 (.835)	2.73 (.941)	1.51 (.599)	1.39 (.496)	1.59 (.470)	2.52 (.697)	1.18 (.232)
5	1.83 (.811)	2.16 (.744)	2.48 (.763)	1.39 (.454)	1.37 (.495)	1.64 (.480)	2.61 (.634)	1.19 (.292)
6	1.69 (.587)	2.10 (.843)	2.61 (.924)	1.36 (.527)	1.43 (.469)	1.59 (.430)	2.34 (.786)	1.20 (.298)
7	1.81 (.628)	2.13 (.672)	2.27 (.803)	1.44 (.445)	1.46 (.492)	1.63 (.485)	2.34 (.688)	1.25 (.309)
8	1.92 (.754)	2.09 (.781)	2.24 (.662)	1.46 (.444)	1.36 (.452)	1.61 (.452)	2.64 (.688)	1.15 (.246)
9	1.61 (.615)	1.93 (.624)	2.65 (.654)	1.29 (.468)	1.42 (.446)	1.55 (.452)	2.51 (.674)	1.13 (.223)

Discussion

The overall object of the present study was to investigate withdrawal symptoms in regard to restriction of smartphone usage. In order to assess whether or not there is support for the hypotheses, different parts of the analysis will be emphasised. In the following section, we will discuss hypotheses one, two, and three in conjunction with the main effect of condition, while for hypotheses four, five, and six, we will emphasise the two-way interaction effect between level of addiction and condition. In accordance with hypothesis one, the results revealed that those who were restricted from their smartphone scored significantly higher on the SWS. There was no support for hypotheses two and three. In regard to hypothesis four, those with higher levels of smartphone addiction, in comparison with those with lower scores on smartphone addiction, were more negatively affected by the smartphone-restricted condition than by the control condition on the SWS. The present study found no support for hypothesis five, but partial support for hypothesis six.

Furthermore, we will consider the results in the light of relevant theories and studies. Finally, we will present limitations and strengths associated with methodology and design, as well as implications and suggestions for the direction of future studies.

Summary of Findings

Hypothesis one postulated that participants who were restricted from using their smartphone would score significantly higher on the SWS, and therefore experience more withdrawal symptoms in terms of craving, depression/anxiety, irritability/impatience, and difficulty concentrating during the restriction period compared to the controls on the SWS. There was a significant main effect for condition, where the restricted condition had a higher mean SWS score compared to the control condition.

The restricted condition had a higher mean score on the withdrawal scale compared to the control condition, which provides support for this hypothesis. This finding helps support hypothesis one by indicating that individuals are negatively affected when restricted from interaction with their smartphones. This evidence indicates that smartphone restriction provokes primarily psychological, but also some physical, withdrawal symptoms similar to those found in other behavioural addictions.

Hypothesis two postulated that participants who were restricted from their smartphone would have a significantly higher FoMO scores during the restriction period, compared to the controls. The results revealed no significant main effect for condition. This would indicate that the overall FoMO scores were not significantly higher for the restricted condition, compared to the control condition, irrespective of the effect of time.

This finding does not support hypothesis two, as the result indicates that there is no difference in the FoMO scores between the restricted and control condition. FoMOs representing the social aspect of withdrawal could help explain the lack of support for this hypothesis. As the participants had access to laptops and tablets during the restriction period, they were not fully isolated from social platforms (e.g. SNSs).

The third hypothesis stated that participants who were restricted from their smartphone would score significantly higher on Negative Affect, compared to the controls on the PANAS scale, and lower on Positive Affect during the restriction period, compared to the controls on the PANAS scale. There was no significant main effect for condition on Positive Affect, thereby representing no significant difference between the restricted condition and the control condition in terms of Positive Affect scores.

In regard to the Negative Affect, there was no significant main effect for condition. This suggests that there was no significant distinction between the restricted condition and the control condition in terms of Negative Affect scores.

These results do not support the hypothesis because there was no evident distinction between the conditions regarding the PANAS scale. It was speculated that restriction of ones' smartphone would cause a decrease of Positive Affect and an increase in Negative Affect due to the mechanisms involved in withdrawal. Thus, it is interesting that there were significant results for SWS, which includes aspects related to Negative Affect. However, the results indicate that it is uncertain whether being restricted from the use of ones' smartphone has an impact on the affective states included in the PANAS scale.

Hypothesis four postulated that participants with higher scores on smartphone addiction, compared to those with lower scores on smartphone addiction, would be more negatively affected by the smartphone restricted condition than by the control condition on the SWS. Accordingly, a significant two-way interaction effect (Level of Addiction X Condition) was expected. There was a significant interaction effect between the level of smartphone addiction and condition, which indicates that the influence of condition on SWS scores depends on whether the participants had a higher or lower level of smartphone addiction. The two independent variables in the analysis consisted of two levels each, where the groups with higher and lower levels of smartphone addiction were comparable in the restricted- and control condition. For this reason, it became evident that the impact (measured by SWS) on the group with higher levels of smartphone addiction was greater compared to those with lower levels of addiction in the restricted condition. The difference in impact between these groups was significantly larger than the difference in scores between the

groups with higher and lower levels of addiction in the control condition. Hence, having higher scores on levels of smartphone addiction makes them more prone to experiencing negative effects associated with smartphone restriction. This interaction effect made it possible to exclude individual components (e.g. neuroticism) as a possible explanation in the higher SWS scores in the group with higher levels of smartphone addiction.

The results provide support for hypothesis four, implying that those with higher levels of smartphone addiction would be more negatively affected (on the SWS) by the restricted condition than those with lower scores on smartphone addiction. This was the relationship found when comparing how those with higher and lower levels of smartphone addiction would be influenced by the control condition.

The fifth hypothesis stated that participants with higher scores on smartphone addiction, compared to those with lower scores on smartphone addiction, would be more negatively affected by the smartphone restricted condition than by the control condition on the FoMOs. Accordingly, a significant two-way interaction effect (Level of Addiction X Condition) was expected. The interaction effect between levels of addiction and condition was not significant, which means the hypothesis cannot be supported.

There was a significant interaction effect of time and level of smartphone addiction on the FoMO scores. This indicated that the influence of time on the FoMO scores depended on whether the participants had higher or lower levels of smartphone addiction. However, due to a lack of a significant interaction effect on level of addiction and condition, it is not possible to distinguish whether the higher FoMO scores were caused by restriction or by individual factors (e.g. neuroticism) within the higher addiction level group in the restricted condition. The hypothesis is therefore not supported by these findings.

Hypothesis six stated that participants with higher scores on smartphone addiction, compared to those with lower scores on smartphone addiction, would be more negatively affected by the smartphone restricted condition than by the control condition on the PANAS scale. Accordingly, a significant two-way interaction effect (Level of Addiction X Condition) was expected. We found no significant interaction effect between level of addiction and condition in regard to the Positive Affect scores, which means that there is no support for the Positive Affect aspect of the hypothesis.

A significant two-way interaction effect was found for level of addiction and condition in regard to the Negative Affect scores. This implies that the influence of condition (restricted or control) on Negative Affect scores depends on whether the participants had a higher or lower level of smartphone addiction. By separating higher and lower levels of

addiction into restricted and control condition, four groups were created and a comparison between the higher and lower levels of addiction is possible within the conditions. This significant interaction effect enables an exclusion of possible scores caused by individual components within the group with higher levels of smartphone addiction.

The results revealed that the negative impact (measured by PANAS) on the group with higher levels of smartphone addiction, was greater compared to those with lower levels of addiction in the restricted condition. This difference in negative impact was significantly greater than the difference in scores between the groups with higher and lower levels of addiction in the control condition. Because Negative Affect correlates with stress and stress being a component in withdrawal symptoms, it illustrates the relevance of this finding, despite weak results for Positive Affect.

The result provides partial support for hypothesis six, implying that those with higher levels of smartphone addiction would be more negatively affected (on the SWS) by the restricted condition than those with lower scores on smartphone addiction. This is when comparing them with how those with higher and lower levels of smartphone addiction would be influenced by the control condition. The significant findings are solely related to the Negative Affect aspect, as there was no significant interaction effect for Positive Affect.

Effects of Withdrawal

Cheever and colleagues (2014) studied restriction of smartphones, which is one of the few other studies to have a design similar to that of the present study. Therefore, a comparison of these two studies may be enlightening. In the Cheever et al. (2014) study, the participants were randomly assigned into one of two conditions: one condition turned in their smartphone, while the other condition were allowed to keep their smartphone but had to turn it off for the duration of the study. They then measured withdrawal related anxiety (State Trait Anxiety Inventory; STAI) at three time intervals with a 25-minute break between them; the duration of the experiment was 75 minutes. The results indicated that anxiety level rose over time. This effect was found solely in the heavy smartphone use group and in the moderate smartphone users who had their device taken away.

There are some notable differences that emerge when we compare the study done by Cheever et al. (2014) with the present study. The present study's results indicated that when completely restricted from their smartphones over a period of time, the participants with higher levels of smartphone addiction had higher SWS and Negative Affect scores compared to participants with lower levels of smartphone addiction. These results are similar to the findings in the study by Cheever et al. (2014), where the group with high smartphone usage

reported higher levels of anxiety when restricted from their smartphone. This was compared to the condition where the participants had their smartphones in their possession. Multiple studies suggest that frequency of use is related to level of addiction, interrelated fact that interrelates these findings (Tossell et al., 2015; van Deursen et al., 2015). Nevertheless, the two studies differ in terms of withdrawal trends. Cheever et al.'s (2014) results indicated that STAI scores rose over time for the heavy smartphone user group, while the present study found that SWS scores decrease over time for the participants in the higher level of smartphone addiction group. A plausible reason for these contrasting results could be that the studies were carried out over very different lengths of time. The present study restricted the participants from using their smartphones for 72 hours, while the study by Cheever et al. restricted the participants for only 75 minutes. This could have affected the results considering that the present study had four hours between each of the nine measures throughout the study, and this in itself is longer than the entire study conducted by Cheever et al. These findings could indicate that when participants who are high users or have a higher level of smartphone addiction are restricted from their smartphones, withdrawal symptoms will increase rapidly. This elevation in withdrawal symptoms will take place from the moment they turn in their smartphones and continue for the first few hours of the restriction period, before decreasing steadily. These are merely speculations that would need further empirical verification. However, the findings for low daily users in the Cheever et al. (2014) study and participants with lower levels of smartphone addiction in the present study are quite similar. Both studies found that when these two groups are restricted from using their smartphones, their withdrawal and anxiety scores are stable over time. A possible reason for the contrasting findings in the present study and the study conducted by Cheever et al. (2014) could be attributed to the use of different scales. While they used an anxiety measure, the present study included a revised version of a cigarette withdrawal scale, the FoMOs as well as the PANAS scale. Even though items reflecting anxiety are a part of these withdrawal-related scales, they could possibly detect different symptoms, and these might result in different findings.

Stress

Previous research has found evidence supporting that an increase in the Negative Affect Schedule was positively correlated to self-reported stress (Watson et al., 1988). In addition, it is reasonable to conclude that the SWS, when reporting negative effects for the individual, includes the presence of negative emotions that could cause stress (Folkman, 2008; Lazarus & Folkman, 1984). The SWS and Negative Affect could therefore help

interpret the findings in the present study, where the results suggested that the participants with higher levels of smartphone addiction were more affected by the smartphone restriction than those with lower levels of smartphone addiction. Hence, higher scores on smartphone addiction scales could be linked to higher levels of stress during a smartphone restriction period.

Some studies have suggested that using one's smartphone can in fact cause a temporary outlet for stress (Lavoie & Pychyl, 2001; Thomée, Eklöf, Gustafsson, Nilsson, & Hagberg, 2007). A study performed by Patel and colleagues (2006) revealed that children who got to play a handheld video game before going into surgery had lower levels of stress and anxiety than children who had one of their parents present but did not get to play a handheld video game. A handheld video game does have characteristics that are similar to smartphones, which makes this comparison relevant regarding the interpretation of the present findings. One could argue that if the presence of these types of devices can help reduce stress, it may also mean that restriction of the same types of devices could in fact cause stress. With this in mind, the mean SWS and Negative Affect scores in the present study for the group with higher level of smartphone addiction could be related to the stress of not being able to interact with one's smartphone.

Connectedness

Faulkner and Culwin (2005) explored user characteristics associated with text messaging, primarily Short Message Service (SMS). Since 2005, multiple text message platforms have been introduced together with an increase in user base (Petronzio, 2012). In fact, apps like WhatsApp, Facebook Messenger and Viber are the most used instant messenger apps worldwide (Schwartz, 2016). For this reason, results from the Faulkner and Culwin study will be regarded as relevant for some of the present study's results on the SWS- and FoMO scores. A classification of SMS content revealed that the primary motive for using SMS was either asking questions, giving instructions, signing off or exchanging informal personal messages. As the evidence suggests here, the main aspect of messaging is coordination of events and social gatherings, as well as strengthening social bonds (Faulkner & Culwin, 2005). These results, together with the fact that most facets of the modern society have integrated smartphone use and similar mobile technological devices, add to the understanding of the results of the present study. When participants are restricted from interacting with their smartphone, this automatically makes it more challenging to fully engage in the aspects of society facilitated by smartphones. The significant effect was found especially for those who had higher levels of smartphone addiction in regard to SWS. Being

unable to ask questions, provide immediate instructions or exchange personal information on the go could cause a higher score on SWS and FoMOs, due to restriction of communication with individuals in ones' environment. In addition, it could be related to the process apps that are accessible on the smartphone, which enable interaction with the general society through news, bus tickets, emails, and so on. This is in conformity with some of the challenges reported by the restricted participants in the present study, where almost half of the restricted participants reported difficulty as a result of being restricted from the process apps, as well as social communication. Further, the participants reported challenges associated with planning and immediate inaccessibility to other persons.

There may be potential dispositions among those with higher levels of smartphone addiction that possibly make them more sensitive in terms of degree of connectedness or independence, which would give them higher scores on SWS during the restriction period. In addition, these individuals could have a stronger need or experience a higher degree of vulnerability in being partly separated from activities in the general society. This would indicate that the term addiction could be somewhat inaccurate, when individuals have a genuine need for a smartphone in order to interact at a minimum level in society. These are merely speculations, and future research is needed to acquire knowledge about these topics.

The Social Aspect

Social Networking Sites. The results from the present study emphasise SWS and Negative Affect's role in behavioural addictions involving Internet access, including the smartphone. It is evident that being restricted from interacting with one's smartphone can precipitate negative outcomes for the individual. As smartphones contain several different components, they likewise facilitate multiple interactions. One could therefore assume that a component of the smartphone is related to the social aspect. Even though the present study did not find support for the hypotheses related to the FoMOs, there were still some significant findings. Therefore, FoMO will briefly be discussed in this section. In order to look deeper at the mechanism associated with withdrawal symptoms and smartphone addiction, an adequate amount of knowledge about SNSs is necessary. With the increase in popularity of these sites, many companies have developed their own apps in order to make it possible to stay connected (Griffiths, 2013; Kuss & Griffiths, 2011). Some of the most popular SNSs to this date are Facebook, Instagram, Twitter, and Snapchat. Time spent on SNSs since they were first introduced over a decade ago has grown rapidly, which could suggest that these services might potentially pose a risk of addiction (Kuss & Griffiths, 2011). Other studies have indicated that habitual use can lead to an increase in frequency and time spent engaging in an

activity or with a device, which could be a potential indicator of risk of addiction (van Deursen et al., 2015).

FoMO represent fear and worry that other people may engage in events and experiences that one will miss out on, and FoMO is thus closely related to SNSs. In this context, SWS and Negative Affect are relevant to include due to their relation to stress, and its link to anxiety. The negative emotions of fear and worry carry an anxiety feature, which is present when participants are restricted from their smartphone, manifested as a withdrawal symptom. Anxiety being listed as one of the main withdrawal symptoms in several of the substance-use disorders in the DSM-IV, illustrates its relevance in this context (American Psychiatric Association, 2009).

The present study's findings are supported by previous research showing that being restricted from checking various technological devices, for instance, has been linked to anxiety (Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013; Rosen, Whaling, Rab, Carrier, & Cheever, 2013). A restriction period in this regard can provoke withdrawal related anxiety. The smartphone restriction condition may have experienced more SWS and Negative Affect due to inaccessibility to social engagement online. An increase in user base suggests that the various SNSs have become the primary platform for social engagement. This in turn may indicate that restriction from a smartphone could imply restriction from the social community. One can assume that this applies especially to social communities with peers. Nevertheless, these are mostly speculations based on reflections deriving from an interpretation of the present study's findings. There are number of theories that may explain the results in the present study, and these will be duly discussed.

Self-determination theory. The self-determination theory proposed by Deci and Ryan (1985) provides a pragmatic viewpoint when trying to understand the occurrence of smartphone withdrawal and engagement on SNSs. According to this theory, psychological well-being is based on fulfilment of three innate psychological needs: the need for competence, the need for autonomy, and the need for relatedness. The need for competence represents a need to master and have an effect on the surroundings. It may be regarded as a motivational energy aimed at acquiring the competence needed to influence and interact with the environment in a satisfying way. The need for autonomy reflects the need to make independent choices as well as having the ability to decide what to choose. Autonomy represents ownership over ones' own actions that are unified with the self. The need for relatedness refers to the universal need to feel a connection with other significant individuals, as well as the need to express emotions and desires. The social environment becomes a place

for acceptance and recognition, which indicates that deficits in this need could lead to harmful effects on the psychological well-being (Deci & Ryan, 1985, 2002; Przybylski et al., 2013; Ryan & Deci, 2000).

Results from studies show that satisfaction of these needs, in various aspects of life, is related to beneficial behavioural regulation (Hagger & Chatzisarantis, 2007; Przybylski, Weinstein, Ryan, & Rigby, 2009; Ryan & Deci, 2000). Through acquiring knowledge from these basic needs, it becomes evident that results from SWS, PANAS scale (Negative Affect), and FoMOs can be presumed to be mechanisms that arise from deficits in basic psychological needs. This link can appear in one of two ways, either direct or indirect. The direct way refers to a gravitation towards the use of SNSs due to one's perception of this activity as a means by which to develop the social aspect of competence. In addition, it could satisfy the need for relatedness through the strengthening of social bonds. The indirect way is by FoMO serving as a mediator between low fulfilment of basic needs and engagement in SNSs (Przybylski et al., 2013). This theoretical angle serves as a possible explanation for the present study's results, whereby it illustrates how FoMO can occur. It further indicates that high FoMO scores could be associated with deficits in innate psychological needs and ultimately in psychological well-being.

An interpretation of the present study's findings in the context of self-determination theory would suggest the participants in the restriction condition were prevented from meeting their psychological needs and therefore report higher withdrawal scores. SWS and the Negative Affect aspect of the PANAS could further be related to deficiency in the needs of the participants with higher levels of smartphone addiction. Nevertheless, this topic requires more empirical investigation and research in the future to determine significant effects.

The extended self. A highly related term in regard to the social aspect is the extended self, proposed by Belk (1988). In the construct of the sense of self, he claimed that an individual's possessions represent an important part in reflecting one's identities. Possessions could become an extension of the self, both knowingly and unknowingly. The extended self can be divided into categories, where the components related to mind and body are regarded as the closest to the self, while the objects to which the individual feels attached are the most extended. When their possessions are taken away, a diminished sense of self would occur. This implies an emergence of negative emotions. Control is regarded as a key factor associated with possessions that increases the likelihood of becoming an extension of the self. In this context, control of the object would lead to a closer association with the self

(McClelland, 1951). Another relevant element is the degree of investment and effort directed at the object and the creation of an extension of the self through this process. By comparing this to a smartphone, it is evident that the owner controls the smartphone and invests time and effort in the device. The basic premise for interaction between an individual and a smartphone is through the individual controlling and manipulating the smartphone, which indicates that a smartphone is likely to be associated with the individual's sense of self. Buying a smartphone and investing time and money in it increases the probability that the smartphone will function as an extension of the self.

In pace with the rapid evolution of the digital world, the term has been conceptually updated, and the potential for self-extension has also increased. One consequence of technological changes is the extension of the self into graphical representations of the individual, such as avatars that can affect our offline sense of self. The digital platform has gone from being somewhat private to becoming the main platform for revealing and projecting ourselves. In addition, what is shared and what is kept in the private sphere have changed. An increase in sharing of private information on SNSs may leave the user in a vulnerable position, where frequent updates are required in order to maintain or gain control. Peers play an important part in co-construction and reaffirming of each other's sense of self through the diverse actions made possible on SNSs (Thompson & Cupples, 2008). Through digital technology, the offline and online self become jointly constructed; thus, imposing a restriction on an individual that removes him/her from the online self, such as smartphone restriction, could provoke withdrawal related symptoms (Belk, 2013; Belk, 1988). One might also speculate whether individuals with higher levels of smartphone addiction attribute larger parts of their actual selves to their online selves. This will be indicated by the SWS and Negative Affect scores.

The interpretation of these findings could serve as an argument for two of the three main perspectives on smartphone addiction: addiction as caused by access to various kinds of platforms through the smartphone as a medium, and addiction caused by the platforms (smartphone) alone.

Why Do Individuals Develop Smartphone Addiction?

Individual predispositions. Individual predispositions associated with reward and punishment sensitivity could contribute to the addictive effect of smartphones. The behavioural inhibition system (BIS) and behavioural activation system (BAS) influence and inform behaviour when the individual is faced with reward and punishment. The BIS is associated with conditioned punishment sensitivity, while the BAS is related to conditioned

reward sensitivity. It has been proposed that individuals who are predisposed with a high BAS sensitivity engage in approach behaviour, like substance use (Gray, 1982). A study by Andreassen, Torsheim, Brunborg, and Pallesen (2012) found positive associations between scores on the BIS and parts of the BAS with Internet addiction. For this reason, one could hypothesise that these processes are involved in smartphone addiction as well.

The reward deficiency syndrome represents another relevant aspect regarding individual predispositions. Researchers have studied the association between numerous behavioural disorders and specific genes. Results have indicated that certain genetic anomalies are associated with alcoholism. These genetic anomalies are assumed to be connected to other addictive disorders, like behavioural addictions. Because of the genetic deficit, a sensory deprivation of the pleasure mechanisms occurs in the brain, and one consequence is the inability to obtain reward and pleasure following ordinary activities. The deficiency is believed to stem from a genetic variation, more specifically related to the dopamine receptor gene. Individuals carrying the A1 allele seem to have an inadequate number of the dopamine D2 receptor gene. These lower numbers of dopamine receptors, which are highly involved in the sensation of pleasure, cause these individuals to engage in sensation-seeking behaviours. Included here are behavioural- and substance use addictions (Blum et al., 2000; Blum, Cull, Braverman, & Comings, 1996; Blum & Noble, 1994; Comings et al., 1996). The severity of smartphone addiction may not seem very likely to be derived from this thrill-seeking behaviour. Nevertheless, these same genetic dispositions could be present in those vulnerabilities involved in developing behavioural addictions, like smartphone addiction. There have been some problems trying to replicate the findings regarding genetic vulnerabilities and caution must be observed when interpreting this theory in new contexts (Blum & Noble, 1994).

Integrative pathway model for problematic mobile phone usage. A group of researchers proposed a model devised to explain how problematic mobile phone usage can occur and suggested there were three different pathways that lead to it (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015). The first pathway is called the *excessive reassurance pathway* and characterises people with problematic use that is motivated by the urge to receive reassurance from others and sustain relationships. It is indicated that symptoms related to this pathway derive from factors such as low self-esteem, anxiety, emotional instability, or insecure attachment. The *impulsive-antisocial pathway* represents the second pathway and coincides with individuals who exhibit poor impulse control. This results in uncontrolled drives that manifest themselves as risky, antisocial, and/or addictive

mobile phone usage. Key features of this pathway include specific impulsivity traits such as urgency, low self-control, and lack of planning, and to some psychopathic traits like engaging in cyberbullying and wanting to use mobile phones in banned areas. Furthermore, excessive mobile smartphone use has also been related to Attention Deficit Hyperactivity Disorder (ADHD) symptoms. This pathway, in other words, is related to the antisocial pattern of use and originates from a pathway model to Pathological Gambling (Blaszczynski & Nower, 2002). The third pathway is denoted the *extraversion pathway* and applies to those who have addictive symptoms related to problematic mobile phone usage. This excessive use is driven by an urge to communicate and establish relationships with other people. Problematic use through this pathway is believed to be connected to reward sensitivity and sensation seeking. This personality trait has also been linked to aggressive behaviour associated with smartphone use, such as phoning while driving and sexting (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015). It would seem that smartphone withdrawal related to the FoMOs would be of particular relevance to the latter pathway.

The type of problematic use differs across the three pathways, where the excessive reassurance pathway is regarded as an addictive pattern of use, the impulsive pathway as an antisocial pattern of use and the extraversion pathway as a risky pattern of use. Each of these types results in distinct symptoms or behaviours. This framework describes smartphone addiction as something that can arise from three different paths that can be distinguished from each other. By identifying the differences, one could determine which path that needs the most focus in terms of severity and at the same time look at the specific addictive components in the different pathways.

The research behind this model is limited and because of this, it may be a deficient model. It is, however, a comprehensive model that contributes to understanding the present state and at the same time guides future research (Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015).

Utility Value

Studies exploring aspects of smartphone addiction, like the present study, are very important. A few reasons for this will be highlighted, specifically distributed consumption and the effect of smartphone usage on sleep.

The Theory of the Distribution of Alcohol Consumption suggested by Skog (1985) was originally derived from Ledermann's theory of alcohol consumption. The theory suggests that there is a skewed distribution of users and that addiction only affects a small part of the population. However, even though only 10–15% of the population can be

considered addicted to alcohol, this group alone consumes 40–50% of the total alcohol consumption of the entire population (Skog, 1985). If one puts this into the context of smartphone addiction, a challenge would be that there is a huge number of users, and these users often have high frequency and a large amount of time invested in using their device. This makes the risk of harmful consequences large despite seemingly relatively low scores on addiction scales. Alcohol, for example, is something most individuals are only exposed to, at most, a few times a week, while most individuals interact with their smartphone several times a day. However, it should be noted that most of the consequences of alcoholism clearly would be more harmful than for smartphone addiction.

Smartphone addiction has been linked to high frequency of use. This would then mean that users with high frequency have more exposure to their liquid crystal display (LCD) screens, and with high frequency, the chance of harmful risks also increases (Tossell et al., 2015; van Deursen et al., 2015). In recent years, several studies have indicated that the use of electronic devices such as smartphones and tablets shortly before bedtime has been positively related to difficulties sleeping in both adolescents (Lemola, Perkinson-Gloor, Brand, Dewald-Kaufmann, & Grob, 2015) and adults (Chang, Aeschbach, Duffy, & Czeisler, 2015; Exelmans & van den Bulck, 2016). One of the main causes of these sleep difficulties, it has been suggested, is the blue light used in LCD screens for tablets, smartphones and other electronic devices. This blue light causes the brain to suppress levels of melatonin, a hormone that helps promote sleep (Chang et al., 2015). Chang and colleagues' (2015) study reported findings suggesting that use of electronic devices (e.g. smartphones, tablets) right before going to bed could lead to difficulties sleeping, suppression of melatonin, negatively affect REM sleep, and delay the circadian rhythm. They further argued that sleep deficiency and disruptions in relation to the circadian clock could impact individuals' performance, health, and safety. These findings correspond with some studies reporting that poor and brief periods of sleep have been linked to impaired academic performance (Dewald, Meijer, Oort, Kerkhof, & Bögels, 2010). The International Data Corporation (2013) reported that eight out of ten adults, and nine out of ten young adults, reach for their phone within 15 minutes of waking. For this reason it is not unlikely that a large number of individuals also check their smartphones shortly before bedtime or if they wake during the night. These consequences can help to display the benefits of the present study and the importance of awareness of the potential harmful effects of high smartphone usage.

Methodological Considerations

In order to conduct a holistic evaluation of the findings in the present study, it is necessary to highlight the methodological strengths and limitations.

Strengths. Psychological variables are dynamic by nature (Ployhart & Vandenberg, 2010). As these variables fluctuate daily within the same individual, information regarding the dependent variable could get lost if it is not tracked continuously. The design in the present study has similarities to diary studies, which have been acknowledged for capturing both inter- and intra-individual variations (Ohly, Sonnentag, Niessen, & Zapf, 2010). For this reason, a strength of the present study is the multiple measurements of the same phenomenon over time.

Compared to other, similar studies, the present study has some strengths related to design and implementation. Cheever and colleagues (2014) designed the restriction period in their study to last for only 75 minutes. Length of experimental phase is regarded as an asset in the present study, where participants were restricted from their smartphone for 72 hours. This would allow for a greater assessment of fluctuations in the psychological variables, because the measurements are conducted over several days. An additional strength is related to scales used to measure withdrawal. Instead of concentrating solely on anxiety measures, like Cheever et al. (2014), the present study used a wider selection of scales in order to capture multiple variations within the withdrawal aspect. Anxiety is merely one out of several components measured.

Another strength of the present study's design is the fact that the participants actually handed in their smartphones and were unable to access them during the experimental phase. Skierkowski and Wood (2012) conducted a similar study, the exception being that the participants were allowed to keep their smartphone but were told not to use it. By keeping the smartphone locked away, in the present study, we achieved a higher level of experimental control.

The significant two-way interaction effect between level of addiction and condition in hypotheses four and six (Negative Affect), constitutes a strength in this study. The present study yields findings indicating that higher levels of smartphone addiction cause a higher score on withdrawal-related symptoms (as measured by SWS and the PANAS scale), when restricted from the smartphone. This is evidenced by a greater difference between the higher and lower addiction level groups in the restriction condition, compared to the difference between higher and lower addiction level groups in the control condition. The interaction

effect also controls for individual factors influencing these scores, as they are significantly different from those with higher smartphone addiction scores in the control condition.

Limitations. Selection bias is a possible weakness of the present study. All the participants knew that they would potentially be required to hand in their smartphones for 72 hours, which likely affects the decision to volunteer for the study. Hence, one could assume that individuals with higher levels of smartphone addiction and excessive use were less likely to sign up for participation. This could affect the present study in a sense that the participants taking part might not be representative of the general addiction levels in the general pool of smartphone users.

The phrasing of the advertisement used for recruiting may represent another limitation. More participants might have volunteered if the advertisement had not disclosed the fact that their smartphones would be restricted for a period of time, and if it had been stated merely that this was a smartphone-related experiment. Some of the participants assigned to the control condition expressed disappointment in terms of their experimental allocation, which could potentially have affected some of their scores. However, not informing participants about the design in advance, could have led to several subjects withdrawing from enrolment or not being willing to participate.

A factor worth mentioning is the participants' choice to pick freely the weekend during which they wished to participate in the study in either November 2016, January 2017 or February 2017. However, this could be a limitation considering the participants could adjust their weekend plans accordingly and not necessarily do the same things they would have done during an average weekend. Hence, the participants were informed in advance of the possibility that they might have to hand in their smartphones. This could have instilled a feeling of being in control. Faulkner and Culwin (2005) have suggested based on their findings that there are more text messages sent during the weekend than during the week. This could have led to inflated scores for the participants in the present study, due to being restricted from their smartphone during the weekend in comparison to restriction during the week. However, it is worth mentioning that the study by Faulkner and Culwin is 12 years old and there has been a considerable increase in app usage and smart-technology since then. One could therefore assume that there has been an increase of smartphone usage in the weekdays as well, considering all the new functionalities smartphones possess nowadays. Future studies should nevertheless explore whether there is a difference in usage during the week compared to the weekend, and if this could affect addiction and withdrawal scores.

Another possible limitation of the present study is the preponderance of females in the sample. This may be a limitation as some studies have suggested that men and women engage in different types of smartphone usage. If this is the case, then it could potentially have affected the results of the present study, considering some studies suggesting that social usage is more likely to lead to addiction than process usage (van Deursen et al., 2015; Jenaro, Flores, Gamez-Vela, Gonzailez-Gil, & Caballo, 2007). However, there is still some debate on whether there are any large differences between the genders when it comes to smartphone use and addiction.

It is also worth mentioning that the participants included in the present study could be described as what Henrich, Heine, and Norenzayan (2010) referred to as a 'WEIRD' sample. This is used to describe individuals from western, educated, industrialised, rich, and democratic societies. WEIRD samples already account for 95% of psychological research (Arnett, 2008). Using a WEIRD sample could therefore compromise the generalisability of the results, due to issues such as cultural differences. However, smartphone addiction is a problem that can be just as serious outside WEIRD samples and future studies should explore if there is any difference in smartphone use, addiction, and withdrawal symptoms between different types of samples.

An area of improvement for the present study would be to measure how much the participants used SNSs and other technological devices (e.g. laptop, tablet) during the restriction period. This would enable the researcher to explore whether usage of other platforms increased while they were restricted from their smartphones and if this could potentially account for lower scores related to withdrawal. Nevertheless, by doing this, one would no longer be looking solely at smartphone addiction itself, but addiction to technological devices and addiction to social media in general, which would have defeated the purpose of the present study.

The scale used to measure smartphone withdrawal was adapted from a cigarette withdrawal scale. In spite of the Cigarette Withdrawal Scale showing high internal consistency (Etter, 2005), the present study, to the researchers' knowledge, represents the first adaptation of this scale to a smartphone withdrawal scale. Thus, although, the SWS had a high internal consistency it has not been used in any other studies, and this may be regarded as a weakness.

In addition, none of the scales used in the present study to measure withdrawal symptoms were scales measuring only anxiety, but had incorporated items reflecting anxiety (e.g. SWS, Negative Affect). This could potentially be regarded as a weakness since anxiety

is an important component of withdrawal. A scale designed purely to measure anxiety might have been more sensitive in terms of measuring withdrawal than the scales used in the present study. Thus, including an anxiety scale, such as STAI, might strengthen the study's validity. Arguably though, this inclusion could cause a larger overlap between the scales, which might ultimately result in similar survey fatigue and other response biases.

Although the sample primarily consisted of young adults, one might expect that a study like this would be more relevant when investigating adolescents. It is likely that they have incorporated smartphone usage in their daily life to a larger extent, and that smartphone addiction as a phenomenon could be more extensive in this age group.

Theoretical Implications

The present study adds to the field of addiction research in several ways. In terms of behavioural addiction, the findings complement the body of evidence that considers smartphone addiction as a facet of behavioural addiction. To the authors' knowledge, this is the first study that makes the smartphone physically unavailable to the participants and keeping it restricted for a period of more than one day in an experiment. This, in addition to including a comprehensive battery of withdrawal measures, makes the design unique within its field. The findings indicate that being restricted from interaction with ones' smartphone causes higher scores on several withdrawal related scales, compared to the controls. Having higher scores on smartphone addiction, within the restriction condition also indicated higher scores on certain withdrawal related scales. These findings indicate that being restricted from ones' smartphone has a larger negative effect on some individuals than on others. This effect seems to increase with the level of smartphone addiction. The most salient findings were related to the SWS scores, which would indicate that the negative effect is especially related to withdrawal symptoms similar to other addictions. The present study contributes to knowledge regarding smartphone addiction, which can help establish insight into effects of smartphone usage and its connection to smartphone addiction scores.

Practical Implications

The authors of the present study have no intention of pathologizing behaviour that could be labelled as a bad habit (Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015). However, there is a certain urgency to recognise that disproportionate smartphone usage can cause negative consequences for the user and their surroundings. Previous studies, for instance, have found that smartphone usage can cause symptoms of depression (Lu et al., 2011; Thomée, Härenstam, & Hagberg, 2011), anxiety (Beranuy, Oberst, Carbonell, & Chamarro, 2009), and be negatively associated with academic performance (Jacobsen &

Forste, 2011). In addition, smartphone usage has been linked with traffic hazards (Cazzulino et al., 2014; Sagberg, 2016). Findings from the present study will aid the expansion of knowledge and understanding surrounding this part of the addiction field. This knowledge may have practical implication for health professionals and policymakers seeking to highlight appropriate usage in educational and professional settings, as well as in traffic accident prevention efforts. An example of implementing a reduction in smartphone usage before bedtime was introduced by a Norwegian insurance company called "If" in 2016. They had a campaign called "Offline O'Clock" where the aim was to reduce harmful effects of smartphone usage associated with sleeplessness. This was implemented as a consequence of research on smartphone usage and sleep (If, n.d.).

The present study's research will also guide development and implementation of interventions and preventive measures. Even though smartphone usage will be a problem for only a small percentage of the population, the considerable size of the user base presumably makes this type of addiction relevant to a larger percentage of the population compared to other types of addiction.

Conclusion

The present study explored how subjective withdrawal scores varied during a smartphone restriction period of 72 hours. The primary aim was to examine the psychological impact of smartphones on individuals by understanding how restriction contributed to withdrawal related symptoms. In addition, the relationship between withdrawal scores and level of smartphone addiction was investigated. As the number of users of smartphones has continued to grow over the last decades, individuals are relying more on their smartphones in their daily life. Acquiring knowledge about the potential negative effects of excessive use and addiction is therefore regarded as important in order to understand the underlying psychological processes.

The results revealed that being restricted from ones' smartphone causes more negative effects compared to not being restricted. Furthermore, spurred by the restriction, higher levels of smartphone addiction elicited more withdrawal related symptoms, measured by the SWS and Negative Affect Schedule, compared to those who have lower levels of smartphone addiction. This is evident due to the significant difference in withdrawal-related scores between higher and lower levels of smartphone addiction in the restriction condition and the difference between higher and lower levels of smartphone addiction in the control condition. Furthermore, it is worth mentioning that this analysis excluded individual factors (e.g., neuroticism) as a possible explanation for higher scores in the higher level of smartphone addiction group within the restricted condition. These results would further indicate that a large part of the negative effects, primarily withdrawal symptoms, experienced by the participants due to the restriction period are similar to those of other types of behavioural addictions. The findings from the present study help support smartphone addiction's position within the behavioural addiction hierarchy.

Further, it is suggested that smartphones to a certain degree are incorporated within the individual and could be regarded as an extension of the self. This could explain the addictive property despite the lack of substance, and at the same time why restriction from it provokes negative effects. Multiple implications derive from these findings and may be considered when implementing preventive measures.

Given the result of the present study, it is important in the future to fully explore the field of behavioural addiction with particular focus on withdrawal symptoms. Moreover, withdrawal trends should receive attention as well because of the scarcity of literature on this topic in the field of behavioural addictions. It would also be of interest to compare withdrawal trends across the spectrum of addictions, both in terms of behavioural- and

substance use addictions. As previously mentioned, this is the first study of its kind to the authors' knowledge. Thus, future studies should take the present study's strengths and limitations into account when investigating this topic further.

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Appendix

Appendix A - Modified Smartphone Withdrawal Scale (SWS)

SWS

Instruksjon: Ta stilling til de følgende påstandene ved å bruke skalaen fra 1 (svært uenig) til 5 (svært enig). Svar på alle påstandene.

		1 = Svært uenig				**5 = Svært enig**
		1	**2**	**3**	**4**	**5**
1.	Jeg føler meg deprimert i dette øyeblikk	❑	❑	❑	❑	❑
2.	Min moral er lav her og nå	❑	❑	❑	❑	❑
3.	Jeg føler meg bekymret akkurat nå	❑	❑	❑	❑	❑
4.	Jeg føler meg engstelig akkurat nå	❑	❑	❑	❑	❑
5.	Den eneste jeg tenker på nå er å bruke smarttelefonen min	❑	❑	❑	❑	❑
6.	Jeg savner smarttelefonen min veldig i dette øyeblikk	❑	❑	❑	❑	❑
7.	Jeg føler et uimotståelig behov til å bruke smarttelefonen min akkurat nå	❑	❑	❑	❑	❑
8.	Jeg vil gjerne holde smarttelefonen min i hånden min i dette øyeblikk	❑	❑	❑	❑	❑
9.	Jeg er irritabel akkurat nå	❑	❑	❑	❑	❑
10.	Jeg føler meg lett sint akkurat nå	❑	❑	❑	❑	❑

11.	Jeg har ingen tålmodighet akkurat nå	❑	❑	❑	❑	❑
12.	Jeg føler meg nervøs akkurat nå	❑	❑	❑	❑	❑
13.	Det er vanskelig å tenke klart akkurat nå	❑	❑	❑	❑	❑
14.	Det er vanskelig å konsentrere seg akkurat nå	❑	❑	❑	❑	❑
15.	Det er vanskelig å fokusere på oppgaven jeg skal gjøre i dette øyeblikk	❑	❑	❑	❑	❑