Current Psychology
https://doi.org/10.1007/s12144-020-00785-2

Attention deficit hyperactivity symptoms predict problematic mobile phone use

Maria Panagiotidi[1] · Paul Overton[2]

Abstract
Attention-deficit-hyperactivity disorder (ADHD) is the most commonly diagnosed childhood disorder characterised by inattention, hyperactivity/impulsivity, or both. Some of the key traits of ADHD have previously been linked to addictive and problematic behaviours. The aim of the present study was to examine the relationship between problematic mobile phone use, smartphone addiction risk and ADHD symptoms in an adult population. A sample of 273 healthy adult volunteers completed the Adult ADHD Self-Report Scale (ASRS), the Mobile Phone Problem Usage Scale (MPPUS), and the Smartphone Addiction Scale (SAS). A significant positive correlation was found between the ASRS and both scales. More specifically, inattention symptoms and age predicted smartphone addiction risk and problematic mobile phone use. Our results suggest that there is a positive relationship between ADHD traits and problematic mobile phone use. In particular, younger adults with higher level of inattention symptoms could be at higher risk of developing smartphone addiction. The implication of our findings for theoretical frameworks of problematic mobile phone use and clinical practice are discussed.

Keywords Smartphone addiction · Problematic mobile phone use · ADHD · Inattention

Introduction

Smartphones have become an integral part of our lives. According to recent statistical reports, the number of smartphone users estimated for 2017 exceeded 2.3 billion and users were expected to exceed 5 billion by 2019 (Carvalho et al. 2018). Previous studies found that 15% of young American adults between 18 and 29 years of age heavily depend on their smartphones for online access and that 46% consider their smartphone essential (Smith 2015). Smartphone use has been affecting our daily routines, habits, social behaviours and interactions. However, research investigating smartphone use and how it is changing people's lives is still at a very early stage. Existing evidence suggests that both positive and negative outcomes have been associated with mobile phone use. For example, smartphones provide many benefits to healthcare professionals, such as better clinical decision-making and clinical outcomes for the patients (Ventola 2014). Smartphones also can increase the user's sense of confidence, provide amusement, socialisation, and improve daily life productivity (Jung 2014).

Despite the benefits, excessive mobile phone use has been linked to a number of negative effects such as sleep disturbances, stress, anxiety, withdrawal, and deterioration in well-being, decreased academic performance and decreased physical activity (Thomée et al. 2011; Lastella et al. 2020; Tangmunkongvorakul et al. 2019). Studies suggest that mobile phone overuse can also lead to a number of psychological disorders (Thomée et al. 2011; Beranuy et al. 2009; Dhir et al. 2018; Hawi and Rupert 2015; Lee et al. 2014b) and it can have a negative impact on daily life by affecting life satisfaction and academic performance (Samaha and Hawi 2016). Previous studies have found positive associations between scores in smartphone addiction scales and social phobia, depression, anxiety, and daytime dysfunction scores in young adult populations (Demirci et al. 2015; Elhai et al. 2017; Dhir et al. 2018; Panova et al. 2019; Enez Darcin et al. 2016).

The increasing number of individuals affected by non-chemical addictions has resulted in the inclusion of "Internet Gaming Disorder" in the latest version of the Diagnostic and Statistical Manual of Mental Disorders, DSM-V (American Psychiatric Association 2013). In addition, substance abuse

✉ Maria Panagiotidi
m.panagiotidi@salford.ac.uk

[1] School of Health and Society, University of Salford, Salford, UK

[2] Department of Psychology, University of Sheffield, Cathedral Court, 1 Vicar Lane, Sheffield S1 2LT, UK

Published online: 19 May 2020

use and internet addiction might share similar family factors (Yen et al. 2007). Since most users access the internet and can even play online games using their phones, smartphones can lead to problematic use and disrupt an individual's functioning in various settings (e.g. social, academic) (Smith et al. 2015). Terms such as 'smartphone addiction', 'problematic mobile phone use', 'compulsive mobile phone use', and 'mobile phone overuse' have been used to describe excessive mobile phone use (Al-Barashdi et al. 2015). In this study problematic mobile phone use and smartphone addiction is used to refer to individuals engrossed in their mobile phone/smartphone to the extent that they neglect other areas of life.

A number of factors have been associated with smartphone addiction and problematic mobile phone use including impulsivity (Zhang et al. 2015; Cao et al. 2007), personality traits (Beranuy et al. 2009; Aboujaoude 2010), and mental health problems (Enez Darcin et al. 2016). In particular, Attention Deficit Hyperactivity Disorder (ADHD) has been repeatedly linked to addiction (Harstad and Levy 2014; Biederman et al. 1999). ADHD is a behavioural disorder defined by either an attentional dysfunction, hyperactive/impulsive behaviour or both (DSM-V; American Psychiatric Association 2013). Symptoms of ADHD persist into adulthood in half of the children diagnosed (Spencer et al. 2002).

Some of the key traits of ADHD have previously been linked to addictive behaviours. In particular, individuals with ADHD have higher levels of impulsivity and are more prone to boredom (Kass et al. 2003). These behaviours have been associated with addiction (Zhang et al. 2015; Elhai et al. 2018). Several studies have investigated the relationship between ADHD and addiction and suggest that the condition seems to be linked to substance use dependence (Crunelle et al. 2013; Young et al. 2015) as well as behavioural addictions (Yen et al. 2009). Individuals with ADHD demonstrate problematic behaviours with many forms of interactive media (Zhang et al. 2015).

One of the main symptoms of ADHD, impulsivity, has been linked to smartphone addiction (Kim et al. 2016; Wilmer and Chein 2016). Several studies investigating problematic use of different types of media have found a positive relationship between ADHD and problematic use (Cho et al. 2008; Ko et al. 2009; Yoo et al. 2004; Panagiotidi 2017). More specifically, Ko et al. (2008) found that students with internet addiction are more likely to have adult ADHD. In addition to this, problematic use of technology has been observed in individuals with high level of ADHD traits but without a diagnosis (Panagiotidi 2017; Panagiotidi and Overton 2018). Smartphones combine various media features in one device (e.g. games, internet). This could result in a positive association between ADHD and problematic smartphone use.

Even though a number of studies have been conducted on problematic mobile phone use, there is a lack of clear theoretical frameworks that allows understanding its cause. Problematic mobile phone use is mostly considered as a form of behavioural addiction and most attempts to explain its cause draw from models of internet addiction. Billieux (2012) proposed a theoretical framework for problematic mobile phone use, which takes account of both personality and individual factors as well as behavioural addiction. According to the integrative model, there are four pathways that can lead to problematic mobile phone use; an impulsive pathway, a relationship maintenance pathway, an extraversion pathway and a cyber-addiction pathway (Billieux 2012). According to this model, ADHD symptoms are included in the impulsivity pathway. This further suggests that there is a positive relationship between ADHD and problematic mobile phone use.

ADHD symptomatology can be viewed dimensionally, with inattentive and hyperactive-impulsive symptoms distributed continuously in the general population (Panagiotidi 2017; Hudziak et al. 1998; Panagiotidi et al. 2017a; Panagiotidi et al. 2017b). Consequently, higher levels of ADHD symptoms could potentially predict smartphone addiction risk and problematic mobile phone use. To our knowledge, no study has investigated the relationship between smartphone addiction and ADHD traits in an adult population. The main aim of this study was to examine the contribution of inattention and hyperactivity, as well as overall ADHD traits, to smartphone addiction and problematic mobile phone use. We hypothesized that there would be a positive correlation between level of ADHD traits and problematic mobile phone use and smartphone addiction risk.

Method

Participants

273 participants took part in the study (59.9% female, 2% non-binary/other). The mean age was 31.37 ($SD = 12.17$, Range = 18–70). Most of the participants were British (84.3%) and all were native or excellent English speakers. 39.2% of the participants had an undergraduate degree, 17.9% had a postgraduate degree, and the rest of the participants did not have a degree. Participants were recruited via the University of Sheffield list of volunteers after receiving a personal email or social media (e.g. Twitter). Only individuals who owned a smartphone were invited to take part in the study. Participants completed the study online on Qualtrics.

Materials and Procedure

The study took place online. Participants were recruited via the University of Sheffield list of volunteers, which has maximum exposure of 8306 individuals from a range of backgrounds. A link to the study was provided in the email sent to the list. After providing consent, participants completed a

number of questionnaires listed below and demographic questions (e.g., age, gender, education). The completion of the study took 20–30 min.

Smartphone Addiction Scale

The smartphone addiction scale (SAS; Kwon et al. 2013) measures the level of risk for smartphone addiction. It consists of 6 factors and 33 items with a six-point Likert scale (1: "strongly disagree" and 6: "strongly agree"). Some example items from the SAS are the following: "missed planned work due to smartphone use", "using my smartphone longer than I intended"). The six factors measured by SAS are: daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse, and tolerance. The score in the SAS can range between 33 and 198. The internal consistency of the scale in our study was good ($a = .96$). This was consistent with previous research (Kwon et al. 2013).

Problematic Mobile Phone Use

The Mobile Phone Problem Usage Scale (MPPUS; Bianchi and Phillips, 2005) was administered to measure problematic mobile phone use. It consists of 27 items exploring aspects of behavioural and technological addiction with a focus on problematic mobile phone use (e.g., "I feel uneasy when my mobile phone is out of battery", "I am finding myself permanently checking my mobile phone"). The items are scored on a 10-point Likert-type scale with 1 (not at all true) and 10 (very true). Scores on the MMPUS can range between 27 and 270. The internal consistency reliability of the scale was excellent (.94), consistent with previous studies (Bianchi and Phillips 2005).

ADHD Traits

ADHD traits were measured with the Adult ADHD Self-Report scale (ASRS, Kessler et al. 2005). The ASRS consists of 18 items based on the DSM-IV criteria. The scores obtained through the ASRS have been found to be predictive of symptoms consistent with ADHD (Kessler et al. 2005; Reuter et al. 2006). Subjects are asked to report how often they experience each symptom in a period of 6 months on a five-point Likert scale, which ranges from 0 for never, 1 for rarely, 2 for sometimes, 3 for often, and 4 for very often (Kessler et al. 2005; Reuter et al. 2006). The ASRS has a two-factor structure which includes an Inattention scale and a Hyperactivity/impulsivity scale. Each subscale contains nine items (e.g., "How often do you have problems remembering appointments or obligations?", "How often do you interrupt others when they are busy?"). Scores on the ASRS can range between 0 and 72. The reliabilities (Cronbach's alpha) for the two subscales of inattention (.75) and impulsivity (.77) as well as for the total ASRS (.85) were satisfactory.

Other Measures

Participants were asked to list the type of online and gaming activities they engage in most often using their phones (e.g. surfing the net, online shopping, social networking). Participants were also asked what type of device the own and how many years they owned a mobile phone.

Statistical Analysis

Data were analysed using SPSS 25. Gender differences between ASRS scores, Inattention and Hyperactivity ASRS subscales, MPPUS, SAS scores were analysed with independent samples t-tests. Correlations amongst the variables of interest were examined by Pearson correlation analysis. Finally, multiple linear regression analysis was conducted to examine the contribution of ADHD symptoms in problematic phone use and smartphone addiction risk.

Results

Descriptive Analyses

The mean score on the SAS was 78.8 ($SD = 30.4$, Min = 33, Max = 175). Scores on the MPPUS varied from 27 to 210 and the mean was 95.39 ($SD = 38.4$). Scores in both scales were normally distributed as revealed by the Lilliefors test statistic ($p > .05$). There was a strong positive correlation between the SAS and the MPPUS scores ($r = .87$, $p < .001$).

Age was negatively correlated with SAS scores ($r = -.32$) and MPPUS ($r = -.36$), suggesting that younger participants had more signs of problematic mobile phone use. There was a significant difference between males and females in both SAS and MPPUS scores, $t = -2.4$, $p < .05$ and $t = -2.3$, $p < .05$, respectively. Females reported higher levels of smartphone addiction risk ($M = 82.3$, $SD = 29.25$) compared to males ($M = 72.02$, $SD = 30$). Females also reported more problematic mobile phone usage ($M = 99.7$, $SD = 37.8$) than males ($M = 86.3$, $SD = 37.5$). No relationship was found between level of education and SAS or MPPUS scores.

The average score on the ASRS was 32.8 ($SD = 9.44$, range = 57). Participants reported more inattentive than hyperactive symptoms; the mean on the ASRS Inattentive subscale was 18 ($SD = 5.5$) compared to 14.8 ($SD = 5.6$) on the Hyperactive/impulsive subscale. The two subscales were positively correlated, $r = .45$. No gender differences were found in the ASRS scores and in any subscales. A weak negative correlation was found between age and ADHD traits ($r = -.17$, $p < .05$), with older participants reporting fewer ADHD symptoms.

Relationship Between ADHD Traits, Problematic Mobile Phone Use, and Smartphone Addiction Risk

The relationship between ASRS, SAS, and MPPUS was examined. Moderate correlations were found between overall ADHD traits and both the SAS and MPPUS. In particular, there was a positive relationship between ASRS and total SAS scores, $r = .43$ $p < .001$. A similar relationship was found between the ASRS and the MPPUS, $r = .43$, $p < .001$).

The relationship between ASRS subscales and mobile phone use was also investigated. Inattention scores positively correlated with both the SAS and the MPPUS, r = .44 and r = .44, $p < .001$ respectively. A positive association was also found between the hyperactivity subscale of the ASRS and SAS and MPPUS scores, $r = .29$ and $r = .3$, $p < .001$, respectively.

The relationship between ADHD traits and smartphone addiction risk was investigated further by examining the correlations between ASRS and its subscales and the six subscales of the SAS; Daily Life Disturbance, Positive Anticipation, Withdrawal, Cyberspace Oriented Relationships, Overuse, and Tolerance. All six subscales significantly correlated with overall ASRS scores, as well as Inattention and Hyperactivity scores. The results are presented in detail on Table 1.

To determine the relative contribution of these variables to the MPPUS score, a simultaneous multiple linear regression (Enter method) was conducted with MPPUS score as the dependent variable and the following independent variables; ASRS Inattention subscale, ASRS Hyperactivity subscale, and age (Table 2). The regression equation was statistically significant, F (3, 272) = 38.18, $p < .001$. The results indicated that Inattention scores ($b = .4$, $t = 6.53$, $p < .001$) and age ($b = -.3$, $t = -6.4$, $p < .001$) remained significant predictors of MPPUS. Overall ASRS score and Hyperactivity were not significant predictor of MPPUS scores ($p > .05$), when controlling for the above variables. The model could predict 35% of the variance in self-reported problematic mobile use.

Table 2 Summary of simultaneous linear regression analysis for variables predicting MPPUS score

	Model		
Variable	*B*	*SE(B)*	*β*
ASRS inattention	2.6	.47	.4**
ASRS hyperactivity	.53	.46	.08
Age	−.96	.19	−.3**
R^2	.35		
F for change in R^2	.01		

*$p < .05$

**$p < .01$

Multiple linear regression (Enter method) was performed utilising the SAS total scores as the criterion and ASRS subscale scores (Inattention and Hyperactivity), and age as predictors to determine if ADHD traits and age could predict SAS scores (Table 3). A significant regression equation was found F (3, 272) = 28.23, $p < .001$. Only Inattention ($b = .38$, $t = 6.67$, $p < .001$) and age ($b = -.26$, $t = -6.3$, $p < .001$) were significant predictors of smartphone addiction risk. Overall ASRS score and Hyperactivity were not significant predictor of SAS scores ($p > .05$). This multiple regression accounted for 35.2% of the variability, as indexed by the R2 statistic.

Discussion

In this study, we examined the relationship between ADHD traits, problematic mobile phone use, and smartphone addiction risk in the general population. Our findings indicate that higher levels of ADHD symptoms are associated with

Table 1 Correlations among and descriptive statistics for ASRS and SAS subscales

	M (*SD*)	1	2	3	4	5	6	7	8	9	10
1. ASRS	32.8 (9.44)	–	.85**	.85**	.42**	.3**	.41**	.38**	.39**	.39**	.43**
2. ASRS inattention	18 (5.5)		–	.45**	.42**	.33**	.4**	.39**	.46**	.39**	.44**
3. ASRS hyperactivity	14.8 (5.6)			–	.3**	.19**	.31**	.27**	.21**	.27**	.3**
4. SAS daily life disturbance	11.2 (5.5)				–	.62**	.75**	.62**	.7**	.69**	.8**
5. SAS positive anticipation	14.74 (5.24)					–	.68**	.6**	.63**	.52**	.7**
6. SAS withdrawal	20.54 (9.21)						–	.79**	.72**	.66*	.78**
7. SAS cyberspace oriented relationship	14.8 (6.7)							–	.7**	6**	.71**
8. SAS overuse	13.18 (5.23)								–	.65**	.78**
9. SAS tolerance	6.8 (3.52)									–	.79**
10. MPPUS	95.39 (38.4)										–

Notes. $N = 202$ for all reported data, ** $p < .001$

Table 3 Summary of simultaneous linear regression analysis for variables predicting SAS score

	Model		
Variable	*B*	*SE(B)*	*β*
ASRS inattention	2.1	.38	.38**
ASRS hyperactivity	.42	.37	.08
Age	−.66	.15	−.26**
R^2	.35		
F for change in R^2	.01		

*$p < .05$

**$p < .01$

increased smartphone addiction risk and level of problematic mobile phone use. This is consistent with previous research on children and adolescents (Byun et al. 2013). Inattention symptoms and age were the best predictors of problematic use and addiction risk; younger individuals with more self-reported inattention symptoms had higher levels of smartphone addiction symptoms and general problematic phone use. These findings suggest that subclinical ADHD symptoms, especially inattention symptoms, could contribute to problematic technology usage in adults.

There are a few possible explanations for the positive relationship between ADHD traits, especially inattention, and problematic mobile phone use. A link has been found between symptoms in ADHD, such as distractibility and ability to supress irrelevant information, and multitasking (Ophir et al. 2009). In particular, mobile phones encourage multicommunicating, a form of multitasking, which involves engaging in two or more overlapping synchronous conversations (Reinsch et al. 2008). Previous studies have shown a positive relationship between multicommunicating and ADHD symptoms (Seo et al. 2015). Another feature related to ADHD and problematic mobile phone use is sensation-seeking personality (Parker et al. 2004; Leung 2008; Pironti et al. 2016). Sensation seeking refers to a personality trait defined as need for novel, varied, and complex experiences and sensations, and willingness to take risks in order to achieve this (Pironti et al. 2016). Adults with ADHD compared with controls and relatives have higher levels of sensation seeking traits, especially boredom susceptibility (Parker et al. 2004; Pironti et al. 2016). This could potentially lead to problematic mobile phone use through engaging in multiple activities (e.g. social media, instant messaging).

The mean scores on the SAS in our study was 78.8, which is slightly lower than scores reported by other researchers (Kwon et al. 2013; De-Sola Gutiérrez et al. 2016). This difference could be the result of the more diverse group recruited in our study. Previous research has been focussed on younger samples (mainly college students), while in our study participants were recruited from the general population and the mean age was 31.37. Age has been shown to negatively correlate with problematic mobile phone use and behavioural addictions in general (Shaw and Black 2008). Another potential explanation for this finding could be potential geographical and cultural differences. Previous research suggests that populations in East Asian countries report higher levels of problematic mobile phone use and mobile internet dependence than western populations (Ching et al. 2015; Shin 2014). In South-East Asian countries, however, the adverse impact of smartphone addiction has been taken seriously and has led to a series of studies and social work by the government and health care givers to curb and alleviate the problem (Mok et al. 2014).

Individuals with more ADHD symptoms, particularly inattention symptoms, reported a higher level of problematic phone use and smartphone addiction risk. Examining the relationship between ADHD scores and different aspects of smartphone addiction did not reveal any differences. Higher levels of ADHD symptoms were associated with problematic use in all the subscales of SAS. This suggests that individuals with more self-reported ADHD symptoms show higher levels of daily life disturbance by their smartphone use and exhibit more withdrawal and overuse symptoms. Billieux (2012) proposed an integrative pathway model of problematic mobile phone use, suggesting four pathways of problematic mobile phone use. ADHD symptoms would be part of the impulsive pathway, which would lead to antisocial patterns of use. In our study, ADHD traits appear to be associated with different types of problematic use, including an addictive pattern of use. Future studies should examine potential relationships between ADHD symptoms and antisocial patterns of smartphone use.

The findings of this study have important implications for researchers investigating problematic mobile phone use as they provide further evidence for a role of ADHD symptomatology as a risk factor in behavioural addictions. Furthermore, our results should be taken into account when developing potential interventions for ADHD. In particular, future research should examine whether mobile phone restrictions or monitoring can be beneficial in individuals with ADHD symptoms. In addition to this, the relationship between inattention symptoms and smartphone addiction risk should be considered when developing interventions, which require smartphone use, such as mobile health applications (e.g., Schoenfelder et al. 2017).

This study has the following limitations. First, the methodology of our study does not allow us to examine whether the relationship between ADHD symptoms and mobile phone use is causal, since it is cross-sectional. Future research should establish whether inattention traits lead to increased risk of addictive mobile phone use or whether high levels of mobile phone use can affect inattention levels. Another limitation of our study is that it relied solely on self-reports. In particular, problematic smartphone use was measured using

questionnaires and not an empirical measurement. It is worth noting, however, that studies have found strong correlations between self-reports of mobile phone use and empirical measurements (e.g. using specifically designed applications) (Lee et al. 2014a). Finally, our study used a non-clinical population. However, our findings are similar to those obtained in studies with clinical populations (Zhang et al. 2015). This further supports the dimensional theory of ADHD and shows that using subclinical populations could provide us with information of clinical relevance.

To our knowledge, this is the first study to investigate the relationship between ADHD traits, smartphone addiction risk, and problematic mobile phone use. A significant positive correlation was found between ADHD symptoms, smartphone addiction risk, and problematic mobile phone use. In particular, younger adults with higher level of inattention symptoms could be at higher risk of developing smartphone addiction. The present results are expected to contribute to expanding the behavioural addiction field and to facilitate further research into its clinical implications.

Compliance with Ethical Standards

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethical Statement and Informed Consent This research was approved by the University of Sheffield Psychology Ethics Research Committee. Informed consent was obtained by all the individuals who took part in the study.

References

Aboujaoude, E. (2010). Problematic internet use: An overview. *World Psychiatry, 9*(2), 85–90.

Al-Barashdi, H. S., Bouazza, A., & Jabur, N. H. (2015). Smartphone addiction among university undergraduates: A literature review. *Journal of Scientific Research and Reports*, 210–225.

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: Author.

Beranuy, M., Oberst, U., Carbonell, X., & Chamarro, A. (2009). Problematic internet and mobile phone use and clinical symptoms in college students: The role of emotional intelligence. *Computers in Human Behavior, 25*(5), 1182–1187.

Bianchi, A., & Phillips, J. G. (2005). Psychological predictors of problem mobile phone use. *Cyberpsychology & Behavior, 8*(1), 39–51.

Biederman, J., Wilens, T., Mick, E., Spencer, T., & Faraone, S. V. (1999). Pharmacotherapy of attention-deficit/hyperactivity disorder reduces risk for substance use disorder. *Pediatrics, 104*(2), e20–e20.

Billieux, J. (2012). Problematic use of the mobile phone: A literature review and a pathways model. *Current Psychiatry Reviews, 8*(4), 299–307.

Byun, Y. H., Ha, M., Kwon, H. J., Hong, Y. C., Leem, J. H., Sakong, J., et al. (2013). Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: A longitudinal study. *PLoS One, 8*(3).

Cao, F., Su, L., Liu, T., & Gao, X. (2007). The relationship between impulsivity and internet addiction in a sample of Chinese adolescents. *European Psychiatry, 22*(7), 466–471.

Carvalho, L. F., Sette, C. P., & Ferrari, B. L. (2018). Problematic smartphone use relationship with pathological personality traits: Systematic review and meta-analysis. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, *12*(3). Article 5. https://doi.org/10.5817/CP2018-3-5.

Ching, S. M., Yee, A., Ramachandran, V., Lim, S. M. S., Sulaiman, W. A. W., Foo, Y. L., & Kee Hoo, F. (2015). Validation of a Malay version of the smartphone addiction scale among medical students in Malaysia. *PLoS One, 10*(10), e0139337.

Cho, S. C., Kim, J. W., Kim, B. N., Lee, J. H., & Kim, E. H. (2008). Biogenetic temperament and character profiles and attention deficit hyperactivity disorder symptoms in Korean adolescents with problematic internet use. *Cyberpsychology & Behavior, 11*(6), 735–737.

Crunelle, C. L., Veltman, D. J., van Emmerik-van Oortmerssen, K., Booij, J., & van den Brink, W. (2013). Impulsivity in adult ADHD patients with and without cocaine dependence. *Drug and Alcohol Dependence, 129*(1–2), 18–24.

Demirci, K., Akgönül, M., & Akpinar, A. (2015). Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *Journal of Behavioral Addictions, 4*(2), 85–92.

De-Sola Gutiérrez, J., Rodríguez de Fonseca, F., & Rubio, G. (2016). Cell-phone addiction: A review. *Frontiers in Psychiatry, 7*, 175.

Dhir, A., Yossatorn, Y., Kaur, P., & Chen, S. (2018). Online social media fatigue and psychological wellbeing – a study of compulsive use, fear of missing out, fatigue, anxiety and depression. *International Journal of Information Management, 40*, 141–152.

Elhai, J. D., Dvorak, R. D., Levine, J. C., & Hall, B. J. (2017). Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology. *Journal of Affective Disorders, 207*, 251–259.

Elhai, J. D., Vasquez, J. K., Lustgarten, S. D., Levine, J. C., & Hall, B. J. (2018). Proneness to boredom mediates relationships between problematic smartphone use with depression and anxiety severity. *Social Science Computer Review, 36*(6), 707–720.

Enez Darcin, A., Kose, S., Noyan, C. O., Nurmedov, S., Yılmaz, O., & Dilbaz, N. (2016). Smartphone addiction and its relationship with social anxiety and loneliness. *Behaviour & Information Technology, 35*(7), 520–525.

Harstad, E., Levy, S., & Committee on Substance Abuse. (2014). Attention-deficit/hyperactivity disorder and substance abuse. *Pediatrics, 134*(1), e293–e301.

Hawi, N. S., & Rupert, M. S. (2015). Impact of e-discipline on children's screen time. *Cyberpsychology, Behavior and Social Networking, 18*(6), 337–342.

Hudziak, J. J., Heath, A. C., Madden, P. F., Reich, W., Bucholz, K. K., Slutske, W., et al. (1998). Latent class and factor analysis of DSM-IV ADHD: A twin study of female adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry, 37*(8), 848–857.

Jung, Y. (2014). What a smartphone is to me: Understanding user values in using smartphones. *Information Systems Journal, 24*(4), 299–321.

Kass, S. J., Wallace, J. C., & Vodanovich, S. J. (2003). Boredom proneness and sleep disorders as predictors of adult attention deficit scores. *Journal of Attention Disorders, 7*(2), 83–91.

Kessler, R. C., Adler, L., Ames, M., Demler, O., Faraone, S., Hiripi, E. V. A., et al. (2005). The World Health Organization adult ADHD self-report scale (ASRS): A short screening scale for use in the general population. *Psychological Medicine, 35*(2), 245–256.

Kim, Y., Jeong, J. E., Cho, H., Jung, D. J., Kwak, M., Rho, M. J., et al. (2016). Personality factors predicting smartphone addiction predisposition: Behavioral inhibition and activation systems, impulsivity, and self-control. *PLoS One, 11*(8).

Ko, C. H., Yen, J. Y., Chen, C. S., Chen, C. C., & Yen, C. F. (2008). Psychiatric comorbidity of internet addiction in college students: An interview study. *CNS Spectrums, 13*(2), 147–153.

Ko, C. H., Yen, J. Y., Chen, S. H., Yang, M. J., Lin, H. C., & Yen, C. F. (2009). Proposed diagnostic criteria and the screening and diagnosing tool of internet addiction in college students. *Comprehensive Psychiatry, 50*(4), 378–384.

Kwon, M., Lee, J. Y., Won, W. Y., Park, J. W., Min, J. A., Hahn, C., Gu, X., Choi, J. H., & Kim, D. J. (2013). Development and validation of a smartphone addiction scale (SAS). *PLoS One, 8*(2), e56936.

Lastella, M., Rigney, G., Browne, M., & Sargent, C. (2020). Electronic device use in bed reduces sleep duration and quality in adults. *Sleep and Biological Rhythms, 18*, 121–129.

Lee, H., Ahn, H., Choi, S., & Choi, W. (2014a). The SAMS: Smartphone addiction management system and verification. *Journal of Medical Systems, 38*(1), 1.

Lee, Y. K., Chang, C. T., Lin, Y., & Cheng, Z. H. (2014b). The dark side of smartphone usage: Psychological traits, compulsive behavior and technostress. *Computers in Human Behavior, 31*, 373–383.

Leung, L. (2008). Leisure boredom, sensation seeking, self-esteem, and addiction. *Mediated Interpersonal Communication, 1*, 359–381.

Mok, J. Y., Choi, S. W., Kim, D. J., Choi, J. S., Lee, J., Ahn, H., et al. (2014). Latent class analysis on internet and smartphone addiction in college students. *Neuropsychiatric Disease and Treatment, 10*, 817.

Ophir, E., Nass, C., & Wagner, A. D. (2009). Cognitive control in media multitaskers. *Proceedings of the National Academy of Sciences, 106*(37), 15583–15587.

Panagiotidi, M., & Overton, P. (2018). The relationship between internet addiction, attention deficit hyperactivity symptoms and online activities in adults. *Comprehensive Psychiatry, 87*, 7–11.

Panagiotidi, M. (2017). Problematic video game play and ADHD traits in an adult population. *Cyberpsychology, Behavior and Social Networking, 20*(5), 292–295.

Panagiotidi, M., Overton, P. G., & Stafford, T. (2017a). Attention-deficit hyperactivity disorder-like traits and distractibility in the visual periphery. *Perception, 46*(6), 665–678.

Panagiotidi, M., Overton, P. G., & Stafford, T. (2017b). Increased microsaccade rate in individuals with ADHD traits. *Journal of Eye Movement Research*, *10*(1). https://doi.org/10.16910/10.1.6

Panova, T., Carbonell, X., Chamarro, A., & Puerta-Cortés, D. X. (2019). Specific smartphone uses and how they relate to anxiety and depression in university students: A cross-cultural perspective. *Behaviour & Information Technology*, 1–13.

Parker, J. D., Majeski, S. A., & Collin, V. T. (2004). ADHD symptoms and personality: Relationships with the five-factor model. *Personality and Individual Differences, 36*(4), 977–987.

Pironti, V. A., Lai, M. C., Müller, U., Bullmore, E. T., & Sahakian, B. J. (2016). Personality traits in adults with attention-deficit hyperactivity disorder and their unaffected first-degree relatives. *BJPsych Open, 2*(4), 280–285.

Reinsch Jr., N. L., Turner, J. W., & Tinsley, C. H. (2008). Multicommunicating: A practice whose time has come? *Academy of Management Review, 33*(2), 391–403.

Reuter, M., Kirsch, P., & Hennig, J. (2006). Inferring candidate genes for attention deficit hyperactivity disorder (ADHD) assessed by the World Health Organization adult ADHD self-report scale (ASRS). *Journal of Neural Transmission, 113*(7), 929–938.

Samaha, M., & Hawi, N. S. (2016). Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Computers in Human Behavior, 57*, 321–325.

Schoenfelder, E., Moreno, M., Wilner, M., Whitlock, K. B., & Mendoza, J. A. (2017). Piloting a mobile health intervention to increase physical activity for adolescents with ADHD. *Preventive Medicine Reports, 6*, 210–213.

Seo, M., Kim, J. H., & David, P. (2015). Always connected or always distracted? ADHD symptoms and social assurance explain problematic use of mobile phone and multicommunicating. *Journal of Computer-Mediated Communication, 20*(6), 667–681.

Shaw, M., & Black, D. W. (2008). Internet addiction. *CNS Drugs, 22*(5), 353–365.

Shin, L. (2014). A comparative study of mobile internet usage between the US and Korea. *Journal of European Psychology Students, 5*(3), 46–55.

Smith, K. L., Hummer, T. A., & Hulvershorn, L. A. (2015). Pathological video gaming and its relationship to substance use disorders. *Current Addiction Reports, 2*(4), 302–309.

Smith, A. (2015). *US smartphone use in 2015*. Pew Research Center: USA.

Spencer, T. J., Biederman, J., Wilens, T. E., & Faraone, S. V. (2002). Novel treatments for attention-deficit/hyperactivity disorder in children. *The Journal of Clinical Psychiatry, 63*, 16–22.

Tangmunkongvorakul, A., Musumari, P. M., Thongpibul, K., Srithanaviboonchai, K., Techasrivichien, T., Suguimoto, S. P., Ono-Kihara, M., & Kihara, M. (2019). Association of excessive smartphone use with psychological well-being among university students in Chiang Mai, Thailand. *PLoS One, 14*(1), e0210294.

Thomée, S., Härenstam, A., & Hagberg, M. (2011). Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults-a prospective cohort study. *BMC Public Health, 11*(1), 66.

Ventola, C. L. (2014). Mobile devices and apps for health care professionals: Uses and benefits. *Pharmacy and Therapeutics, 39*(5), 356.

Wilmer, H. H., & Chein, J. M. (2016). Mobile technology habits: Patterns of association among device usage, intertemporal preference, impulse control, and reward sensitivity. *Psychonomic Bulletin & Review, 23*(5), 1607–1614.

Yen, J. Y., Yen, C. F., Chen, C. C., Chen, S. H., & Ko, C. H. (2007). Family factors of internet addiction and substance use experience in Taiwanese adolescents. *Cyberpsychology & Behavior, 10*(3), 323–329.

Yen, J. Y., Yen, C. F., Chen, C. S., Tang, T. C., & Ko, C. H. (2009). The association between adult ADHD symptoms and internet addiction among college students: The gender difference. *Cyberpsychology & Behavior, 12*(2), 187–191.

Yoo, H. J., Cho, S. C., Ha, J., Yune, S. K., Kim, S. J., Hwang, J., et al. (2004). Attention deficit hyperactivity symptoms and internet addiction. *Psychiatry and Clinical Neurosciences, 58*(5), 487–494.

Young, S., Sedgwick, O., Fridman, M., Gudjonsson, G., Hodgkins, P., Lantigua, M., & González, R. A. (2015). Co-morbid psychiatric disorders among incarcerated ADHD populations: A meta-analysis. *Psychological Medicine, 45*(12), 2499–2510.

Zhang, Y., Mei, S., Li, L., Chai, J., Li, J., & Du, H. (2015). The relationship between impulsivity and internet addiction in Chinese college students: A moderated mediation analysis of meaning in life and self-esteem. *PLoS One, 10*(7), e0131597.